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Abstract
Least Developed Countries (LDCs) of Sub-Saharan African have been recipients of official development assistance for more than 5 decades; however they are still characterized by chronic problems of poverty, low living standards and weak economic growth. The hot question is: Is aid effective in promoting economic growth? Thus, this paper investigates the impact of aid on the economic growth of 12 least developed countries in Sub-Saharan Africa over a period of 20 years. I take a fixed effects instrumental variable approach and the results imply that aid has a statistically insignificant negative impact on economic growth. I therefore conclude that aid is ineffective in promoting growth, perhaps due to misallocation of aid or inefficient use.

Keywords
Least Developed Countries, LDSs, Sub-Saharan Africa, development assistance, poverty, living standards, economic growth

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1. Introduction

The fundamental role of foreign aid, given in the form of loans and grants, is to mitigate poverty and promote economic growth in developing countries. However, the results of official development assistance (foreign aid) have not universally met the fundamental objective of aid in different countries (Lohani 2004). According to Dambisa Moyo, Zambian economist and author of *Dead Aid*,

> Over the past 60 years at least $1 trillion of development-related aid has been transferred from rich countries to Africa. Yet real per-capita income today is lower than it was in the 1970s, and more than 50% of the population -- over 350 million people -- live on less than a dollar a day, a figure that has nearly doubled in two decades" (Moyo 2009).

Proponents of aid argue that aid has a positive impact on economic growth for the following reasons: 1) aid supplements domestic savings and capital formation; 2) it can close the foreign exchange gap (Fayissa and El-kaissy, 1999). 3) In Askarov and Doucouliagos' 2015 study, (cited in Morrissey 2001), "Aid can increase investment in physical and human capital. 4) Aid is also associated with technological transfer that increases capital productivity and promotes endogenous technical change."

On the other hand, opponents of aid argue that foreign aid is ineffective in Africa for several reasons including: 1) it comes at a cost and heavily in debts African governments; 2) it perpetrates corruption when aid is given to corrupt governments; 3) it increases dependency syndrome and weakens governments' efforts of collecting revenue; 4) large inflows of foreign currency can strengthen the recipients' domestic currency and raise its export prices, in turn making the country less competitive in the global market (Moyo 2009).

Furthermore, prior research on the impact of aid on economic growth is not unanimous. Hansen and Tarp (2000) found that effectiveness of aid is dependent on human capital and investment. Malik (2008) found that aid is not effective in the short run and has a negative effect on growth in the long run. Minoiu and Reddy (2009) found that effectiveness of aid is conditional on whether the aid is developmental or not. Also, there are several common challenges that face the empirical investigations of the effectiveness of aid including: 1) accounting for the lagged effect of aid on growth; 2), properly accounting for the two-way causal relationship between aid and growth and 3), properly controlling for the underlying heterogeneity of countries used in regression analysis (Askarov and Doucouliagos 2015). The study of the effectiveness of aid on economic growth is important because it can help donor countries and aid recipients understand how aid can be effectively used to alleviate poverty and attain sustainable economic growth in the least developed countries of Sub-Saharan Africa.

The results of my study support the argument that aid is ineffective for economic growth in least developed countries of Sub-Saharan Africa. For example, after correcting for problems like time fixed effects, heteroscedasticity, unit roots and endogeneity in my model, a percentage increase in net official development assistance (ODA) is associated with a 0.03% decrease in real gross domestic product (GDP); this is not statistically different from 0. However, real total factor

productivity and capital accumulation have one of the largest statistically significant impacts on real GDP and therefore I argue that proper allocation of aid in the economy makes aid very effective.

The rest of the paper is organized as follows: section 2 discusses existing literature and my contribution to it. Section 3 gives an overview of the methods I have used in this study, while section 4 explains where I got my data and describes the nature of the data set used in this study. A discussion of my analysis and interpretation of my results is given in section 5 and finally, section 6 discusses my conclusion based on the empirical results of this paper.

2. Literature Review

Prior empirical economic literature on the relationship between aid and growth in developing countries is mixed. Mallik (2008) uses co-integration analysis to study the relationship of foreign aid and economic growth of the poorest six African countries. In 5 out the 6 countries, Mallik found aid has no significant effect on growth in the short run, while there is a significant negative relationship between aid and growth in the long run.

Hansen and Tarp (2000), conducted a cross country study using a growth model that captures non-linear effects between aid and growth. Their results show that when human capital and investment are not controlled for, aid increases economic growth, but with decreasing returns. Hansen and Tarp conclude that capital accumulation is the channel through which aid impacts growth. In another cross country study, Minoiu and Reddy (2009) structured their research by looking at the effect of two kinds of aid (developmental and non-developmental aid) on per capita GDP growth over long periods. Their results indicate that developmental aid has a positive, large and robust effect on economic growth, while the effect of non-developmental aid on economic growth is mostly neutral and occasionally negative.

On the other hand, Ouattara (2006) uses panel data technique to study the effect of aid on fiscal behavior given that aid is channeled through the public sector and its effect on the economy is contingent on how it is used by the public sector. Ouattara's empirical results suggest that aid has a significant positive impact on public investment and developmental expenditure, while it has a significant negative relationship with non-developmental expenditure. In addition, Tavares (2002) studied the impact of foreign aid on corruption and found that aid has a robust significant negative relationship with corruption.

I add to the existing economic literature by using an instrumental variable approach where I use percentage of population with access to improved water source as an instrumental variable for foreign aid. There are a lot of studies that have taken the instrumental variable approach: for instance Brückner (2009) used rainfall as an instrumental variable to study the impact of growth on Aid; Rahajan and Subramanian (2008) used colonial links and relative population size of the donor to recipient; and Magesan (2015) used Participation in United Nation's Human Rights Treaties. However, I am not aware of any study that uses the instrumental variable I have exploited in this paper. Some prior studies that have used the instrumental variable approach have been criticized for using weak and invalid instruments (Magesan, 2015). Some instrumental variables used in prior studies have been criticized on two to three grounds: 1) high collinearity with aid (e.g. lagged aid, lagged aid squared); 2) not truly exogenous to the economy (e.g. lagged GDP per capita, lagged arms imports) and 3) time invariance (Werker et. Al 2008).

3. Methodology

The objective of this paper is to study the impact of foreign aid on the economic growth of some least developed countries (LDCs) in Sub-Saharan Africa. In this study, I use the Solow

Growth Model's aggregate production function as a guide to structure my regression model. According to Solow Growth Model's aggregate production function, output is a function of capital accumulation (K), labor force/ Population (N) and state of technology (A) (Blanchard and Johnson, 2013). This is written out as

$$Y = F(K, N, A).$$

I use Total Factor Productivity (TFP) to estimate technological progress or state of technology. According to Comin, **"**Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs used in production" (Comin 2006)**.** The Solow residual defined as

$$gY - \alpha * gK - (1 - \alpha) * gL$$

is used as a measurement for TFP growth, where gY denotes the growth rate of aggregate output, gK the growth rate of aggregate capital, gL the growth rate of aggregate labor and alpha the capital share (Comin 2006). TFP is multidimensional and some of its important determinants include human capital, physical infrastructure, institutions (political and economic), financial development, geographical predicament and absorptive capacity (Issakson 2007).Cognizant that TFP accounts for both political and economic institutions, I use TFP to control for quality of government, nature of policies and corruption which appear to be determinants of aid effectiveness (Fayissa and El-Kaissy 1999).

Furthermore, I include the variable "net exports" in my model since it is argued that increasing Sub-Saharan Africa's trade share in the world can outweigh the impact of aid. According to One, "Sub-Saharan Africa's tiny share (3.5%) of global exports was worth

approximately $442 billion in 2014, around 10 times the amount of aid the region received the same year[1]." Hence my primary model in this study:

$$rgdp_{it} = \beta_0 + \beta_1 NetODA_{it} + \beta_2 NetExp_{it} + \beta_3 rtfp_{it} + \beta_4 rkstock_{it} + \beta_5 pop_{it} + u_{it}$$

Where *rgdp* is real gdp (as a measure of economic growth), *NetODA* is net official development assistance received (measure of aid), *NetExp* is trade balance, *rtfp* is total factor productivity, *rkstock* is capital stock, *pop* is population and *u* is the error term.

I use different regression methods that potentially correct for heteroscedasticity, unit roots, trending behavior, serial correlation, unobserved fixed variables and endogeneity. I then compare these regressions and make a conclusion. My main contribution to the existing literature is my instrumental variable approach where I use percentage of population with access to improved water sources (H_20_pop) as an instrumental variable for foreign aid. Human well-being indicators such as infant mortality, life expectancy, literacy etc. rather than macroeconomic indicators are the recommended determinants of aid allocation to a country (Fayissa and El-Kaissy 1999). On the other hand, real GDP only accounts for total final output in the economy. Therefore, theoretically, percentage of population with access to improved water sources is not used in the accounting of real GDP; however it is a wellbeing indicator that can potentially be used to determine aid allocation. Therefore, I suspect that H_20_pop is highly correlated with aid, but is not directly correlated with real GDP and therefore is uncorrelated with the error term of my model.

[1] One. "Trade and Investment" http://www.one.org/international/issues/trade-and-investment/

4. Data

My study uses panel data for 12 African countries over the span of 20 years (1995 – 2014). All the data used in this study is from Penn World Table version 9.0 and the World Bank's Database: World Development Indicators. The African countries of interest are Benin, Burkina Faso, Burundi, Mauritania, Mozambique, Rwanda, Senegal, Lesotho, Sierra Leone, Tanzania, Togo and Sudan. My key variables from Penn World Table 9.0 include real gross domestic product (GDP) at constant national prices (in million 2011US$); total factor productivity at constant national prices (2011=1); capital stock at constant national prices (in million. 2011US$); and Population (in millions). Data on the following variables are from the World Bank's Database: net official development assistance received (as percentage of gross national income (GNI); external balance on goods and services (percent of GDP), commonly referred to as trade balance or net exports; and improved water source (percent of population with access).

The summary statistics of these key variables are presented in Table 1. During 1995 to 2014, the average net official development assistance received was 13.15 % of GNI while the average real GDP of these African countries was US$ 25707.81 Million (constant 2011 US$). The mean on net exports (-19.75 % of GDP) implies that these African countries have, on average, been running trade deficits for 20 years. On the other hand, only 53.8% of the total population of these African countries, on average, has access to improved water sources.

Table 1. Summary Statistics of Key Variables

Variable	Observations	Mean	Standard Deviation	Minimum	Maximum
Net ODA received (% of GNI)	240	13.15	8.61	1.22	53.48
Real GDP (Constant 2011 Million US$)	240	25707.81	37874.27	2546.94	180328.80
Net Exports (% of GDP)	239	-19.75	20.44	-118.26	6.10
Capital Stock (Constant 2011 Million US$)	240	63160.07	95285.89	6654.39	512623.80
Total Factor Productivity	240	0.95	0.15	0.56	1.28
Population (Millions)	240	13.73	12.75	1.75	50.44
Access to Water (% of Population)	240	62.06	11.84	35.70	82.10

5. Analysis and Results

Table 2: Preliminary Regression

Source	SS	df	MS		
Model	2.9595e+11	5	5.9191e+10	Prob > F	0.0000
Residual	4.6470e+10	233	199442183	R-squared	0.8643
Total	3.4242e+11	238	1.4388e+09	Root MSE	14122

rgdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
net_oda	-503.3378	128.9794	-3.90	0.000	-757.4528	-249.2229
net_Exp	2.259717	52.0087	0.04	0.965	-100.2077	104.7271
rtfp	20967.31	7186.75	2.92	0.004	6807.996	35126.63
rkstock	.1031206	.0199218	5.18	0.000	.0638707	.1423704
pop	1892.539	148.8858	12.71	0.000	1599.205	2185.874
_cons	-19997.76	8474.099	-2.36	0.019	-36693.41	-3302.11

Preliminary regression results show that aid and real GDP has a negative relationship where a one point increase in net ODA reduces real GDP by US$ 503.34 and this coefficient is statistically significant from zero. The rest of the independent variables have statistically significant positive coefficients, except for the coefficient on net exports which has a statistically insignificant positive coefficient. However, there is evidence of heteroscedasticity, serial correlation, non-stationarity, unit roots and trending behavior in this regression output - the specific tests for these problems are included in the appendix. Thus, I potentially correct for these problems by running a first differenced as well as a de-trended regression using robust standard errors and logged variables – except for net exports because it has negative values.

Table 3: De-trended Regression

```
Linear regression                               Number of obs     =        239
                                                F(5, 233)         =    1282.46
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9652
                                                Root MSE          =     .19139
```

lrgdp_dt	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnetODA_dt	-.1198737	.0306706	-3.91	0.000	-.1803007	-.0594466
netEXP_dt	.0006892	.0006669	1.03	0.303	-.0006248	.0020032
lrtfp_dt	1.200889	.1096828	10.95	0.000	.9847921	1.416986
lrkstock_dt	.4601635	.0228998	20.09	0.000	.4150463	.5052806
lpop_dt	.5660361	.0266018	21.28	0.000	.5136252	.6184469
_cons	.0008038	.0124336	0.06	0.949	-.0236929	.0253006

The results from the regression of de-trended show that there is still a negative relationship between aid and real GDP where a percentage increase in aid reduces real GDP by 0.12% and the coefficient is statistically different from zero. Surprisingly the coefficient on net exports is not practically and statistically significant from zero. The rest of the independent variables have statistically significant positive coefficients. Furthermore, the first differenced

regression yields similar results to the regression of de-trended variables as far as the sign, magnitude and significance of coefficients estimates are concerned. See first differenced regression output below:

Table 4: First Differenced Regression

Linear regression

Number of obs	= 237
F(5, 231)	= 212.31
Prob > F	= 0.0000
R-squared	= 0.9567
Root MSE	= .07791

clrgdp	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
clnetODA	-.0670772	.0402963	-1.66	0.097	-.1464724	.012318
dnetEXP	.0008234	.0010942	0.75	0.453	-.0013326	.0029793
clrtfp	1.058939	.1812455	5.84	0.000	.701833	1.416044
clrkstock	.5049199	.1021231	4.94	0.000	.3037081	.7061316
clpop	.5192678	.1409524	3.68	0.000	.2415512	.7969843
_cons	.0016393	.0052268	0.31	0.754	-.008659	.0119375

On the other hand, Cognizant that the countries in my model are heterogeneous, I also estimate my model using time and country fixed effects to net out unobserved fixed variables. The results show that all my dependent variables have a positive relationship with real GDP except for aid and net exports. Also, all the coefficient estimates of my model are statistically significant from zero. However, the negative coefficients on net exports does not make sense as a majority of the economies of LDCs in Sub-Saharan Africa are tethered to commodity prices of their exports; Rodrik (2007) asserts that there is a direct relationship between the profitability of a country's tradable commodities and economic growth. The coefficient on net official development assistance suggests that a percentage increase in net ODA reduces real GDP by 0.03%, while TFP has the largest impact on real GDP. A percentage increase of TFP increases real GDP by 0.91%. See Table below

Table 5: Fixed Effects Regression

```
i.country         _Icountry_1-12      (_Icountry_1 for country==Benin omitted)
i.year            _Iyear_1995-2014    (naturally coded; _Iyear_1995 omitted)

Linear regression                               Number of obs     =        239
                                                F(35, 203)        =   18513.81
                                                Prob > F          =     0.0000
                                                R-squared         =     0.9995
                                                Root MSE          =     .02532
```

lrgdp	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnet_oda	-.0254101	.0054001	-4.71	0.000	-.0360576	-.0147626
net_Exp	-.0006843	.0002782	-2.46	0.015	-.0012327	-.0001358
lrtfp	.9099721	.018708	48.64	0.000	.8730851	.9468591
lrkstock	.3660657	.011382	32.16	0.000	.3436237	.3885077
lpop	.6720259	.0875759	7.67	0.000	.4993509	.8447009
_Icountry_2	-.0944086	.0459574	-2.05	0.041	-.1850236	-.0037935
_Icountry_3	-.3446654	.0217897	-15.82	0.000	-.3876285	-.3017024
_Icountry_4	.0502099	.1385289	0.36	0.717	-.2229301	.3233499
_Icountry_5	.3693702	.0836801	4.41	0.000	.2043766	.5343637
_Icountry_6	-.2784852	.0865143	-3.22	0.001	-.449067	-.1079034
_Icountry_7	.0663196	.0163586	4.05	0.000	.0340651	.0985741
_Icountry_8	.007316	.0301465	0.24	0.808	-.0521243	.0667564
_Icountry_9	.0124697	.0447454	0.28	0.781	-.0757556	.1006949
_Icountry_10	.5017463	.1383099	3.63	0.000	.229038	.7744546
_Icountry_11	-.079905	.1388949	-0.58	0.566	-.3537667	.1939567
_Icountry_12	-.2371432	.0356729	-6.65	0.000	-.3074801	-.1668063
_Iyear_1996	.006397	.0126093	0.51	0.612	-.018465	.031259
_Iyear_1997	-.0122268	.0169176	-0.72	0.471	-.0455837	.02113
_Iyear_1998	.0055923	.0126349	0.44	0.659	-.0193202	.0305047
_Iyear_1999	.0148259	.0138954	1.07	0.287	-.0125719	.0422237
_Iyear_2000	.0277451	.0156064	1.78	0.077	-.0030264	.0585165
_Iyear_2001	.0202424	.0170877	1.18	0.238	-.0134498	.0539346
_Iyear_2002	.0339268	.0190738	1.78	0.077	-.0036813	.0715349
_Iyear_2003	.0315997	.0215682	1.47	0.144	-.0109267	.0741261
_Iyear_2004	.0390008	.0244625	1.59	0.112	-.0092324	.087234
_Iyear_2005	.0385662	.0261948	1.47	0.142	-.0130825	.0902149
_Iyear_2006	.0546239	.0280784	1.95	0.053	-.0007388	.1099867
_Iyear_2007	.0616927	.0306953	2.01	0.046	.0011703	.1222151
_Iyear_2008	.0628272	.032922	1.91	0.058	-.0020857	.1277401
_Iyear_2009	.0609339	.0353162	1.73	0.086	-.0086996	.1305675
_Iyear_2010	.0730919	.037615	1.94	0.053	-.0010744	.1472581
_Iyear_2011	.0833452	.0396493	2.10	0.037	.005168	.1615224
_Iyear_2012	.0866613	.0418423	2.07	0.040	.0041599	.1691626
_Iyear_2013	.1004795	.0445913	2.25	0.025	.012558	.188401
_Iyear_2014	.1135807	.0480149	2.37	0.019	.0189089	.2082525
_cons	4.260529	.2091888	20.37	0.000	3.848068	4.672991

However, I suspect that foreign aid and real GDP have a spurious relationship, or there might be some underlying endogeneity in the model. This is because the economic performance of a developing country can determine if aid should be allocated to it and on the other hand foreign aid has an effect on GDP through different channels in the economic structure of the country. In order to correct for this problem I use improved water source (percent of population with access to improved water source) as an instrumental variable for aid. As a robustness check of my instrumental variable I ran a regression of log (net ODA) on log(H_2O_pop) and other dependent variables that affect aid or have been used in prior research as instrumental variables as cited in Werker et. Al 2008.

Table 6: Instrumental Variable Quality

Linear regression

Number of obs	= 239
F(5, 233)	= 49.77
Prob > F	= 0.0000
R-squared	= 0.4849
Root MSE	= .50304

lnet_oda	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
lh2o_pop	-1.009491	.1650581	-6.12	0.000	-1.334688	-.6842939
lrgdp	-.980642	.104675	-9.37	0.000	-1.186872	-.7744116
lrgdp_1	.1502587	.087444	1.72	0.087	-.0220233	.3225406
lpop	.6916483	.0627507	11.02	0.000	.5680171	.8152795
year	.0244286	.0068967	3.54	0.000	.0108408	.0380165
_cons	-36.11949	13.37586	-2.70	0.007	-62.47257	-9.766407

The results make intuitive sense: as percentage of people with access to improved water sources increases, net ODA decreases. The coefficient on real GDP implies that as the economic performance of the country improves the amount of aid decreases. This was the case of Botswana after it gained its independence; the role of aid decreased as revenues from diamond mining increased (Togo and Wada 2008).

Table 7: Fixed Effects IV Regression

```
. xtivreg lrgdp (lnet_oda = lh2o_pop) net_Exp lrtfp lrkstock lpop, fe vce(robust
> )

Fixed-effects (within) IV regression            Number of obs     =        239
Group variable: ccode                           Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.9942                                         min =         19
     between = 0.9346                                         avg =       19.9
     overall = 0.9390                                         max =         20


                                                Wald chi2(5)      =   4.45e+06
corr(u_i, Xb)  = -0.3985                        Prob > chi2       =     0.0000

                                (Std. Err. adjusted for 12 clusters in ccode)
------------------------------------------------------------------------------
             |               Robust
       lrgdp |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    lnet_oda |  -.0309319   .0542281    -0.57   0.568     -.137217    .0753533
     net_Exp |  -.0003928   .0005298    -0.74   0.458    -.0014313    .0006456
       lrtfp |   .9020897   .0392832    22.96   0.000     .8250961    .9790834
    lrkstock |   .3769718   .0249396    15.12   0.000     .3280912    .4258525
        lpop |   .8541086   .0494813    17.26   0.000      .757127    .9510901
       _cons |   3.801544   .2827884    13.44   0.000     3.247289    4.355799
-------------+----------------------------------------------------------------
     sigma_u |  .29751608
     sigma_e |   .0261815
         rho |  .99231546   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Instrumented:   lnet_oda
Instruments:    net_Exp lrtfp lrkstock lpop lh2o_pop
------------------------------------------------------------------------------
```

The regression results of the fixed effect (within) IV regression show that all the dependent variables have a positive relationship with real GDP, except for net exports and net ODA. Also, all the coefficients of the variables are statistically significant, except for net exports and net ODA. The coefficient estimates are similar to the coefficient estimates of the regression with time and country fixed effects. The IV (within) fixed effects model also implies that a

percentage increase in net ODA reduces real GDP by 0.03%. However, there is not enough evidence to support this relationship as the coefficient on net ODA is statistically insignificant. In contrast, the TFP, capital stock and population coefficient estimates are practically significant and support macroeconomic theory. For instance, according to macroeconomic theory a country's labor force increases as the population of the country increases and hence in the long run when a country reaches its steady state, output grows at the growth rate of technology (estimated by total factor productivity in my model) and population growth (Blanchard and Johnson, 2013).

Table 8: Fixed Effects IV Regression (Using detrended Variables)

```
. xtivreg lrgdp_dt (lnetODA_dt = lwater_dt)  netEXP_dt lrtfp_dt lrkstock_dt lpop
> _dt, fe vce(robust)

Fixed-effects (within) IV regression            Number of obs     =        239
Group variable: ccode                           Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.9592                                         min =         19
     between = 0.9487                                         avg =       19.9
     overall = 0.9485                                         max =         20


                                                Wald chi2(5)      =    2254.47
corr(u_i, Xb)  = 0.2218                         Prob > chi2       =     0.0000

                               (Std. Err. adjusted for 12 clusters in ccode)
------------------------------------------------------------------------------
             |               Robust
    lrgdp_dt |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
  lnetODA_dt |  -.0238895   .0496233    -0.48   0.630    -.1211494    .0733703
   netEXP_dt |  -.0007491   .0003594    -2.08   0.037    -.0014535   -.0000448
    lrtfp_dt |   .9084642   .0443209    20.50   0.000     .8215969    .9953316
 lrkstock_dt |   .3712589   .0248677    14.93   0.000      .322519    .4199988
     lpop_dt |   .6691325   .0813287     8.23   0.000     .5097312    .8285339
       _cons |  -.0000394   .0007549    -0.05   0.958    -.0015191    .0014402
-------------+----------------------------------------------------------------
     sigma_u |  .24443658
     sigma_e |  .02526101
         rho |  .98943291   (fraction of variance due to u_i)
------------------------------------------------------------------------------
Instrumented:   lnetODA_dt
Instruments:    netEXP_dt lrtfp_dt lrkstock_dt lpop_dt lwater_dt
------------------------------------------------------------------------------
```

As a robustness check I also ran fixed effects within instrumental variable regression using de-trended variables since most of the variables trend with time. The coefficients are similar to the regression results in table 7, however, the coefficient on net exports is now statistically significant at the 5 % level. Again, the coefficient on net exports doesn't make sense, nevertheless its coefficient is not practically significant. A summary of my regression approaches is presented in Table 9.

Conclusion

My study investigates the impact of aid (official development assistance) using panel data for 12 least developed countries (LDCs) in Sub-Saharan Africa observed over a period of 20 years (1995 – 2014). An understanding of the historical context of aid given to Africa or developing countries in general might be helpful in interpreting the story that my data supports. According to Moyo 2009, starting from the 1980's, multilateral aid was given in order to help indebted developing countries meet their debt obligations as many countries had accumulated a lot of debt following the oil crisis of the 1970's. However, multilateral aid like budgetary support was provided on condition that developing countries implement policy reforms in order to promote free market systems and good governance. This is in contrast to aid that was given in the 1960's which primarily focused on building physical infrastructure like airports, roads, power stations, telecommunications, schools, health centers among others (Moyo 2009).

My regression results imply that that a percentage increase in net official development assistances reduces real GDP by about 0.03%. However, this is statistically not different from zero and arguably practically insignificant as well. Thus, there is not enough evidence to support this relationship; therefore this goes to show that aid that was transferred around this period (1995 – 2014) was ineffective towards achieving high levels of economic growth. My results

also show that TFP, capital accumulation and population have one of the largest impacts on economic growth. For instance, in the fixed-effect (within) IV regression, a percentage increase in TFP increases GDP by 0.9% and a percentage increase in capital stock increases economic growth by 0.38%. Therefore if aid is inefficient in increasing economic growth over a long-run, it must be the case that it is being misallocated in the economy or it is practically doing little to promote robust capital accumulation, technological progress and labor force participation.

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Appendix

Table 9. Summary of Regression Analysis of the effect of aid (net ODA) on real GDP

Dependent Variable: Log (Real GDP) Time Period: 1995 - 2014					
Variable	**1st Differenced**	**De-trended**	**Fixed Effects (Time and Country)**	**Fixed Effects IV Regression**	**Fixed Effects IV Regression (De-Trended)**
log (Net ODA)	- 0.0671* [0.0403]	- 0.1199*** [0.0307]	- 0.0254*** [.0054]	- 0.0309 [0.054]	- 0.024 [0.05]
Net Exports (% of GDP)	0.0008 [0.0011]	0.0007 [0.0007]	- 0.0007** [0.0003]	- 0.0004 [0.0005]	- 0.0007** [0.0004]
Log (TFP)	1.059*** [0.1812]	1.201*** [0.1097]	0.90997*** [0.0187]	0.9021*** [0.0393]	0.9085*** [0.044]
Log (Capital Stock)	0.5049*** [0.1021]	0.4601*** [0.0229]	0.3661*** [0.0114]	0.37697*** [0.0249]	0.3713*** [0.0249]
Log(Population)	0.5192*** [0.14095]	0.566*** [0.0266]	0.67203*** [0.0876]	0.8541*** [0.0495]	0.6691*** [0.0813]
Total Observations	237	239	239	239	239
R-Squared	0.9567	0.9652	0.9995	0.9390	0.9485
Prob (F-Statistic)	0.000	0.0000	0.0000	0.0000	0.0000
(*), (**), (***) represent 10%, 5%, and 1% levels of significance. Robust standard errors in brackets [ ]. The instrumental variable used in the Fixed effects IV regressions is Improved water Source (percent of population with access)					

Preliminary Regression

```
. reg rgdp net_oda net_Exp rtfp rkstock pop
```

Source	SS	df	MS	Number of obs	=	239
				F(5, 233)	=	296.78
Model	2.9595e+11	5	5.9191e+10	Prob > F	=	0.0000
Residual	4.6470e+10	233	199442183	R-squared	=	0.8643
				Adj R-squared	=	0.8614
Total	3.4242e+11	238	1.4388e+09	Root MSE	=	14122

rgdp	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
net_oda	-503.3378	128.9794	-3.90	0.000	-757.4528	-249.2229
net_Exp	2.259717	52.0087	0.04	0.965	-100.2077	104.7271
rtfp	20967.31	7186.75	2.92	0.004	6807.996	35126.63
rkstock	.1031206	.0199218	5.18	0.000	.0638707	.1423704
pop	1892.539	148.8858	12.71	0.000	1599.205	2185.874
_cons	-19997.76	8474.099	-2.36	0.019	-36693.41	-3302.11

White's Test for Heteroscedasticity

```
White's test for Ho: homoskedasticity
         against Ha: unrestricted heteroskedasticity

         chi2(20)     =    217.75
         Prob > chi2  =    0.0000

Cameron & Trivedi's decomposition of IM-test
```

Source	chi2	df	p
Heteroskedasticity	217.75	20	0.0000
Skewness	78.86	5	0.0000
Kurtosis	11.90	1	0.0006
Total	308.51	26	0.0000

Therefore there is evidence of heteroscedasticity.

Testing for Serial Correlation in Stata

```
predict u, resid
(1 missing value generated)
.
. gen lagu = u[_n-1]
(2 missing values generated)

. reg u lagu
```

Source	SS	df	MS	Number of obs	=	237
				F(1, 235)	=	1586.70
Model	4.0419e+10	1	4.0419e+10	Prob > F	=	0.0000
Residual	5.9864e+09	235	25473856.1	R-squared	=	0.8710
				Adj R-squared	=	0.8705
Total	4.6406e+10	236	196634385	Root MSE	=	5047.2

u	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lagu	.954532	.0239631	39.83	0.000	.907322	1.001742
_cons	154.4315	327.8851	0.47	0.638	-491.5383	800.4013

The p value for the lagged coefficient of the error term is 0.000; therefore serial correlation is a problem that needs to be corrected for.

Fisher Type Augmented Dickey Fuller Test for Unit Roots

Variable	p-value
rgdp	**1.0000**
net_oda	**0.0000**
net_Exp	**0.3268**
rtfp	**0.9964**
rkstock	**1.0000**
pop	**0.0000**

These results show that all the variables have unit roots except for net official development assistance (net_oda) and population (pop) and therefore I can't rule out non-stationarity.

Furthermore, I ran regressions of each variable on a time variable, year, and I found that all the variables were trending except for net exports.