The Impact of Foreign Aid upon Economic Growth

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Abstract

This paper investigates the impact of official development assistance on economic growth. The paper bases its groundwork from models in Karras (2006) that are modified to include squared aid terms to test the Dutch Disease hypothesis. The same 71 aid-receiving developing countries as well as a slightly adjusted time frame from 1961-1998 are used as the data sources. Four models are used for estimation for long-run effects (averaged OLS) and short-run effects (two-way fixed-effects). Both ODA per capita and ODA as a percentage of GDP are utilized in these models. The results demonstrate that in the long-run, foreign aid has a U-shaped relationship with economic growth. In the short-run however, the resulting outcome is opposite, and the Dutch Disease hypothesis is demonstrated. In all instances, official development assistance was statistically significant.

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Introduction:

With 12.7% of the world living on less than $1.90 USD a day, the need to improve living standards has become the focus of various countries and global organizations.[1] Institutions such as the World Bank and the Organisation for Economic Co-operation and Development (OECD) work to provide foreign aid through various monetary programs, with the intent of pushing developing economies into a state which they can carry themselves into further development. The idea is that economies in the low income countries are cursed by poverty traps which prevent them from growing out of a suboptimal economic state. Various studies have been conducted to this regard, attempting to find whether monetary aid is an effective way to help developing economies. However, the results of these studies demonstrate contradicting results regarding foreign aid's effectiveness.

Some research has shown a positive relationship between foreign aid and economic growth (Karras, 2006; Fayissa, Bichaka, and El-Kaissy 1999; Sandrina, 2005), some a negative relationship (Wamboye, Evelyn, Adekola, and Sergi, 2014; Boone 1995) while others have shown the relationship to vary depending on various factors (Burnside, Craig, and David Dollar, 2000). Given the diverse results of these studies, the impact of billions of dollars in aid on the lives of countless impoverished men, women and children is debatably uncertain. For instance, if a study demonstrates that foreign aid has a negative impact upon economic growth, then it brings to question if enormous donations of aid are being wasted. These donations are estimated by OECD totaling 31.5 billion USD for the United States, and 71.2 billion USD for the

[1] World Bank http://www.worldbank.org/en/topic/poverty/overview

European Union in 2014.[2] Undoubtedly, these enormous investments should be allocated as effectively as possible, to ensure the successes of such assistance programs. Such economic questions as these warrant the need for foreign aid economic studies.

The intuition behind foreign aid's positive relationship is that developing countries are stalled by poverty traps preventing their growth. An example of a poverty trap could be malaria which could hinder the labor force, and increase medical expenses in a country. Through foreign aid, a country could purchase mosquito nets to prevent malaria, and therefore help push their economy into a self-sustained growth. However, this notion is contradicted by the intuition behind foreign aids negative relationship. Some developing countries may become dependent upon foreign aid, and instead of progressing into a state of self-sustained growth, their economy remains dormant by using aid to supplement their economy rather than investing it. Furthermore, certain political and economic policies may prevent aid from being used effectively within the receiving country.

Applying the Solow Growth Model framework to a cross-country examination of developing countries, this study will use an econometric analysis to determine aggregate foreign aid's effectiveness in promoting economic growth. Foreign aid will be measured as the total official development assistance received for each country in the model. This paper will incorporate previous literature, specifically Karras (2006) into the development of econometric models. The results of this paper will help determine the correct policy recommendations regarding foreign aid. If foreign aid proves to be helpful for economic growth, then it should be

[2] http://www.oecd.org/newsroom/aid-to-developing-countries-rebounds-in-2013-to-reach-an-all-time-high.htm

pursued, but if it proves to have no or little impact then other economic growth avenues should be considered.

Literature Review:

Sandrina (2005) analyzed the micro-macro paradox regarding foreign aid's impact on economic growth. Her paper tries to explain why previous studies on a micro scale, being studies focusing on cost-benefit analysis, found foreign aid to have a positive effect. However, when studies examined the macro scale, generally cross-country regression studies, the results were ambiguous. Using the structural growth model, as well as applying a GMM-type estimator as suggested by the previous literature, Moreira estimates an autoregressive distributed lag model of the relation between foreign aid and growth for 48 developing countries from 1970-1998. Her paper concluded that previous studies based on more basic Harrod-Domar models contained flaws in macro analysis, and when applying the appropriate econometric frameworks, foreign aid effectiveness on a macro scale demonstrates a positive relationship with economic growth. Her recommendations for further studies include not ignoring time lags in aid-growth relationships, as well as focusing on in-depth country-specific case studies. However, this paper will ignore lags and instead focus on a squared aid term to examine diminishing marginal returns of aid.

Burnside and Dollar (2000) explained the relationships among foreign aid, economic policies, and economic growth. Their paper uses a panel dataset of 58 countries from 1970 to 1993. Using the neoclassical growth model, and a basis from previous literature including Boone (1995, 1996), they formulate a model using two equations. One to estimate if the effect of aid on growth is dependent on economic policies, and another to estimate if donor governments allocate more aid to countries with good policies. This econometric model was estimated using OLS first and then a two-stage-least-squares procedure. They found that foreign aid only increased economic growth in countries with good fiscal, monetary, and trade policies. In the presence of poor policies, the opposite relationship was observed. While their paper finds that donor countries do not consider the economic policy of host countries as a factor in where to allocate donations, policy plays a crucial role in aid effectiveness in promoting growth. A limitation of this paper's study will be ignoring policies.

Fayissa, Bichaka, and El-Kaissey (1999) studied the relationship between foreign aid's impacts on economic growth in the least developed countries (LDC's). They examined a panel data set comprised of over eighty countries from 1971-1990 within the framework of modern economic growth theories. Their paper's econometric model included independent variables which were suggested in previous literature such as political and civil stability, as well as pupils enrolled in secondary school and was estimated using an OLS regression. Their paper suggests foreign aid increases economic growth through its contribution to domestic capital formation. They conclude that while foreign aid plays a critical role in development, it is dependent upon if the receiving country correctly allocates the aid into forms of investment and domestic savings. Furthermore, their paper demonstrates how increasing political stability and civil liberties increases economic growth.

Wamboye et al (2014) examine Africa's foreign aid dependency and its implications for economic growth. They address how aid to Africa's least developed countries has generated much controversy and draft their paper as a policy recommendation to this issue. Using the framework of the neoclassical growth model, they employ the generalized method of moments (GMM) to estimate a growth model using 32 countries over the period of 1975-2010. They find that in examining Africa's LDCs that both the quality, and quantity of aid matter significantly in creating an effective environment for aid. They measure quality by whether the aid is tied, meaning that the foreign aid received must be spent within the donating country, or untied, meaning the recipient is free to spend aid money unrestricted. Their paper finds that when aid is tied, it constrains economic growth as compared to untied aid. The empirical results demonstrate that small amounts of aid act to retard growth, however large and sustainable amounts over time worked to increase growth rates. This conclusion cannot be generalized however, as they find growth outcomes varied depending upon a country's legal origin, dating back from imperialism on the African continent.

Boone (1995) attests that foreign aid programs were initiated before their relationship with economic growth was understood. His paper focuses heavily upon political regimes and the presence of wealthy elites. The paper's econometric specification is built upon a few interworking models, regressed through OLS and fixed effect. The results of his paper suggest the majority of aid goes to consumption, and increases the size of the government but does not benefit the poor. Furthermore, the results demonstrated that aid programs are not correlated with the basic ingredients that cause investment or growth. Evidentially, aid donations worked to benefit the wealthy elite more than growth producing outlets in the receiving countries. Boone finds that capital shortage is not a primary cause of poverty in aid recipient countries, and that aid geared towards increasing the levels of capital were ineffective at increasing economic growth.

Karras' (2006) paper examined foreign aid and its impact upon growth in the long-run using two different styles of estimation. He compared averaged OLS estimation compared to GMM type estimation to determine the more accurate of the models. He examined two measurements of aid being official development assistance per capita and official development assistance as a percentage of GDP. The following graphs display the trends of these ODA measurements overtime, for 71 countries, which furthermore, will be the basis of this papers data set:

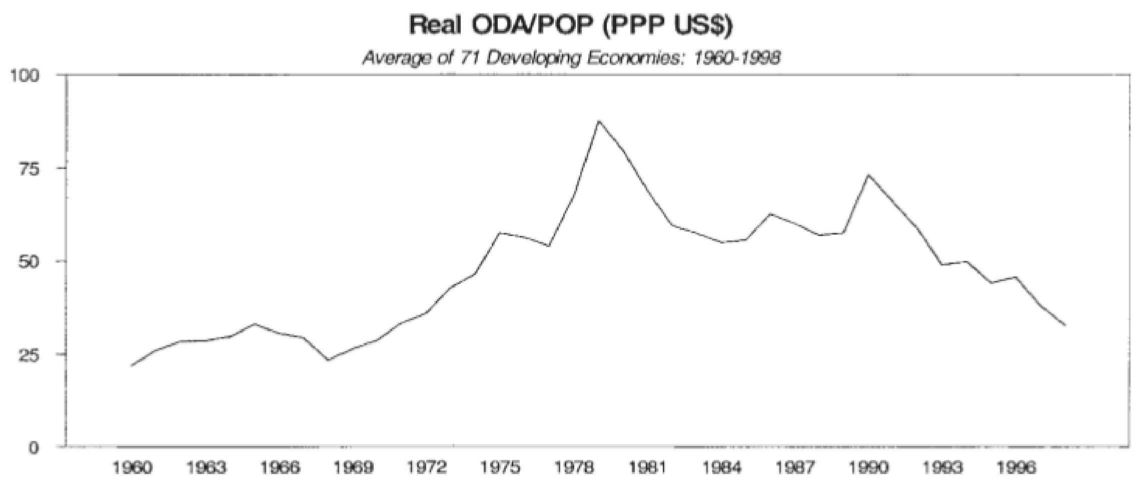

Figure 1. Average foreign aid per Capita, 1960–98

In respects to the ODA graphs, he also including a graph showing economic growth overtime

Figure 2. Average foreign aid as fraction of receiving economy's GDP, 1960–98

containing the same 71 countries below:

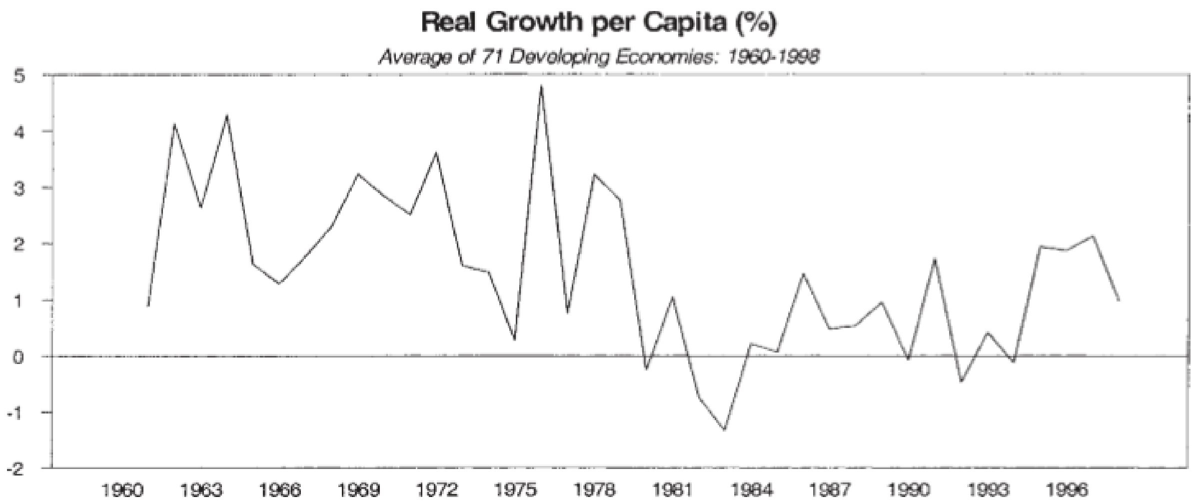

Figure 3. Average growth rate of real GDP per Capita, 1960–98

While it is noted that spikes in both ODA measurements and Growth per capita (%) occurred during the 1970's, no strong evident correlation is observed between these two graphs. On these grounds, Karras sets out his paper upon previous neoclassical growth literature to build a paper explaining foreign aids impact upon growth. He found in comparison to averaged OLS, GMM estimation was more convincing for long-run growth results. His fixed effect regressions demonstrated that ODA had a significant and permanent impact upon GDP per capita growth rates. His models demonstrate increasing ODA per capita by $20 USD resulted in a permanent increase of GDP per capita growth by .16%. When ODA/GDP is observed, a 1% increase permanently raises GDP per capita growth rates by .14 to .26%. Karras' econometric models and dataset will provide the basis for this paper, and this study will attempt model modifications discussed later to examine the foreign aid to growth relationship.

Theoretical Model:

The relevant economic theory used in this paper is the Solow-Swan model developed independently in 1956. An extension of the Harrod-Domar model, the Solow-Swan model demonstrates in a neoclassical fashion that output depends on capital and labor inputs. As a mathematical equation, it can be expressed as the following production function:

$$Y = F(K, L, Aid)$$

Where L represents labor and K represents capital stock. Foreign aid can play a role into this equation as it acts as an investment towards increasing the amount capital. From this theoretical framework, aid would prove to be effective in increasing output as long as it was used efficiently by the receiving country and all other things held constant. It is important to note that the steady state implications of the Solow Swan model will be a lesser part of this study, as the main focus is to examine least developed countries, where their economies are pre-steady state. In that regard, the output function will be estimated using economic growth as an independent variable and aggregate foreign aid as the main dependent variable.

Despite the intuitiveness of foreign aid acting as a positive investment, previous literature has found the relationship between foreign aid and economic growth being not so straightforward. For example, the Dutch Disease hypothesis attests that large increases to a country's income can have negative implications on price competitiveness with foreign markets. Using a foreign aid framework, this means that large amounts of aid create currency appreciation resulting in less competitive products for the country's export markets. Consequently, the country will now seek cheap imports over higher priced domestic goods, which acts to deindustrialize the economy as production allocates to cheaper alternatives.

Given the large amounts of foreign aid given to developing countries, Dutch disease is a very probable concern. For this reason, this paper will test the hypothesis that an inverse U-shaped relationship exists between increasing foreign aid and economic growth in developing countries.

Econometric Methodology:

This paper will attempt to accurately estimate both the long-run and short-run effects of foreign aid upon economic growth. In order to evaluate this, two separate econometric specifications will be estimated, being an averaged OLS to demonstrate the long-run effects, and a two-way fixed-effect to demonstrate the short-run effects. Aid will be measured both in official development assistance (ODA) per capita, as well as ODA as a percentage of GDP. Therefore In total, four models will then be estimated, two averaged OLS models and two two-way fixed effect. Again, these specifications were based upon Karras (2006) paper, *Foreign Aid And Long-Run Economic Growth: Empirical Evidence for a Panel of Developing Countries,* and similarly this paper will use the same 71 countries he examined and a slightly modified time range of 1961-1998 due to issues of obtaining data. All data upon the variables used was obtained from World Bank's *World Development Indicators Database*.

For the OLS estimation, the models will be equivalent to Karras OLS models, but will now include an inflation variable as well as an ODA per capita squared and ODA/GDP squared variable to test for effects from Dutch disease. The basics of the econometric model are built from the Solow-Swan model, in which annual population growth is a proxy for the labor force, and gross capital formation as a percentage of GDP is a proxy for investment. Furthermore, ODA will be factored in from the modification of the neoclassical model. Lastly to stay consistent with Karras' work, the log of the final year's income (in this case 1998) will be a proxy for economic growth rates. This was done because with the averaged OLS, the log of the last year produced more accurate and convincing results than GDP per capita growth rates when estimated as the dependent variable. The two OLS models to estimate for the long-run are demonstrated as follows:

1. $\mathbf{LNGDPCL_i = \beta_0 + \beta_1 LNPOP_i + \beta_2 LNINV_i + \beta_3 LNGOV_i - \beta_4 LNINF + \beta_5 ODA_i - \beta_6 ODAS_i}$
2. $\mathbf{LNGDPCL_i = \beta_0 + \beta_1 LNPOP_i + \beta_2 LNINV_i + \beta_3 LNGOV_i - \beta_4 LNINF + \beta_5 ODAG_i - \beta_6 ODAGS_i}$

Where $LNGDPCL_i$ is the natural log of GDP per capita for 1998 in country i, $LNPOP_i$ is the natural log of the averaged population growth rate (annual %) in country i, $LNGOV_i$ is the natural log of the averaged government expenditure (% of GDP) in country i, $LNINF_i$ is the natural log of the averaged inflation rate (consumer prices %), ODA_i and $ODAS_i$ are the averaged ODA per capita and ODA per capita squared values for country i, and $ODAG_i$ and $ODAGS_i$ are the averaged ODA as a percentage of GDP values for country i. All variables are logged except for the aid variables, which are kept in a standard form for the simplicity of calculating the maximum values of the parabolic relationship.

While averaging the values in an OLS will estimate for the long-run effects, a fixed effect model will measure the effects from year t to t+1. Therefore, the regression will help to compare estimations between long-run and short-run effects. The fixed effect model used in this paper will again be a modified version of Karras' two way fixed effect shown below:

$$growth_{i,t} = w_i + v_t + C(L)growth_{i,t-1} + b \cdot aid_{i,t} + B(L)\Delta aid_{i,t} + u_{i,t},$$

The first change this paper this paper will make from his model will be replacing the lagged growth GMM estimation with the LNPOPG, LNINV, LNGOV, and LNINF variables from the previous OLS. However, in this model the log variables will not be averaged, but instead every observation will be regressed. The second change will be adjusting the lagged aid term with a squared aid-term to test for the Dutch Disease hypothesis. Similar to the OLS models, this two-way fixed-effect regression will be estimated twice, once for ODA per capita and once for ODA as a percentage of GDP. Furthermore, the model will be regressed to control for country and time specific effects, which allows the model to be a two-way fixed effect by definition. The fixed effect model is similarly derived from the neoclassical growth model as is the OLS.

Empirical Results:

Dependent Variable: LNGDPCL	(1)	(2)
$LNPOPG_i$	*** -0.996 (0.352)	*** -0.824 (0.250)
$LNINV_i$	*** 1.855 (0.427)	0.504 (0.364)
$LNGOV_i$	-0.193 (0.605)	*** 1.520 (0.345)
$LNINF_i$	0.103 (0.086)	0.057 (0.063)
ODA_i	** -0.024 (0.012)	
$ODAS_i$	***0.00015 (0.00005)	
$ODAG_i$		*** -20.771 (3.104)
$ODAGS_i$		*** 30.144 (9.060)

*Note: *,**,*** represent a 90%, 95%, 99% confidence levels, respectively. Standard Error reported in parenthesis*

Table 1.

Averaged OLS Regressions

Table 1 displays output from the equations of the averaged OLS regressions. The results demonstrated from both models yielded outcomes similar to the Karras study. The first column represents the OLS estimated for ODA per capita (model 1), while the second column represents the OLS estimated for ODA as a percentage of a countries GDP (model 2). Variable signs of LNINV in model 1 and LNGOV in model 2 represent predicted values, being both statistically and economically significant. The estimated coefficient for LNPOPG is statistically significant in both models, while demonstrating the opposite of the predicted sign. At a 99%

confidence level, increasing population has shown to have a negative impact upon 1998 income.

When examining both instances of ODA, they represent a statistically significant negative impact upon 1998 income. Furthermore, the values of both squared terms represents a statistically significant and negative sign. These results propose the opposite of this paper's hypothesis in that an inverted U-shaped relationship between aid and income is not established, but rather a U-shaped relationship is indicated. These findings suggest that in the long-run, increasing ODA to a country initially reduces income, but after a specific threshold it begins to increase income in 1998. Model 1 demonstrates increasing ODA per capita by 1 USD decreases 1998 income by 2.4% in the long-run. Using derivatives to solve for the inflection point of this parabolic relationship yields $80 dollars. Model 1's estimations suggest that ODA per capita will decrease 1998 income until its value reaches $80 dollars per capita, which at this point ODA will begin to increase income in the long-run.

Using the alternative measure of foreign aid in model 2, it is demonstrated that increasing ODA as a share of GDP by 1% decreases 1998 income by 20.77% in the long-run. Again using the same calculations to solve for the inflection point of the parabola yields 34%. Therefore, model 2's estimations suggest that increasing ODA as a percentage of GDP will decrease 1998 income until its value reaches 34% of the GDP, which at this point it will begin to increase income in the long-run. It is important to note that the ODA relationship predicted in the 2^{nd} model produce results that are surprisingly economically large. Karras noted that this large parameter estimate may not represent a causal relationship between ODA and income, but rather capture the fact that poorer economies will receive more aid. This fact could perhaps distort model 2's results and render model 1 a better indicator of ODA's impact upon the 1998 level of income in the long-run.

While the results of the averaged OLS regressions suggest to reject the null hypothesis, the results of the two-way fixed effect indicate another story. The results of the short-run estimator are as seen in table two.

Table 2. Two-way Fixed Effect Regressions

Dependent Variable: GDPCG	(3)	(4)
$LNPOP_{it}$	** -1.068 (0.424)	*** -1.218 (0.425)
$LNINV_{it}$	*** 3.782 (0.395)	*** 3.648 (0.399)
$LNGOV_{it}$	*** -2.872 (0.466)	*** -2.912 (0.470)
$LNINF_{it}$	*** -0.678 (0.114)	*** -.699 (0.115)
ODA_{it}	* 0.013 (0.007)	
$ODAS_{it}$	-8.17E-7 (0.000012)	
$ODAG_{it}$		*** 15.071 (5.350)
$ODAGS_{it}$		* -21.295 (10.853)

*Note: *,**,*** represent a 90%, 95%, 99% confidence levels, respectively. Standard Error reported in parenthesis*

The two-way fixed-effect regressions are shown in table two are split into columns similarly to the results of the OLS regression. The first column, or model 3, represents the two-way fixed effect regression estimating for ODA per capita. The second column, or model 4, represents the two-way fixed effect regression estimating for ODA as a percentage of GDP. The variables estimated through fixed-effect indicate an overall stronger significance than in the OLS regressions. The exceptions to this observation would be Model 3's LNPOP estimation, the ODA per capita estimation, as well as both squared ODA measurements.

In both models 3 and 4, the estimated signs of INV and INF are as expected. Intuitively, increasing investment has a positive impact upon GDP per capita growth, while increasing inflation would have a negative impact upon growth in the short-run. While these signs aligned with predicted values, the predicted values for both LNPOP and LNGOV demonstrated the opposite of the predicted signs. As was observed in the OLS, population growth in developing countries has a negative impact upon growth, demonstrated in both the long and the short-run models. Government expenditure was shown to be statistically significant and having a negative impact upon growth in both models predicted as well.

The estimated values for ODA per capita and ODA as a percentage of GDP now yield signs suggesting a positive influence upon aid while the squared terms suggest decreasing marginal returns. This demonstrates that in the short-run, an inverted U-shaped relationship between aid and growth can be observed. This is the opposite of what was predicted through averaged OLS encompassing long-run effects. Now, increasing ODA per capita by 10 USD increases GDP per capita growth by .13%. The squared term regarding this variable is now not statistically significant, so solving for the maximum value of the parabola becomes less important. However, the parameter estimates for ODA as a percentage of GDP and its squared term in model 4 are both statistically significant. Increasing ODA as a share of GDP by 1% increases GDP per capita growth by .15% in the short-run. Solving for the inflection point of the existing parabolic relation equates to a value of 35%. Model 4 then indicates that when the ODA as a percentage of GDP ratio reaches 35% or greater, ODA will begin to have a negative impact upon economic growth in the short-run. Before this inflection point is reached, ODA will have a positive impact upon economic growth.

The models 3 and 4 regressed through two-way fixed effect signify a different relationship between ODA and economic growth in the short-run. These findings suggest to not reject the null hypothesis, and that Dutch Disease appears to be affecting the relationship in the short-run.

Conclusions:

In all of the models this paper estimated, the ODA measurements proved to be statistically significant at the 90% level and higher. The results between the averaged OLS regressions and the two-way fixed effect regressions revealed opposite relationships between aid and growth. In the long-run, it is evident that the Dutch Disease is not impacting developing economies. Instead, foreign aid below a certain threshold acts to decrease growth, and only above a certain inflection point will it begin to have a positive impact. The short-run exhibited different results, in which evidence for Dutch Disease can be observed from the estimations. The two-way fixed-effect demonstrates that aid below a certain threshold acts to increase growth, but after a specific inflection point, it will begin to have a negative impact on economies.

While ODA proved to be a significant predictor of income and growth, it does appear to be more significant in the averaged OLS regressions. However, in the averaged OLS regressions, it appears that the remainder of the variables estimated for have less significance than they do in the two-way fixed-effect models. In this regard, it is important to realize the limitations of using an averaged OLS to estimate long-run effects. The majority of papers I examined in regards to predicting ODA's impact regarding economic growth, including Sandrina (2005) and Karras (2006), use GMM-estimation to increase the accuracy of their results. In fact, the very paper which serves as the basis for my paper, being Karras (2006), compared both GMM and averaged OLS estimation, finding the GMM to produce more convincing results. Unfortunately for the purposes of this class, GMM-estimation was not taught so I was unable to use it.

Further limitations of this study include the endogeneity between foreign aid and economic growth, the lack of data for developing countries, and the omittance of human capital in my model. Endogeneity between foreign aid and growth would be apparent as the donations of foreign aid to devolving countries is an impact behind growth, yet growth rates will also attract more foreign aid. So the question that is evident is whether foreign aid is the primary driver behind economic growth or is economic growth the primary driver behind foreign aid. Second, the data reported for developing countries can be at time scarce. There were many observations missing from my full data set, which would require me to omit rows of observations for the two-way fixed-effect estimation. This is due impart to developing countries lacking sufficient funds or stability to report or accurately estimate all variables in my data set. Lastly, while the models in this paper are based off of Karras 2006, it did not include a measure of human capital. The capital expressed in the Solow-swan model captures both physical and human capital which I did not include. The exclusion of education rates for example limit the accuracy of a growth regression.

Despite the limitations of this study, policy recommendations can be derived from the results. In the short-run, foreign aid donors should be aware of the hazards of too much aid, as

Dutch Disease was a demonstrated concern. On the other spectrum, in the long-run aid should be given above a certain threshold to help developing economies grow. Further studies should continue the focus on GMM estimation for increased accuracy in the long-run, and including human capital into their econometric models. Lastly, as Burnside and Dollar (2000), found that political and economic policy have a strong determinate in the efficiency of aid, and models should include dummy variables to control for this. A communist regime would use aid differently than a democratic and capitalist based society. A continuation of this paper would be to examine the impact of foreign aid on growth in different political and economic backgrounds.

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Appendix

Variable Descriptions for OLS Regressions:

Variable	Description	Database
$LNGDPCL_i$	The Natural Log of GDP per Capita for year 1997 (Current US $)	World Development Indicators
$LNPOPG_i$	The Natural Log of the Averaged Population Growth (Annual %)	World Development Indicators
$LNINV_i$	The Natural Log of the Averaged Gross Capital Formation (% of GDP)	World Development Indicators
$LNGOV_i$	The Natural Log of the Averaged General Government Final Consumption (% of GDP)	World Development Indicators
$LNINF_i$	The Natural log of the Averaged Inflation Rate (Consumer Prices Annual %)	World Development Indicators
$AODA_i$	The Averaged Net Official Development Assistance per Capita (current US $)	World Development Indicators
$AODAS_i$	The averaged Net Official Development Assistance per Capita (current US$), Squared	
$AODAG_i$	The Averaged Net Official Development Assistance (% of GDP)	World Development Indicators
$AODAG_i$	The Averaged Net Official Development Assistance (% of GDP), Squared	

Note: All variables Averaged for 1961-1998 period

Variable Descriptions for Two-Way Fixed Effect Regressions:

Variable	Description	Database
$GDPCG_{it}$	GDP per Capita Growth (annual %)	World Development Indicators
$LNPOPG_{it}$	The Natural Log of Population Growth (annual %)	World Development Indicators
$LNINV_{it}$	The Natural Log Gross capital formation (% of GDP)	World Development Indicators
$LNGOV_{it}$	The Natural Log of Final Government Expenditure (% of GDP)	World Development Indicators
$LNINF_{it}$	The Natural Log of Inflation, consumer prices (annual %)	World Development Indicators
ODA_{it}	Official Development Assistance per Capita	World Development Indicators
$ODAS_{it}$	Official Development Assistance per Capita; Squared	
$ODAG_{it}$	The Net Official Development Assistance (% of GDP)	World Development Indicators
$ODAGS_{it}$	The Net Official Development Assistance (% of GDP), Squared	

SAS Code and Output:

OLS REGRESSIONS

```
PROC IMPORT DATAFILE = 'E:\KARRAS\DATA2.CSV'
OUT = WORK.DEVELOPING
DBMS = CSV
REPLACE;
RUN;

Proc means;
run;

** Averages Data;
PROC SUMMARY data = developing;
var POPG INV GOV ODA GDPCG ODA2 GDP INF GDPCL GDPCI;
class country;
output out= WORK.OLS
mean = APOPG AINV AGOV AODA AGDPCG AODA2 AGDP AINF GDPCL GDPCI;
run;

** Log Manipulation;
DATA WORK.OLS1;
set WORK.OLS;
AODAS = (AODA*AODA);

ODAG = (AODA2/AGDP);
ODAGS = (ODAG*ODAG);

LNINF = LOG(AINF);
LNGDPCL = LOG(GDPCL);
LNGDPCI = LOG(GDPCI);
LNPOPG = LOG(APOPG);
LNINV = LOG(AINV);
LNGOV = LOG(AGOV);
RUN;

**Regressions on ODA per Capita;
PROC reg;
model LNGDPCL = LNPOPG LNINV LNGOV LNINF AODA AODAS;
run;

**Regressions of ODA as a Percentage of GDP;
PROC reg;
model LNGDPCL = LNPOPG LNINV LNGOV LNINF ODAG ODAGS;
run;
```

The SAS System

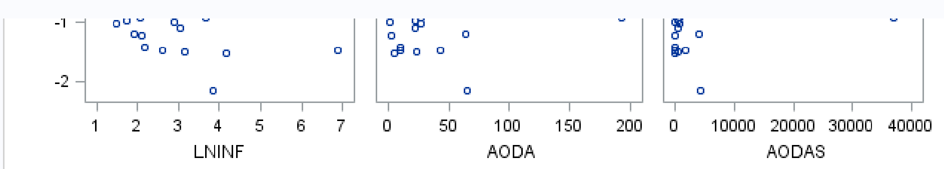
The REG Procedure
Model: MODEL1
Dependent Variable: LNGDPCL

Number of Observations Read	72
Number of Observations Used	71
Number of Observations with Missing Values	1

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	44.75258	7.45876	8.80	<.0001
Error	64	54.25894	0.84780		
Corrected Total	70	99.01152			

Root MSE	0.92076	R-Square	0.4520
Dependent Mean	6.92609	Adj R-Sq	0.4006
Coeff Var	13.29405		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	2.78554	1.62155	1.72	0.0907
LNPOPG	1	-0.99570	0.35248	-2.82	0.0063
LNINV	1	1.85498	0.42701	4.34	<.0001
LNGOV	1	-0.19313	0.60494	-0.32	0.7506
LNINF	1	0.10272	0.08646	1.19	0.2392
AODA	1	-0.02315	0.01155	-2.00	0.0494
AODAS	1	0.00015201	0.00005204	2.92	0.0048



The SAS System

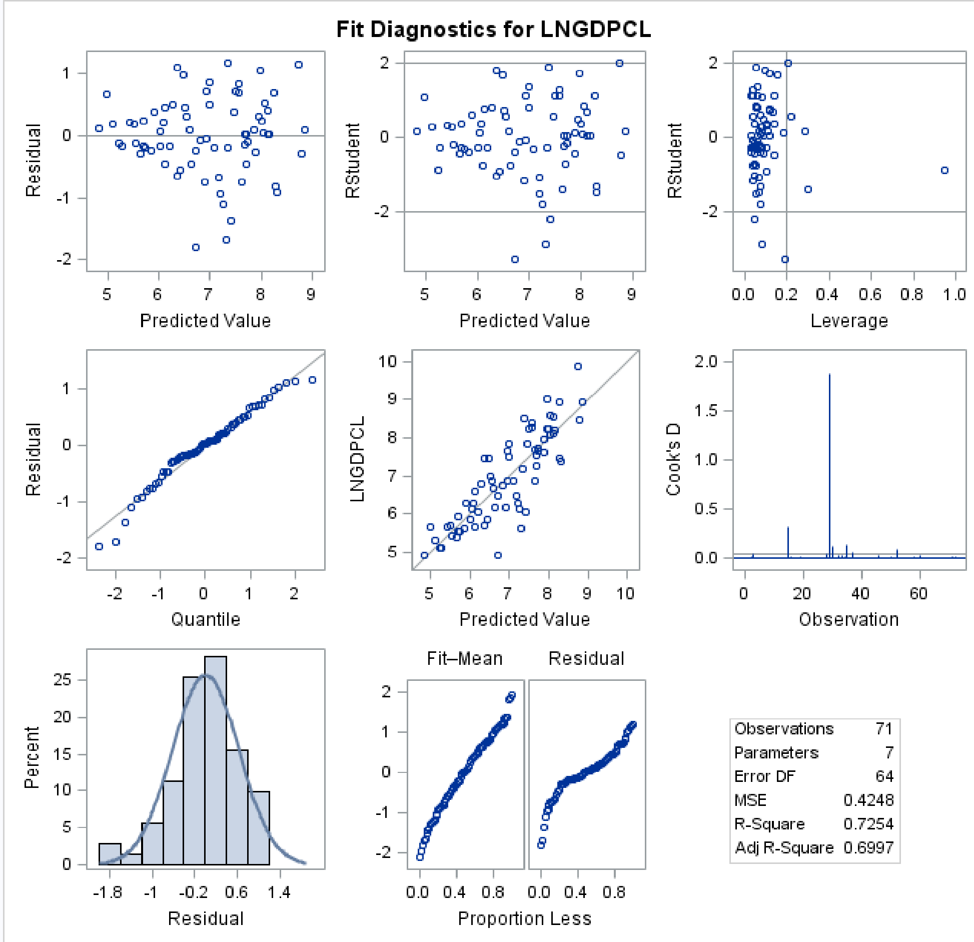
The REG Procedure
Model: MODEL1
Dependent Variable: LNGDPCL

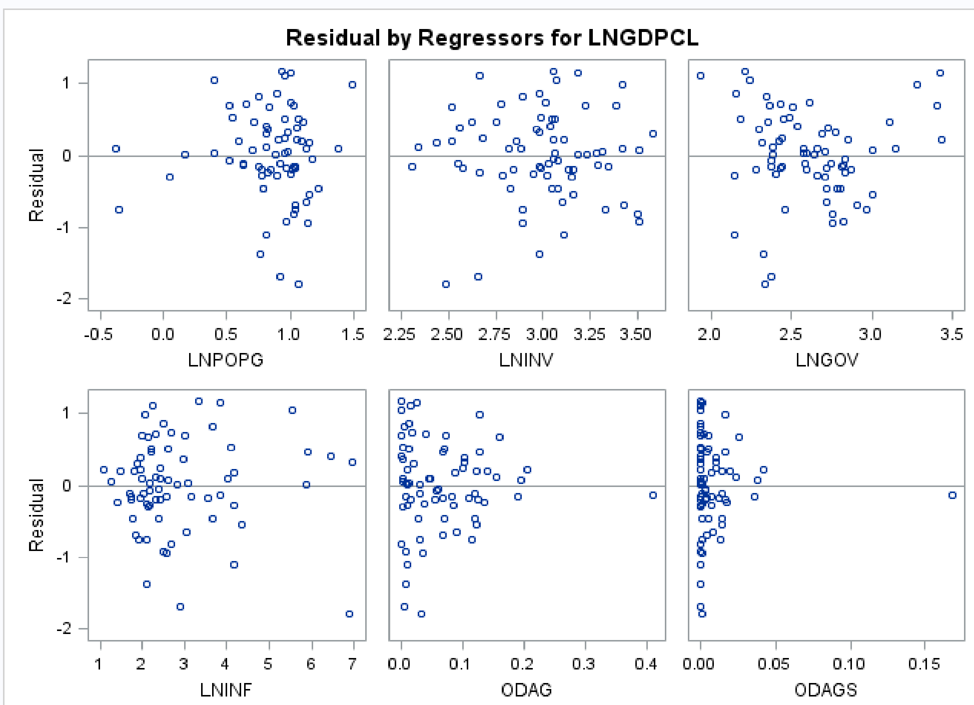
Number of Observations Read	72
Number of Observations Used	71
Number of Observations with Missing Values	1

Analysis of Variance					
Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	71.82491	11.97082	28.18	<.0001
Error	64	27.18661	0.42479		
Corrected Total	70	99.01152			

Root MSE	0.65176	R-Square	0.7254
Dependent Mean	6.92609	Adj R-Sq	0.6997
Coeff Var	9.41021		

Parameter Estimates					
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	3.02935	1.00560	3.01	0.0037
LNPOPG	1	-0.82360	0.25030	-3.29	0.0016
LNINV	1	0.50443	0.36387	1.39	0.1705
LNGOV	1	1.51972	0.34473	4.41	<.0001
LNINF	1	0.05861	0.06255	0.94	0.3522
ODAG	1	-20.77071	3.10441	-6.69	<.0001
ODAGS	1	30.14389	9.05793	3.33	0.0015


Fit Diagnostics for LNGDPCL
Residual
Predicted Value
RStudent
Leverage
Quantile
LNGDPCL
Cook's D
Observation
Percent
Residual
Fit–Mean
Proportion Less
Observations 71
Parameters 7
Error DF 64
MSE 0.4248
R-Square 0.7254
Adj R-Square 0.6997


Residual by Regressors for LNGDPCL
Residual
LNPOPG
LNINV
LNGOV
LNINF
ODAG
ODAGS

TWO-WAY FIXED EFFECT REGRESSIONS

```
PROC IMPORT DATAFILE = 'E:\KARRAS\DATA2.CSV'
OUT = WORK.DEVELOPING
DBMS = CSV
REPLACE;
RUN;

** Log Manipulation;
DATA WORK.TWOWAY;
set WORK.DEVELOPING;
ODAS = (ODA*ODA);

ODAG = (ODA2/GDP);
ODAGS = (ODAG * ODAG);

LNINF = LOG(INF);
LNGDPCL = LOG(GDPCL);
LNGDPCI = LOG(GDPCI);
LNPOPG = LOG(POPG);
LNINV = LOG(INV);
LNGOV = LOG(GOV);
LNGDPC = LOG(GDPC);
LNGDPCG = LOG(GDPCG);

if GDPC = "" then delete;
if GDPCG = "" then delete;
if GDPCI = "" then delete;
if POPG = "" then delete;
if INV = "" then delete;
if GOV = "" then delete;
IF ODA = "" then delete;
if ODA2 = "" then delete;
if GDP = "" then delete;
RUN;

PROC SORT;
by COUNTRY TIME;
run;

PROC PANEL;
ID COUNTRY TIME;
MODEL GDPCG = LNPOPG LNINV LNGOV LNINF ODA ODAS/ fixtwo;
run;

PROC PANEL;
ID COUNTRY TIME;
MODEL GDPCG = LNPOPG LNINV LNGOV LNINF ODAG ODAGS/ fixtwo;
run;
```

The SAS System

The PANEL Procedure
Fixed Two Way Estimates

Model Description	
Estimation Method	FixTwo
Number of Cross Sections	70
Time Series Length	38

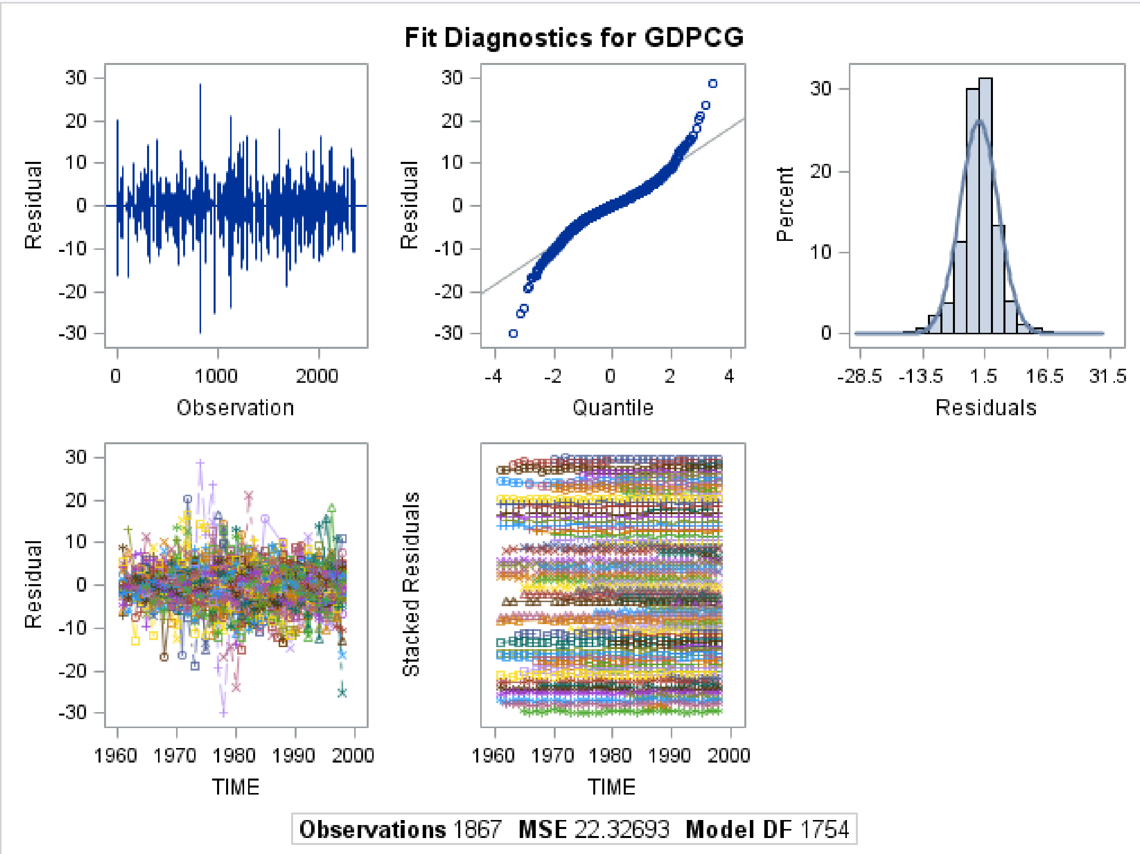
Fit Statistics			
SSE	39161.4343	DFE	1754
MSE	22.3269	Root MSE	4.7251
R-Square	0.2328		

F Test for No Fixed Effects			
Num DF	Den DF	F Value	Pr > F
106	1754	2.37	<.0001

Parameter Estimates						
Variable	DF	Estimate	Standard Error	t Value	Pr > |t|	Label
Intercept	1	-0.73231	1.9499	-0.38	0.7073	Intercept
LNPOPG	1	-1.06793	0.4243	-2.52	0.0119	
LNINV	1	3.782132	0.3946	9.59	<.0001	
LNGOV	1	-2.87186	0.4661	-6.16	<.0001	
LNINF	1	-0.67822	0.1136	-5.97	<.0001	
ODA	1	0.012549	0.00681	1.84	0.0654	
ODAS	1	-8.71E-7	0.000012	-0.07	0.9420	

The SAS System

The PANEL Procedure
Fixed Two Way Estimates



The SAS System

The PANEL Procedure
Fixed Two Way Estimates

Model Description	
Estimation Method	FixTwo
Number of Cross Sections	70
Time Series Length	38

Fit Statistics			
SSE	39261.7383	DFE	1754
MSE	22.3841	Root MSE	4.7312
R-Square	0.2308		

F Test for No Fixed Effects

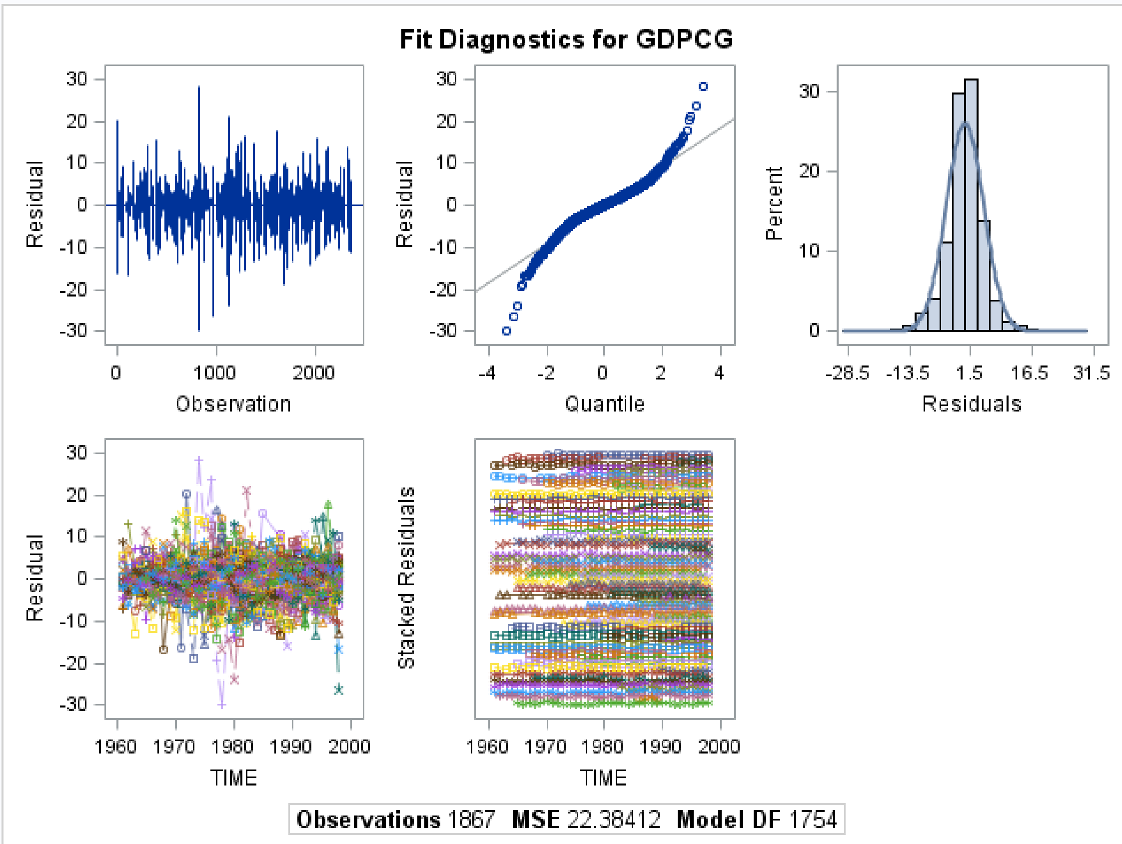
Num DF	Den DF	F Value	Pr > F
106	1754	2.43	<.0001

Parameter Estimates

Variable	DF	Estimate	Standard Error	t Value	Pr > |t|	Label
Intercept	1	-0.13801	1.9865	-0.07	0.9446	Intercept
LNPOPG	1	-1.218	0.4248	-2.87	0.0042	
LNINV	1	3.648442	0.3994	9.14	<.0001	
LNGOV	1	-2.91215	0.4698	-6.20	<.0001	
LNINF	1	-0.69898	0.1146	-6.10	<.0001	
ODAG	1	15.07126	5.3500	2.82	0.0049	
ODAGS	1	-21.2955	10.8533	-1.96	0.0499	

The SAS System

The PANEL Procedure
Fixed Two Way Estimates



Descriptive Statistics:

The SAS System

The MEANS Procedure

Variable	N	Mean	Std Dev	Minimum	Maximum
TIME	2698	1979.50	10.9678889	1961.00	1998.00
ODA	2687	30.2449805	53.6354216	-21.4835876	722.6639156
ODA2	2687	240060908	403310689	-456760000	6056930000
GDP	2572	21680126540	63197292847	11592024.36	883000000000
GDPCG	2534	1.4988364	5.6814471	-47.7225370	37.1275853
INV	2446	20.4804422	9.0857668	-5.7397379	74.8220211
POPG	2698	2.4458294	0.9010110	-6.3428166	11.1806572
GOV	2409	14.2875914	6.5689227	0	64.3924983
GDPC	2561	1035.94	1728.70	37.5181724	19400.10
INF	2220	64.9088465	679.1410315	-13.0565726	23773.13
GDPCI	2698	251.1630641	247.0127346	40.5669362	1365.75
GDPCL	2698	1992.83	2832.10	124.6775752	19400.10