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Rainfall Variability, Foreign Aid and Economic Growth in Sub-Saharan Africa

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Abstract

In this study, we address a broad question that relates foreign development aid to economic growth in 41 Sub-Saharan African (SSA) countries employing panel data spanning a twenty-five-year period. The panel data was analysed using fixed effect Ordinary Least Square (OLS) model. We explored the within-country rainfall distribution to identify the impact of foreign development aid per capita (Value of Official Development Assistance) on GDP per capita. Identifying aid with exogenous rainfall shocks will plausibly address the endogeneity bias identified in previous studies. In the first stage, we find that rainfall shocks negatively correlate with amount of aid per capita received suggesting that countries with negative economic shock receive more foreign assistance than countries without. However, in stage two, we find that aid per capita has a statistically weak and negative impact on income per capita in the region. We can identify several practical reasons why aid may fail to translate to growth in this region. For one, because aid is a form of unearned rents, aid meant for public consumption could be privately appropriated by political elites, distort capital accumulation, and could undermine the broader economic development when there is an income shock. While SSA countries receiving aid may not grow faster than countries without, aid might still play an economically useful role at the micro-level. Specifically, aid could be beneficial if local inputs at the micro-level are actively involved in allocation of resources and deployed for the identification of developmental needs. Aid could also be useful at suppressing civil conflict associated with climate vagaries.

Keywords:
Foreign development aid, income, rainfall, Africa

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INTRODUCTION

It has long been argued whether foreign development aid inflow causes any significant effect on the economic growth of recipient countries (Chenery and Strout 1996, Boone 1996, Burnside and Dollar 2000, Easterly 2003, Moss et al. 2006). Aid is endogenous to economic growth. The complex institutional arrangement and the socio-political dynamics that determine the inflow and subsequent use of aid by national government break the simple causality link assumed in many aid studies[1] (Gomanee et al. 2005, Easterly and Easterly 2006, Clemens et al. 2012, Roodman 2014). In addition, the complexity of disentangling the purpose of aid and the duration of aid's expected window of relief demand a high level of understanding that is often lacking (Clemens et al. 2012, McArthur and Sachs 2018). For instance, aid for the construction of a new road or railroad might affect economic activity within a short-span, while funding for a vaccination might take a longer time, and aid for humanitarian activities might never relate to growth (Clemens et al. 2012).

In this study, we address the aid-growth paradox by exploiting the within-country rainfall shocks in 41 sub-Saharan Africa (SSA), where such shocks have a significant but transitory impact on GDP per capita (Brückner & Ciccone, 2011) to explore the effect of foreign development aid per capita on income growth from 1981-2006. The idea is that, following a rainfall shock in an agricultural dependent economy (Magadza 1994, Collier & Gunning 1999, Cooper et al. 2008, Barrios et al. 2010), inflow of foreign development aid can be a channel for improving income. Identifying foreign aid per capita with rainfall shocks will plausibly address the bidirectional causality and endogeneity bias identified as the main concerns in previous studies. From a policy perspective, unravelling the aid-growth paradox would satisfy donors' yearnings for value for money and guide practitioners searching for better ways to make developmental projects more effective.

Our main finding indicates that rainfall-driven foreign development aid inflow is followed by a statistically weak decline in the log GDP per capita. Our analysis is reasonably robust to a range of alternative specifications as per the causal impact of foreign aid on log GDP per capita. There are several explanations on the links between foreign development aid and economic growth in the literature (e.g., Boone 1996, Easterly 2003, Easterly & Easterly 2006, Moss et al. 2006). Perhaps the most widely stated support for foreign aid is that it is a capital inflow that could augment local resources in less-developed countries (Chenery & Strout 1996, Dalgaard et al. 2004, Gomanee et al. 2005, Clemens et al. 2012, McArthur & Sachs 2018). In this simple version, foreign aid is cast as having a "magic wand" that can solve many of the developmental problems in the region. For instance, in a recent finding, McArthur and Sachs (2018) using plausible parameters, paints three stylized scenarios to illustrate the potential economy-wide impacts of both soil nutrient loss and replenishment and how foreign aid can be aimed at agriculture to boost rural productivity and real wages.

However, an alternative and a more nuanced view that fits our result is that foreign development aid is an external capital with significant negative effects on the economic growth of recipient countries. Because foreign aid is fully consumed; either through maintaining or even raising current consumption, it cannot foster capital accumula-

[1] Most especially, claims that aid is useful for economic growth have received greater focus and sharper criticisms in the Sub-Saharan African (SSA) region. Despite the significant amount of financial aid received, the region is still susceptible to the adverse impact of climate and climate change (Hulme et al. 2001). For instance, Oversees Development Aid (ODA) in cash and kind from one country (bilateral), private agencies (NGO) and multilateral organisations (Development agencies) to sub-Saharan Africa accounted for about 11.7 percent of the continent's GNI in 2003 (excluding Nigeria and South Africa). In addition, exactly half of the region's 46 countries with data for 2003 received in excess of 10 percent of GNI in ODA, and 11 received more than 20 percent (Moss et al., 2005).

tion that leads to possible higher output that promotes growth. Rather than complementing domestic production, aid could distort the domestic income by fostering a consumerist culture that relies on the importation of inappropriate technology (Boone 1996, Easterly et al. 2004, Easterly & Easterly 2006). A pass on the data, as revealed by the results presented in Section 3, suggests that the more nuanced view is closer to the truth. While negative rainfall shocks correlate with greater amount of aid per capita received, we find that foreign aid per capita has a weak and negative impact on income per capita in the region.

Nevertheless, amidst the controversies of whether aid works or not, it is suggested that a more appropriate question to ask, is not whether aid works, but when it works, with greater emphasis on the quality of institutions as condition that help countries reap the benefits from aid interventions (Burnside and Dollar 2000, Kosack 2003, Bräutigam et al. 2004, McGillivray et al. 2006, Glennie and Sumner 2014). Again, the statistical validity of the conditional impact of aid is fraught with selection bias which may confound identification and causal impact. Countries with weak institutions and poor income might also be the ones in greater need of aid, and developing countries might be unable to afford strong institutions that will make aid translate to improved livelihoods (Acemoglu et al. 2001).

Another challenge is to distinguish between the respective purpose of aid and the duration of the expected window of relief that aid is supposed to provide (McArthur and Sachs 2018). Clemens et al. (2012), in contrast to the early observation in Boone (1996), believes that more aid is followed on average by more growth. The study distinguishes between aid that supports growth in the short-to-medium term and the ones with long-term impact (Clemens et al., 2012, Roodman 2014). To capture the time lag, it differenced all variables, and regress lagged aid on growth (Clemens et al., 2012). Roodman (2014) in a replication observes a flaw in the identification technique arising from contemporaneous endogeneity in Clemens et al. (2012). The bias, in this case, arises because foreign aid is partly a function of future growth. For instance, political instability might affect future growth by causing foreign aid inflow to slow from diplomatic sanctions amidst fears by donor-agencies that autocrats might appropriate the foreign intervention for private use. In this situation, a relationship between aid in year $t - 1$ and economic growth in year t will not necessarily tell us about the causal impact. To better explain the conditions and situations when aid works, we need more exogeneity in conditions that relate foreign aid to macroeconomic growth.

The third challenge faced in unravelling the aid-growth paradox is if aid inflow responds to the business motive of foreign donors in recipient countries (Alesina & Dollar, 2000) or if it responds to the developmental needs of the recipient countries (Ndikumana & Boyce 2011, Sharples et al. 2014, Thacker 2015). Specifically, in a recent document, Sharples et al. (2014) show that out of the net cash flow of $134 billion, mainly in the form of loans, foreign investment and aid to SSA, $192 billion is taken out as outflow in the form of profits made by foreign companies and tax dodging (Sharples et al., 2014). In essence, the region suffers a net loss of $58billion a year which calls for questioning and justifying the current models of aid and development. Distinguishing between these two underlying objectives is therefore important for understanding if foreign assistance is given for other reasons than poverty alleviation (Alesina & Dollar, 2000, Lahiri & Raimondos-Møller, 2000, Svensson 2003). If, according to the findings of Sharples et al. (2014), that the extent of capital flight (outflow) from the sub-Saharan Africa region is greater than net inflow (aid), then it is possible for aid to respond to profit maximation incentives rather than the social benefits as it relates to the objective of improvement in

the welfare of the recipient countries.

As main contribution, we address these challenges by conditioning the effect of foreign development aid indirectly on the current and lagged within country variation in rainfall to explore if aid is a channel for improving income per capita in the SSA region. Because the effect of rainfall shocks on income are transitory (Brückner and Ciccone 2011), and given the link between agriculture, income and rainfall distribution in SSA (Magadza 1994, Collier & Gunning 1999, Cooper et al. 2008, Barrios et al. 2010), foreign aid can provide economic relief in the advent of rainfall shocks [1](Burnside and Dollar 2000, Fearon et al. 2009). Our measure of foreign development aid capita uses the Net Overseas Development (ODA) consisting of disbursements of loans made on concessional terms and grants by official agencies of the members of the Development Assistance Committee (DAC), multilateral institutions, and non-DAC countries to promote economic development and welfare in countries on the list of ODA recipients. Also, we estimate reduced-form models; for one, we relate rainfall shocks directly to foreign aid per capita (first-stage regression) and in another, we relate foreign aids per capita, conditional on the interaction with rainfall shocks, on income per capita (reduced-form estimation). With the first stage reduced-form estimation, we can test the assumption of whether aid flows into Africa in response to the development needs or profit ventures of the donor agencies. Assuming the business motivation concerns of foreign donors is true; naturally, we should expect that less foreign aid should follow a negative rainfall shock. This is because a fall rainfall induces negative shock to income (Brückner & Ciccone, 2011) and therefore less profit for the MNL and donor agencies which may stimulate a reduction in the net inflow of aid.

However, an understandable caveat to our finding on the impact of foreign aid is the choice of the outcome of interest. Perhaps, aid would perform better, if, for instance, we relate it to how it prevents the outbreak of civil conflict associated with climate vagaries (Savun & Tirone 2012). While the climate-conflict link is highly contentious (Gleditsch 2012, Theisen et al. 2012), however, civil conflict may be more pronounced when there is a negative income shock (Fearon & Laitin 2003, Collier & Hoeffler 2004). In addition, income shock due to rainfall variability could stimulate civil conflict in the SSA (Hendrix & Salehyan 2012, Hsiang et al. 2013, Fjelde and von Uexkull 2012, von Uexkull 2014). Nevertheless, in the advent of rainfall shocks, financial aid could be used in compensating or restoring social balance following the loss in livelihood (Fearon et al. 2009). To account for this, we model a reduced-form analysis that conditions rainfall variability on its interaction with foreign aids to ascertain the effectiveness of aid at preventing drought-related civil conflict. We demonstrate that while rainfall change is unimportant in influencing armed civil conflict (Gleditsch 2012, Theisen et al. 2012), however, foreign aids per capita may reduce the occurrence of conflict in SSA. We wrap up our position on the aid-growth debate in Section 4 where we offer practical policy recommendation for aid effectiveness in the SSA region.

In the Section that follows; we present the empirical framework and discuss our data and measurement for the study.

[1] Several foreign interventions; for instance, in the health-related interventions, routine immunizations has been used to eradicate small pox, and polio, and medical interventions for supporting people living with HIV and AIDS have led to improvement in the treatment of the disease. Also, enormous progress has been made using foreign aid to fight against malaria, river blindness, guinea worm, and diarrhoea in the SSA region. Financial aid and support in the education like building of classes, provision of instruction materials have seen many children back in school, and the unconditional cash transfer following disaster or climate shocks to the poor household has accounted for a reduction in poverty status at the micro level.

METHODOLOGY

Data and empirical framework

The sub-Saharan Countries include African countries south of the Sahara Desert. SSA countries covered in this study include: Angola, Burundi, DR Congo, Cameroon, Central African Republic, Chad, Republic of the Congo, Gabon, Kenya, Nigeria, Rwanda, Tanzania, Uganda, Sudan, Djibouti, Ethiopia, Botswana, Somalia, Lesotho, Madagascar, Malawi, Mozambique, Namibia, South Africa, Swaziland, Zambia, Zimbabwe, Benin, Mali, Burkina Faso, Ivory Coast, Gambia, Ghana, Guinea, Guinea Bissau, Liberia, Mauritania, Niger, Senegal, Sierra Leone, Togo. Sub-Saharan Africa has a wide variety of climate zones some of which include: Sahel, savanna, sudan savanna, forest-savanna mosaic, hot semi-arid, moist broadleaf forests, equatorial forests, tropical rain forest, woodlands, Serengeti ecosystem, Afromontane forests, grasslands, shrublands, semi-deserts, cape florists, bushveld.

In a Fixed Effect (FE) OLS estimation, we link within country variation in log of foreign aid per capita ($Log\ F_{c,t}$) on log GDP per capita ($Y_{c,t}$) in country *c,* year *t* conditional on country fixed effects (δ_c), time trends (ϕ_t), and other time varying country characteristics $\sigma(S'_{c,t})$ in equation 1.

$$Log\ Y_{c,t} = \delta_c + \Phi_t + \beta(Log\ F_{c,t}) + \sigma(S'_{c,t}) + \mu_{c,t} \quad (1)$$

where the $Log\ Y_{c,t}$ of income is per capita received in country *c* in year *t* and is the log $F_{c,t}$ of foreign aids per capita. Our measure of foreign development aid per capita uses the Net Overseas Development (ODA) consisting of disbursements of loans made on concessional terms (net of repayments of principal) and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in countries and territories in the DAC list of ODA recipients. The data is from the World Bank database. We capture the possible role of institutions using the Polity2 measure from the Polity IV data set.

In an extended reduced-form estimation (equation 2), we further condition the link between log Foreign aid per capita ($Log\ F_{c,t}$) on log GDP per capita ($Y_{c,t}$) in country *c* in year *t* on time varying log of country rainfall distribution ($Log\ R_{c,t}$), and the interaction of log of aid per capita and log of rainfall $\alpha(F_{c,t}{*}R_{c,t})$, and other time varying country characteristics $\sigma(S'_{c,t})$. Available evidence indicates that rainfall shock has a transitory and significant impact on income (Brückner and Ciccone 2011). The reduced-form estimation in Equation (2) explores if foreign aid helps in ameliorating the negative impact of rainfall shocks on income.

$$Log\ Y_{c,t} = \delta_c + \Phi_t + \beta(Log\ F_{c,t}) + \gamma(Log\ R_{c,t}) + \gamma(Log\ R_{c,t}) + \alpha\ Log\ (F_{c,t} * R_{c,t}) + \sigma(S'_{c,t}) + \mu_{c,t} \quad (2)$$

Log rainfall ($Log\ R_{c,t}$) is measured using the log of the current and lagged country-averages of rainfall ($Log\ F_{c,t}$= $Log\ F_{c,t-1}$; $Log\ F_{c,t}$) because income growth like conflict could respond slowly to climate fluctuations (Burke *et al.* 2009). Climate data is from the replication dataset of Burke *et al.* (2009) study which is available online through www.pnas.org/cgi/content/full/0907998106/DCSupplemental.

However, equations (1) and (2) do not solve our other challenges as it relates to; first, whether aid inflow into SSA actually responds to the endogeneity concerns arising from selection and model misspecification bias and second, whether aid from foreign donor respond to development needs in times of crisis in the recipient countries or the profit motive of the donors. Endogeneity arises because rich countries may have better response package and institutional arrangement to address income decline following a rainfall shock by providing drought based

and rainfall-linked insurance facilities that insure the most deprived members. Foreign counterpart may prioritise the distribution of interventions and aid benefits based on the country-level extent of preparedness to rainfall shocks. This bias in the choosing of aid recipient countries may confound the estimates in equation (1).

While one way of addressing this bias is by controlling for the lagged values of foreign aid received as done in Clemens et al. (2014), however, Roodman (2014) in a replication observes a flaw in the identification technique in Clemens et al. (2012) and observes that contemporaneous endogeneity is still persistent in Clemens et al. (2012). Contemporaneous endogeneity arises because the residual of lagged political instability and growth in time *t* are correlated, and donor-agencies, out of fear that autocratic leaders might appropriate aid for private use or through diplomatic sanction, might ration disbursement.

To address the challenge, as it relates to the direction of causality of equation (1), we exploit the within country variation in rainfall to identify the impact of foreign aid per capita on GDP per capita. A strong argument for using rainfall shocks to identify foreign aid inflow is that in an agricultural dependent economy, negative rainfall shocks could induce an economic recession (Brückner and Ciccone 2011). Given the core objective of rendering assistance to deprived households, more foreign aid might follow negative rainfall shocks. In addition, it helps to test if aid flows to recipient countries in response to development needs. If we go by Sharples et al. (2014) that aid inflow responds more to business motives of donor agencies, then, a positive or non-significant relationship should be expected between rainfall shock and the net flow of capital into the SSA. A negative relationship implies that aid intervention by donor agencies addresses the developmental needs and is useful in times of crises in the region. The first stage, equation 3, is a correlation between log of current and lagged rainfall and aid. Equation 3 is useful for identifying the causal impact of foreign aid per capita on income per capita model expressed earlier in equation (1).

$$Log\ F_{c,t} = \delta_c + \phi_t + \lambda_1(Log\ R_{c,t}) + \lambda_2(Log\ R_{c,t-1}) + \sigma(S'_{c,t}) + \mu_{c,t} \quad (3)$$

where is the log of foreign aid per capita received in country *c* in year *t* and Log rainfall ($Log\ R_{C,t}$) takes the current and lagged country-averages of rainfall $Log\ R_{C,t-1}$; $Log\ R_{C,t}$. Equation 3 relates rainfall shocks to log of foreign aid per capita conditional on country fixed effects (δ_C), time trends (ϕ_t) and other controls.

Given the plausible correlation of rainfall shocks and foreign aids per capita, and on the assumption that rainfall shocks influence income growth through of foreign aid, we can re-estimate Equation (1) which is the second stage model to estimate the causal impact of aid per capita on GDP per capita.

RESULTS AND DISCUSSION

Foreign Development Aid and GDP per Capita

Fixed effects OLS results for the determinants of income per capita change are presented in Table 2. Standard errors are robust to heteroscedasticity and are clustered at the country level to allow for possible serial correlation. The results are presented in Table 2. In Model 1 (where Log of foreign aid takes a linear form) and Model 2 (where Log of foreign aid takes a quadratic form), there is a positive correlation between an increase in foreign aid per capita and the GDP per-capita (Table 2). In Models (1) and (2), we did not account for the plausible endogeneity of foreign aid with income growth. Therefore, results in the Models 1 and 2 may not represent the causal impact of foreign aid per capita on growth and supportive of previous argument that suggest the positive role of foreign aid as a source of capital inflow that augments government spending in SSA.

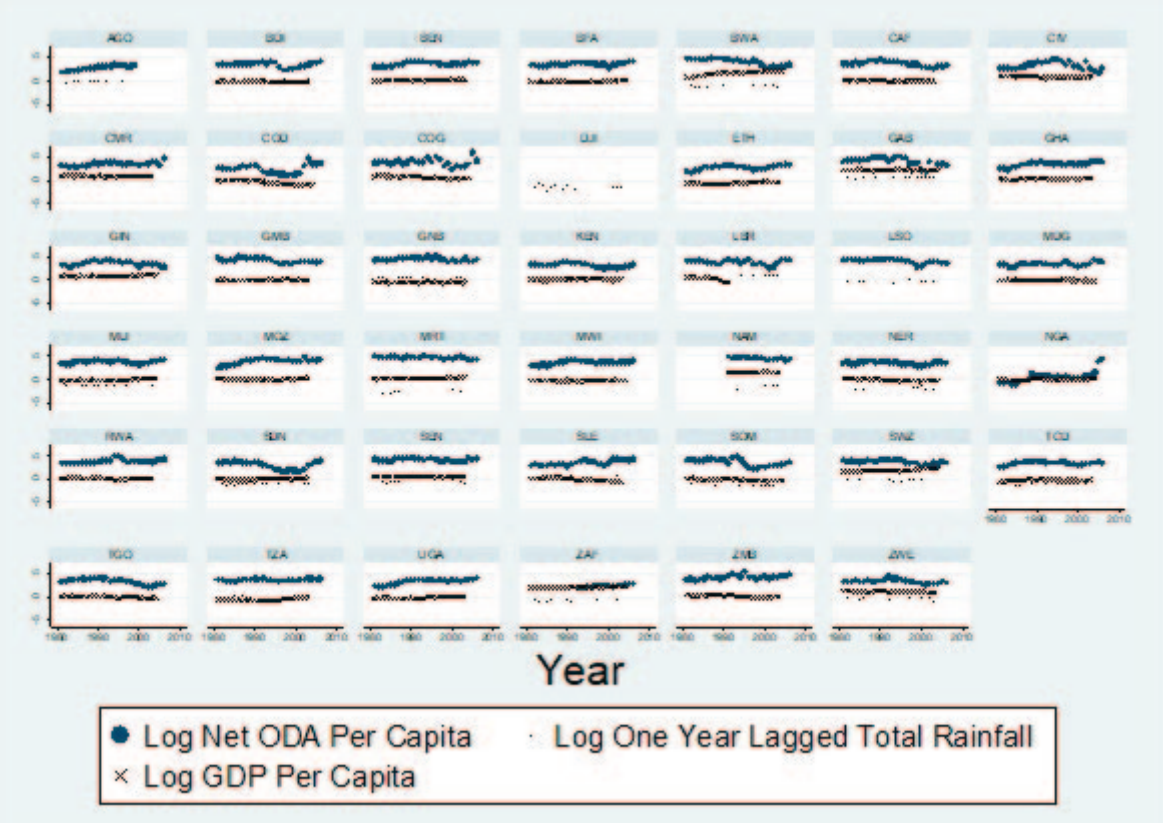

Figure 1. Scatter Plots of Trends of Country-Specific Foreign Aid (ODA), Rainfall and GDP per Capita.

Table 1

Summary and Descriptive Statistics

Variables	f	Mean	S.D.
Log GDP per capita	867	0.32	0.74
Polity IV (Combined democracy/autocracy score of Polity2, Polity IV dataset)	1049	-2.06	5.7
Log Foreign Aid Per Capita (Net official development assistance and official aid received)	1010	3.5	0.85
Log Foreign Aid (in current US$).	1010	19.31	0.98
Interaction (Log Foreign Aid/capita × Log rainfall)	855	-0.8	2.97
Log All Rainfall per annum	889	-0.23	0.76
New war onset (Dummy, Year in which a high-intensity war starts)	975		

However, in Models 3 to 5 in Table 2, we re-estimate the main equation for income growth using IV estimation. Specifically, we instrument log of foreign aid with the current and lagged values of annual rainfall in the SSA region. In contrast to our earlier results (Models 1 and 2) in Table 2, the results indicate that statistically weak but negative impact of the log of foreign aid per capita on economic growth. In particular, 10 percent lower levels of foreign aid per capita lead to an improvement by in the GDP per capita by 0.027 points (Model 3), 0.004 points (Model 4) and 0.003 points (Model 5) and the effect is statistically

significant at the 90 percent confidence level. The results suggest that amount of foreign aid per capita weakly reduces the extent of economic growth in the SSA countries. We can identify several practical reasons why aid may fail to uplift the socio-economic conditions of the poorest in SSA. For example, while aids may serve political interests, the economic benefits of aid are lost when political elites use it to foster systematic clientelism and achieve personal gain (Deaton 2013). In addition, because aids are a form of unearned rents accruing to governments, aids meant for public good could be privately appropriated by political elites and could undermine the broader economic development (Easterly et al. 2004, Moss et al. 2005).

Additional reason why aid might be more of an economic curse rather than a blessing could be because it displaces savings, particularly in the public sector savings and cause drainage of foreign exchange reserves when the recipient countries have to pay back in the form of interests (Bauer 2004, pp 41-52). Also, because economic growth depends on investment as a share of GDP, and if the incentives to invest were unfavourable, then aid will not increase investment. Indeed, as explained intuitively in Easterly 2003, aid could worsen the incentives to invest if aid inflow is conditional on the recipient's future poverty ("Samaritan's dilemma") (Easterly 2003). Aid may ultimately lower the recipient's long-term growth rate if the inflow of finished consumer product from the donor through the dumping of cheap food in the market discourages the growth of domestic production.

The effect of (instrumented) foreign aid per capita on economic growth responds to the functional form of the model. For instance, the diagnostic tests indicate that the result is more robust in model 5 of Table 2 where both the dependent variable and the Log Foreign Aid per capita are squared (non-linear). In essence, the results from the instrumented models (Models 3, 4, and 5) in Table 2 indicate that income per capita is less likely to grow in countries that are the recipient of more aid. This result is similar to those of others, such as Easterly et al. (2004), Svensson (2003), Moss et al. (2006) Shleifer (2009), and Roodman (2015), who are highly critical of the positive influence of aid on economic growth.

Perhaps a better appropriate way of avoiding this is to supply aid in the form of machinery and to bridge the gap in technology that would restore the primary sector and make them competitive for export and trade. It may also be relevant for countries to effectively leverage on the high natural endowment and biodiversity in the subregion. Foreign aids may be targeted at investments that harnesses the potentials of these natural endowment. However, this strategy must be pursued with caution within a sustainable framework.

Does aid inflow respond to disaster/negative shock?

In this section, we present the first stage estimates for Table (2) which also helps in determining if aid inflow correlates with the plausible development needs of the recipient countries or just determined by some random economic incentives the correlation between aid donor agencies. In the reduced first stage, we run a regression of log of current and one-year lag rainfall on the amount for foreign aid per capita (Table 3). We find that a negative rainfall shock induces more foreign aid inflow in the affected region (Table 3). Across the three Models (6,7 and 8), which correspond respectively to the first stage estimates of Models (3, 4 and 5) in Table 2, we find that the results are showing that rainfall shock is highly correlated with foreign aid holds.

In particular, Table 3 reports our estimates of the contemporaneous rainfall shocks on Foreign aid per capita. In column 1, our results indicate that 10 percent lower rainfall levels at t – 1 lead to a 3 percent increase in Foreign aid per capita and that the effect is statistically significant at the 99 percent confidence level. Columns 2 and 3 (First Stage for models 4 and 5 in Table 2) augment the spec-

Table 2
Impact of Foreign Aid on Income Per Capita

Dependent Variable: Log GDP per Capita	Model 1	Model 2	Model 3	Model 4	Model 5
[a]Log Foreign Aid	0.15***		-0.27*		
	(0.03)		(0.15)		
[a]Log Foreign Aid^2		0.03***	-0.1	-0.04*	-0.03*
		(0.01)	(0.3)	(0.02)	(0.02)
Polity2 lagged 1 year	-0.08	-0.2	767	-0.01	-0.002
	(0.6)	(0.6)	Yes	(0.4)	(0.3)
Observations	854	854	Yes	767	743
Instruments Included?	No	No	9.8***	Yes	Yes
Country and Time FE?	Yes	Yes	Yes	Yes	Yes
Kleibergen-Paap rk LM			9.8***	11.67***	13.12***
Cragg-Donald Wald F-stat			5	6	7
Kleibergen-Paap rk Wald F			6	7	8
Hansen Over ID test			2.1	2.16	0.14

Table 2 is the regression of Foreign Aid on Log GDP per capita in 41 Sub-Saharan African countries from 1981-2006. In Models (1) and (2), we did not account for endogeneity concerns, whereas, in Models (3) to (5), we instrument the log of Foreign Aid per capita with current and one-year lagged values of the log of annual rainfall. Models (1) and (3), both the dependent variable, Log GDP per capita and the Log foreign Aid takes a linear formModels (2) and (4), Log GDP per capita is linear while the Log Foreign Aid per capita takes a non-linear form.Model (5), both the dependent variable and the Log Foreign Aid per capita are squared (non-linear). In all the Models, the Standard errors are in parenthesis, robust and clustered at the country level. *, ** and *** indicate the significance of the parameter estimates at p values of < 10, 5 and 1% respectively.[a]Foreign Aid is the Net Overseas Development per capita (ODA) consists of disbursements of loans, and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in recipient countries. The data is from the World Bank database.

Table 3
First-Stage Correlation Between Log Rainfall Shocks and Log Foreign Aid Per Capita

Dependent Variable: Log Foreign Aid/capita	Model 6	Model 7	Model 8
Log Rainfall $_t$	-0.12	-0.90	-1.15*
	(0.10)	(0.68)	(0.7)
Log Rainfall $_{t-1}$	-0.30***	-2.25***	-2.33***
	(0.1)	(0.67)	(0.68)
F-stat	6***	6.7***	7.72***

Table 3 is the correlation between Log Rainfall Shocks and Log Foreign Aid per capita. Models 6, 7 and 8 are the first-stage estimates for Models 3, 4 and 5 in Table 2. The dependent variable is Log Foreign Aid per capita which consists of disbursements of loans, and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in recipient countries. The data is from the World Bank database. Robust Standard errors are in parenthesis and clustered at the country level, and *, ** and *** indicate the significance of the parameter estimates at p values of < 10, 5 and 1% respectively.

ification in column 1. Column 2 shows that a 10 percent drop in rainfall at t – 1 has a 22.5 percent statistically significant effect on the increase in Foreign aid at t and 23.3 percent increase in Column 3. Hence, the main effect of rainfall shocks on Foreign aid per capita is contemporaneous.

The motive for the generosity of donor agencies and aid giver has recently been under severe scrutiny (Sharples et al. 2014). For one, it is argued that aid inflow responds to the business motive of foreign donors and not out of pure generosity as it is often portrayed (Ndikumana and Boyce 2011, Sharples et al. 2014, Thacker 2015). Using data of aid inflow and capital outflow from Africa, Sharples et al. (2014) show that out of the net cash flow of $134billion, mainly in the form of loans, foreign investment and aid to SSA, while $192 billion is taken out as an outflow in the form of profits made by foreign companies and tax dodging (Sharples et al. 2014). If, the findings of Sharples et al. (2014), then, it is possible for less aid to respond to negative income shock arising from negative rainfall. Because rainfall shock will likely induce an economic recession which may create disincentives profit-motivated and concerned foreign donor, then a negative rainfall shock should generate less aid. However, our results in Table (3) demonstrate that the pattern of aid is likely to be higher in countries experiencing negative rainfall shocks. More importantly, our result offers evidence of the validity of the assumption the correlation of rainfall shock on foreign aid, a necessary condition before our 2-stage SLS could be valid (Imbens and Angrist 1994, Angrist et al. 1996, Angrist and Krueger 2001).

Can aid moderate impact of rainfall shocks?

In this section, we present the reduced estimates which also help to show if aid inflow complements positive rainfall shocks or moderate negative rainfall shock (Table 4). In the reduced first stage, we run a regression of log of current and one-year lag rainfall on GDP aid per capita and conflict (Table 4). In columns (1) and (2), the dependent variable is the Log GDP per capita, and in columns (3) and (4), the dependent variable is the onset of civil war. Robust Standard errors are in parenthesis and clustered at the country level.

Column 1 (Table 4) estimates the effect of current rainfall shocks on GDP per capita. Our results indicate that 10 percent lower rainfall levels lead to a 1 percent drop in income per capita and that the effect is statistically significant at the 99 percent confidence level. In Column 2, we add controls for foreign aid; the result shows that rainfall at t and t – 1 has a statistically insignificant effect on GDP per capita. This result is consistent with the findings in Brückner and Ciccone (2011) where the relationship between rainfall level and income is established at 0.75 percent levels.

In Column 3 and 4, where our dependent variable is the incidence of conflict, we find that the effect of rainfall on conflict is statistically insignificant (Table 4). However, after accounting for foreign aid per capita, we find that a 10 per cent increase in levels of foreign aid per capita reduces the probability of conflict by 1 percent (Table 4). In all our estimation, no significant evidence suggests that aid can moderate the negative shocks from rainfall in SSA. Our result on the insignificance of rainfall on conflict supports the alternative conclusion in the recent literature suggesting that climate not be to be blamed for civil war in Africa (Nordås and Gleditsch 2007, Buhaug 2010, Gleditsch 2012, Theisen et al. 2012). Nevertheless, our conclusion on the role of foreign aid as a useful tool for preventing civil wars in the wake of negative economic shocks and for suppressing conflict and social cohesion is supported by the findings of Fearon et al. (2009) and Savun and Tirone (2012). In particular, Savun and Tirone (2012) show that foreign aid can cushion government spending from the downward pressures of economic shocks and provide recipient governments with resources that can make rebellion a less attractive option.

Table 4
Reduced-Form Effect of Rainfall Shocks on Income growth and Civil War Conditional on the Moderating influence of Foreign Aid

	Model 9	Model 10	Model 11	Model 12
Log Rainfall	0.10**	0.08	-0.01	0.13
	(0.04)	(0.19)	(0.05)	(0.14)
Log Rainfall lagged 1 year	0.05	0.06	-0.01	-0.03
	(0.003)	(0.04)	(0.06)	(0.06)
Log Foreign Aid (Net ODA per capita*)		0.03		-0.1**
		(0.05)		(0.05)
Interactions				
(Log Net ODA ×Polity2)		0.02		-0.01
		(0.3)		(0.03)
(Log Rainfall ×Log Net ODA)		0.01		-0.05
		(0.05)		(0.04)
Observations	778	767	849	817
Within Country R-Squared	0.03	0.05	0.05	0.09

Table 4 accounts for the reduced-form estimation of the effect of rainfall on Log GDP per capita (Models 9 and 10) and civil war (Models 11 and 12) conditional on the moderating influence of foreign aid per capita. In Models (9) and (10), the dependent variable is the Log GDP per capita, and in models (11) and (12), the dependent variable is the onset of civil war. Robust Standard errors are in parenthesis and clustered at the country level. *Foreign Aid is the Net Overseas Development per capita (ODA) consists of disbursements of loans, and grants by official agencies of the members of the Development Assistance Committee (DAC), by multilateral institutions, and by non-DAC countries to promote economic development and welfare in recipient countries. The data is from the World Bank database.

CONCLUSION AND RECOMMENDATION

It has long been argued that foreign development aid inflow has significant effects on the economic growth of recipient countries; however, what is not evidently clear is the direction and sign of causation. As emphasized by the literature, foreign aid inflow could have both negative and positive impact on economic growth of recipient countries and this could be for several reasons. For one reason, because foreign aid is a form of capital inflow, it can augment local resources and provide necessary inputs for economic growth. In another instance, it is possible for aid to support political patronage; and, in which case, it does not foster capital accumulation that leads to possible higher output that promotes growth. We exploit the within-country rainfall shocks in sub-Saharan Africa (SSA), where such shocks have a significant but transitory impact on GDP per capita to explore the effect of foreign aid per capita on income growth. The argument is that following a rainfall shock in an agricultural dependent economy, inflow of foreign aid can be a channel for improving income shocks. Our analysis relates a negative rainfall shocks to significant inflow of foreign aid. However, our instrumental variables results indicate that countries in the SSA region with more inflow of foreign aid per capita record negative but weak improvements in income growth. For example, rainfall-driven foreign aid inflow is followed by a weak decline in the income per capita. Considering the huge potentials of agriculture in economies of sub-Saharan countries as well as the fact that agriculture is still largely climate dependent in the sub-region, it becomes very important that government actively seek out strategies to mitigate the effects of climate change in their countries. Shifting focus in this direction will

have positive effects on the economy thereby supporting development.

While countries receiving aid may not grow faster rate than countries without, nevertheless, aid might still play an economically useful role at a micro level, particularly, if it involves active local resource engagement in planning and implementation. Several accounts exist showcasing the positive impact of aid in Africa where the donor agency involved the local resource in the implemetation and planning. For instance, in Easterly (2004), the author recount how an NGO project of a British aid organization called Water Aid is able to carry clean water from springs on top of the mountains to villages down in the Ethiopian Valley. Previously, the process of fetching water by the villagers was very tedious; usually involving walking long distances to fetch water from a polluted river that transmitted disease. Children were kept out of school and farmers out of farming from the trade-off of time allocation for fetching water and other productive activities (Easterly 2004). The project, according to Easterly (2004), was run entirely by Ethiopians, with representatives from the villages on the board of the agency and the villagers watered their cattle and collected drinking water for a nominal fee paid to Water Aid to be used for maintenance of the system (Easterly 2004). The project was a huge success at the micro level probably because it identified the specific needs of the people and replicating this process on a broader scale could help in positively translating foreign aid to economic growth in the SSA region.

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