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Foreign Aid and Economic Growth: A Post-Soviet Analysis of Emerging Markets

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[FOREIGN AID AND ECONOMIC GROWTH]

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Introduction

Foreign aid is an issue that has been hotly contested over the decades. As recently as the US presidential debates of 2012, the issue dominated national and even global news headlines. Foreign aid makes up a tiny percentage of the national budget, yet receives unprecedented attention (White House Budget, 2009). Whether politically motivated, humanitarian in response, or directed towards development projects, the question remains: Is foreign aid effective? Though small in percentage, the amount of money spent on foreign aid is significant. In an era of fiscal austerity, is there a better use of Western money?

From an empirical perspective, there has been significant debate. Various studies over the years have attempted to end the discussion, only to add to the growing controversy surrounding the subject. While there is much literature prior to the publication of Burnside and Dollar (2000), this paper marks a shift in the dialogue surrounding foreign aid. I will thus solely focus my studies on their work and the relevant discussions that followed.

In my analysis, I will examine the relationship between economic growth and aid receipts per capita in the global post-Soviet world. By limiting my analysis to the years since the collapse of the Soviet Union, I hope to minimize the effect to which political motives cloud aid receipts. In addition, I will seek to highlight the extent to which global changes in information technology have acted as a catalyst for development, and have created an environment where aid is utilized more effectively.

Literature Review

While much debate over the years contested the effectiveness of foreign aid, Burnside and Dollar (2000) caused a significant stir in the development community with their study. Burnside and Dollar realized that much previous literature had attempted to measure the effect of foreign aid on

savings, investment, and growth in developing countries, but that authors' studies were largely inconclusive, and mired in econometric issues.

The authors primarily examined the work of Boone (1995,1996) and their use of instrumental variable techniques. Boone, like many economists prior, found no significant positive impact of aid on growth. Burnside and Dollar used this theoretical starting point, but built on its foundations. Burnside and Dollar reckoned that growth of developing countries depends not only on a revenue stream, but also on sound economic policies. This would seem to support the idea that foreign aid does not always have a positive impact on growth rates; countries with poor economic policies would squander any receipt of foreign aid. Therefore the authors derived the hypothesis that aid affects growth, but that its impact is conditional on sound economic policies that promote growth.

Burnside and Dollar also departed from available studies in that they utilized a newly developed World Bank database on foreign aid. In this new database, grant components of concessional loans are added to traditional grants to paint a more realistic picture of overall aid receipts.

In building their growth equation specification, the authors rely heavily on existing literature. They build upon the neo-classical growth model, indicating that "a lump-sum gift of aid should have a positive effect on growth, which would be transitory if there were diminishing returns to capital." Good policies would act as a multiplier and increase the impact this aid has on growth. Thus the authors conclude that if aid is added to the growth equation, an interaction term between policy and aid should also be included. Therefore in addition to the obvious measures of growth, such as log real GDP from the previous period and level of foreign aid as a fraction of GDP, the authors also include an interaction term between policy and aid as an attempt to measure aid effectiveness.

To capture policy variables, Burnside and Dollar created a policy vector for all factors affecting economic growth. Their vector included a dummy variable for trade openness (where closed economies have average tariffs above 40%, or black market premiums above 20%, or "pervasive" government

control), inflation (as a measure of monetary policy), as well as budget surplus and government purchases relative to GDP.

Burnside and Dollar also included a vector of all exogenous variables not affected by shocks to growth or level of aid. These are included to try and capture political or institutional factors that might also affect growth. This vector included a measure for property rights security and government bureaucracy efficiency (data on this before 1980 is not available, thus 1980 measurements are used for the entire regression on the assumption that institutional factors change very slowly), ethnolinguistic fractionalization (data on this also does not rapidly change over time, thus the authors used measures from previous literature that found ethnic fractionalization to be correlated to bad policies and poor growth performance), an assassinations variable to capture civil unrest, an interaction term between ethnic fractionalization and assassinations, as well as broad money (measures liquidity, and includes easily accessible accounts as well as physical money), which is lagged to avoid endogeneity. Finally, regional dummy variables for sub-Saharan Africa and East Asia were included.

Burnside and Dollar recognize that foreign aid and growth may be correlated over periods of a few years, but not on a year to year basis. They divided their sample set into four year averages, using data from 1970 to 1993. Based on available data, the authors derive a dataset for 56 countries, with approximately 270 total observations.

In all analysis of foreign aid and economic growth across the literature, OLS and 2SLS (two-stage least-squares) are used. Two-stage least squares is used due to the fact that aid receipts relative to GDP may be endogenous. That is to say, it is jointly determined with the dependent variable GDP growth. Aid and economic growth are jointly determined, and as such their error terms may be correlated. The sign of this correlation is not obvious. It might be perceived as a negative correlation, as aid donors respond to negative growth shocks by providing more aid. However aid is not always given specifically for development, and may be a result of a strategic donor interest.

Burnside and Dollar run a wide range of regressions, with conclusions that largely support their hypothesis. Consistent with some of the previous literature, they find that on average aid has little impact on growth. However, when they further their analysis to include an interaction term between policy and foreign aid, they find that the effect of aid on economic growth is significant, and slightly positive. Thus they conclude that aid, while holding no stand-alone impact on growth, is an effective tool in good policy environments.

While the Burnside and Dollar paper was provocative in its conclusions, many economists were unsettled with the extent to which this academic study influenced actual foreign aid policies. As Esterly (2003) points out, "International aid agencies soon began to mention the results of Burnside and Dollar (2000)." From the United States to the British Department for International Development, and all the way up to the World Bank, the study was cited as compelling evidence for conditional foreign aid. In Easterly, Levine, and Roodman (2003), the authors point out that "If aid stimulates growth only in countries with good policies, this suggests that (1) aid can promote economic growth and (2) it is crucial that foreign aid be distributed selectively to countries that have adopted sound policies." No aid organization wants donations to be wasted, and as such the issue "effective" aid became a mainstay of the international dialogue.

While Easterly does not take issue with the academic nature or intuition behind Burnside and Dollar's findings, he is concerned that additional research is required to confirm their results. Easterly thus chose to revisit Burnside and Dollar's study to investigate both the robustness and broader applicability of their results.

Easterly's first attempt to test Burnside and Dollar (2000) came in the form of collaboration with Levine and Roodman (2003). In this study, the authors us the exact same specification and dataset as Burnside and Dollar, though they update the data to include additional countries and observations as

they became available. In simply updating the data while maintaining the original specification, the authors aim solely to test the robustness of Burnside and Dollar's conclusions.

Easterly, Levine and Roodman (2003) first rerun the initial Burnside and Dollar (2000) sample period and data regressions, using a similar technique to eliminate irrelevant variables and outliers. Using the exact same data as Burnside and Dollar, they are able to conclude the results. While this reproduction of Burnside and Dollar's study is a significant finding, they emphasize the fragility of those conclusions. If the data is varied even slightly to expand upon the sample period or data set, the significance of key variables vanishes.

The authors update the data set to include 62 countries with 356 observations. When including this new data, the interaction term of aid and policy changes sign and becomes statistically insignificant. Even when the results are run on the entire sample (including outliers), the interaction term is not statistically significant. These findings on their own do not negate the Burnside and Dollar (2000) study, nor do they suggest that aid is ineffective. That said, the findings of Easterly, Levine and Roodman (2003) do cast significant doubts on the authors' conclusions, specifically the explanatory power of the interaction term between aid and policy.

While this recreation of the Burnside and Dollar (2000) study on its own suggests caution, many other authors had much stronger criticisms about their specification. I will examine a subset of three papers and their initial reactions, and discuss their critiques. I will also examine a subsequent study by Burnside and Dollar (2004), where they attempt to justify their original conclusions.

In Easterly's (2003) individual work, he takes considerable issue with Burnside and Dollar's definitions of "aid," "policies," and "growth." Easterly argues that when any of these narrow definitions is expanded, the explanatory power of Burnside and Dollar's model is called into question.

With respect to "aid," Easterly prefers to use the standard definition from the OECD as grants and concessional loans net of repayment of previous aid loans. Basically, this would treat forgiveness of

any past loans as aid. While the correlation between Burnside and Dollar's aid measure and the OECD measure (called net Official Development Assistance or ODA) is high, when Easterly used ODA in his regression analysis he found it not statistically different from zero.

While Easterly agrees with using an index for establishing "good policy," he suggests the index be comprised of alternative variables. Easterly suggests measuring openness and trade distortions using a black market premium, financial depth (M2/GDP), and growth in trade-to-GDP as a measure of integration with the global economy. Rerunning the Burnside and Dollar regressions with these new measures, all are found to be significantly correlated with growth. However, when the alternative index is used, the interaction term between aid and good policy is no longer statistically significant.

"Growth" in the Burnside and Dollar (2000) study was measured as change in real per capita GDP over each four year period. Easterly does not disagree with the concept of growth, but is concerned that four year period may not be sufficient time to capture global business cycle changes. Furthermore, good policy changes within a country may not have had sufficient time to come into effect. Thus Easterly runs regressions using eight, 12, and 24 year periods. These longer periods all create insignificant results with regards to the interaction term between aid and policy.

Guillaumont and Chavet (2001), like Easterly (2003), are skeptical of Burnside and Dollar's measures of aid and growth. They also propose the use of net ODA, as they feel it more fully incorporates all aspects of aid. The World Bank measure used by Burnside and Dollar (2000), they point out, "may be an appropriate procedure if one wishes to evaluate the quality of the aid offered by a donor country. But it does not seem to be a relevant measure of the potential benefit drawn by a recipient country during a given period from the net flow actually received." (Page 74)

Similar to Easterly, Guillaumont and Chavet believe that longer pooled periods more fully capture long term effects of policy changes, and utilize 12 year periods in their regressions. They believe this longer period strikes a balance between effect of growth and measure of vulnerability. Their model

includes a vulnerability index which attempts to measure external and climactic shocks, and their impact on a country's economic standing. They believe that the omission of these variables would cause the impact of aid or the interaction of aid and policy on growth to be overestimated. In their index, size of shocks is measured through a proxy of weighted instability of agriculture value added to GDP, instability is measured through index of instability in real value of exports (short and long term) as well as trend of the terms of trade, and population size is measured through log of population. They believe that larger populations are less vulnerable to trade shocks.

Under OLS, the authors find that growth is positively influenced by a good environment index (low vulnerability). However, their findings are opposite of the results of Burnside and Dollar (2000), indicating that a better policy environment actually leads to lower economic growth. The authors are cautious, but suggest that this may be due to the fact that aid can have a larger effect where policies are initially weak (larger net change). Guillaumont and Chavet also find that high vulnerability leads to more aid, though policy does not appear significant. They hypothesize that this may be due to the longer periods. Higher levels of aid appear to have a positive effect on growth, though only when the country is similarly vulnerable. Aid in it of itself does not significantly depend on policy, though policy independently is a significant factor of growth.

Dalgaard and Hansen (2001) do not take issue with Burnside and Dollar's aid measurement, as they determine that there is no statistically significant difference between the World Bank measure and ODA. However the authors do take considerable issue with the exclusion of outliers as Burnside and Dollar considered them "special cases." If the Burnside and Dollar model included the outliers, the coefficient of the interaction term of aid and policy on economic growth is not statistically significant. Dalgaard and Hansen test the sample using an applied influence measure, and find the outliers to be leverage points, meaning they have an above average influence on fitted values. They therefore

conclude that lack of significance of Burnside and Dollar's interaction term cannot be attributed to big outliers.

Similar to Easterly (2003) and Guillaumont and Chavet (2001), Dalgaard and Hansen (2001) believe the Burnside and Dollar (2000) model to be misspecified. They state that "in most models with tax financed productive government expenditure there is an inverse U-shaped relation between the relative size of the public sector and growth." (Dalgaard and Hansen, 24) They believe that there is a possibility that good policies may benefit growth, and at the same time reduce effectiveness of aid, as they are in effect substitutes for one another. As the link between aid and growth is ambiguous, a careful analysis with a more fully specified model will aid in empirical testing. In order to capture the potential for diminishing returns, they suggest adding aid squared and policy squared to the Burnside and Dollar model.

Dalgaard and Hansen suggest that the exclusion of these variables could be the reason that the Burnside and Dollar (2000) results fail when tested for robustness. When the full model is tested, Dalgaard and Hansen find evidence for diminishing returns to aid. Running the regression, they find that both aid and aid squared are statistically significant, though policy squared and the interaction term of aid and policy fail to achieve any level of conventional significance. The authors therefore conclude that the relationship between aid and good policy is incredibly ambiguous, and if anything policy would reduce aid effectiveness as the two act as substitutes.

Due to the high levels of criticism against their work, Burnside and Dollar (2004) return to the data to reassess their results. They find it odd that even with the high level of scrutiny of their initial study "critics have not been able to agree among themselves about what the right model is: some find that aid never works anywhere (suggesting that it should be eliminated) while others find that it has a positive effect everywhere (suggesting that it should be given out indiscriminately)." (Burnside and

Dollar, 2004, 2) Burnside and Dollar (2004) revisit their initial regression analysis, while focusing on a new data set from the 1990's.

With their new data set, Burnside and Dollar (2004) once again find significant evidence to support their hypothesis that aid spurs growth conditional on institutional variables. That said, they do recognize the fragility of their results; they cannot fully reject the alternative hypothesis that aid never works anywhere. They recognize that despite their belief that institutions are important for economic growth, "it is possible to find specifications in which the institutional quality variable is not significant." (Burnside and Dollar, 2004, 18) They believe that a more nuanced approach where policy makers take into consideration multiple sources of data is the most useful strategy for allocating aid.

While the literature surround the growth equation is fairly exhaustive, one variable conspicuously absent is that of telecommunications infrastructure. Burnside and Dollar (2004) even admit that "we have not attempted to identify exactly which institutions and policies are important for aid effectiveness: rather we are interested in the question of whether the whole package of growth-enhancing institutions and policies is also a determinant of the productivity of aid." (Burnside and Dollar, 2004, 3) The exclusion of telecommunications may have been simply overlooked, or it may have been omitted due to lack of relevant data. Indeed, the surge of information technology and rapid development of infrastructure to support it is a far more recent event than academic works published at the turn of the century would capture.

Measuring telecommunications infrastructure is a very important variable. In Roller and Waverman (2001), the authors point out that "economic returns to telecommunications infrastructure investment are much greater than the returns on just the telecommunication investment itself." (Roller and Waverman, 909-910) When infrastructure is developed, communication across parties improves and the costs of doing business fall. From a theoretical perspective, this allows higher unit productivity.

The spillover effect of investment in telecommunications would lead to benefits in productivity in other sectors.

Roller and Waverman (2001) conduct a study on the simple correlation between telecommunications investment and growth. They utilize data from 21 OECD countries from 1970-1990. Estimating their model, they find a causal relationship between telecommunications investment and growth. The coefficient on investment is sufficiently large and significant, even when adjusted for country specific fixed effects. Roller and Waverman's findings suggest further research into telecommunications, as this offers a significant policy variable. Infrastructure in a country creates a positive environment for investment, which in turn spurs economic growth.

Theory and Regression Technique

In working with World Bank data, accuracy and reliability are increased. In analyzing this data, I choose to follow the theoretical growth models of Burnside and Dollar, but run regression techniques following the example of Roller and Waverman. To the extent that individual and unobserved country specific characteristics may be correlated with right hand side variables, I will test fixed and random effect models to determine which provides a better fit. I will test the model and adjust as necessary during the regression stage. I will implement various stages of fixed and random effect pooled OLS regressions.

When using panel data in the common specification such that

$y_{it} = \beta_0 + \beta_1 x_{it} + v_{it}$

We know that the error term v_{it} is comprised of two separate components

$v_{it} = a_i + u_{it}$

Where a_i represents individual specific characteristics and u_{it} represents idiosyncratic random errors with zero mean and constant variance (for all i observations with t periods).

As some data was more difficult to gather, I rely on the fixed and random effect estimations to help with interpretation of the data. Because intuition about individual country characteristics is not necessarily clear, I will model both fixed and random effects. It may be intuitive that certain laws, customs, regulations, and cultural characteristics are country specific. However, it is equally intuitive that countries are subject to random shocks such as war, instability, drought, or other natural disasters. Unlike policies, laws, and customs, random shocks would not be correlated with other independent variables, though they would have an impact on economic growth.

Data

All of the data used in my analysis was sourced from the World Bank Data Indicators. The data was gathered yearly, and I used information for 62 countries over a 20 year period from 1993-2012. All data is in real 2005 US dollars. Following the literature, and in an effort to try and correct for changes in global business cycle, I divided the data into five four-year periods (1993-1996, 1997-2000, 2001-2004, 2005-2008, and 2009-2012). In limiting my data set to the years following the collapse of the Soviet Union, I am furthering the data analyzed by previous literature. Large sums of money were spent during the Cold War in claims of regional influence and proxy wars of global dominance, spending that may have clouded previous analysis of the effects of foreign aid. While political motivations still dominate the aid world, my belief is that the extent to which this is the primary consideration has been reduced in the past two decades. In later regressions, I transform the data to include logs and squares of data.

In an additional departure from previous studies, I have used a different measure for economic growth. While Gross Domestic Product (GDP) is effective in measuring a country's overall production, it can occasionally over-estimate economic well-being. If, for example, a country is a large producer of commodities such as oil or minerals, GPD would be relatively high. However if those commodities are owned and extracted by a foreign organization, much of the income generated would flow out of the

country to wherever the foreign organization is based. Thus the measure of GDP would over-estimate the economic strength. In recent years, many international organizations have turned to a separate measure, Gross National Income (GNI). GNI measures the total output by residents of a nation, including any income generated abroad. GNI is more accurate with respect to economic well-being as it measures not only income, but how much of that income remains within the country.

Variable	Mean	Standard Deviation	Minimum	Maximum
GNI Per Capita (GNIpercap)	$2,319.37	$2,355.11	$1,74.66	$12,626.45
ODA Per Capita (ODApercap)	$49.04	$56.99	$0.13	$458.69
Inflation (inflation)	50.53%	435.05%	-6.90%	7,382%
Cell Phone Penetration (cellpenetration)	27.47%	35.71%	0%	143.22%
Policy (policy)	1,292.66	4,102.30	0	61,557.39
Log GNI Per Capita (lgni)	7.21	1.09	5.16	9.44
Log ODA Per Capita (loda)	3.25	1.32	-2.03	6.13
Log Cell Phone Penetration (lcellpen)	1.51	2.85	-7.74	4.96
Cell Penetration Squared (cellpensq)	2,026.18	3,868.53	0	20,510.92

Summary Statistics

GNIpercap = Gross National Income per person, measured in real 2005 US dollars

ODApercap = Net Official Development Assistance received per person, in real 2005 US dollars**

inflation = Inflation rate, as a measure of monetary policy

cellpenetration = Cell phone penetration, measured as subscriptions per 100 people

policy = The interaction of cell phone penetration and ODA per capita

lgni = The change in Gross National Income per person

loda = The change in net Official Development Assistance received per person

lcellpen = The change in cell phone penetration

lcellpensq= The change in cell phone penetration squared

**As a note, Net Official Development Assistance is measured as the sum of concessional loans (made with interest rates below market value and/or grace periods), grants issued to promote economic development and welfare, and loans issued with more than a 25% grant component.

Model 1

Literature seems divided on the effect of foreign aid on economic growth. Starting from this very basic and limited perspective, I build the following model.

$lgni = \beta_0 + \beta_1 loda + \beta_2 inflation + \beta_3 cellpenetration + v_{it}$

Where the log GNI per capita acts as the dependent variable and is dependent on:

loda = The change in net Official Development Assistance received per person

inflation = Inflation rate, as a measure of monetary policy

cellpenetration = Cell phone penetration, measured as subscriptions per 100 people

Hypothesis

Following the literature, I will first test the extent to which foreign aid (measured as the change in ODA per capita), inflation, and cell phone penetration have an effect on the change in GNI per capita. I will start with the (perhaps unrealistic) expectation that foreign aid always improves GNI per capita. Thus I will expect the sign on the coefficient of loda (β_1) to be positive and statistically significant.

H0: $\beta_1 > 0$

H1: $\beta_1 \leq 0$

Results

Pooled OLS:

F-Statistic: 22.01	Adj R-Squared: 0.1695
Number of Observations: 310	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	7.359	0.162	45.43
loda	-0.134	0.043	-3.13
inflation	-0.0002	0.0001	-1.51
cellpenetration	0.011	0.002	6.85

Using a simple regression technique, and under a Pooled OLS, it appears as if change in foreign aid has a small yet statistically significant impact on economic growth. However, under Pooled OLS the impact is actually *negative*, suggesting that increases in foreign aid would decrease economic growth. Perhaps unsurprisingly, the coefficient on inflation is negative, yet it fails to achieve statistical significance. The only significant indicator with expected sign is that of cell phone penetration, which would suggest that increased subscriptions lead to higher economic output.

While these results are an interesting start, the R-squared value is relatively small, suggesting that additional factors hold explanatory value for this model. I will thus adjust the model with in further regressions.

Fixed One-Way:

F-Statistic: 107.44	R-Squared: 0.9704
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	6.412	0.131	48.93
loda	-0.069	0.027	-2.58
inflation	-0.00001	0.000031	-0.39
cellpenetration	0.0038	0.0004	10.10

Before transforming variables, I first looked at regression results for fixed and random effects models. My primary point of interest was determining which of the models was most appropriate, while looking for consistencies across models. Starting with a fixed one way model, I found similar results to my pooled OLS model. Change in ODA is small, statistically significant, and negative. Inflation fails to achieve significance, and cell phone penetration is positive and statistically significant. The R-Squared value suggests a high level of explanatory power.

Fixed Two-Way:

F-Statistic: 115.10	R-Squared: 0.9743
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	6.605	0.140	47.35
loda	-0.053	0.0259	-2.04
inflation	0.00003	0.00003	0.81
cellpenetration	0.0003	0.0008	0.32
TS1	-0.380	.0777	-4.90
TS2	-0.292	0.0750	-3.89
TS3	-0.212	0.0678	-3.12
TS4	-0.085	0.0493	0.0856

Moving to a fixed two way test, I found nearly identical results for coefficients on change in ODA per capita and inflation. However, cell phone penetration loses its statistical significance. Furthermore, one of the time dummies is not statistically significant. The R-squared value being almost identical, it would seem that a fixed one way effect model is more appropriate.

While intuitively it is not clear whether fixed country-specific factors or random unobservable changes are more relevant when it comes to modeling economic growth, we can determine which is more appropriate from a statistical perspective. Running the random effects model, we also conduct the Hausman Test for covariance between unobserved factors and the independent variables in our equation. To use the random effects model, this covariance must be equal to zero. While failing to reject the null in the Hausman Test indicates that both fixed effect and random effect estimators are consistent, the random effects model is more statistically appropriate due to lower variance in standard error of test statistics.

Random One-Way:

M-Value: 0.01	R-Squared: 0.3385
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	7.335	0.330	22.23
loda	-0.069	0.024	-2.87
inflation	-0.00001	0.000029	-0.45
cellpenetration	0.0037	0.0003	11.12

Evaluating the regression results from my first random effects model, the M-value is quite small. We thus fail to reject the null, indicating that the covariance between the unobserved factors and independent variables equals zero. The random effects model, while statistically more appropriate, has a much smaller R-squared value. The model does a much weaker job explaining the changes in GNI per capita. Interestingly enough, the coefficients for change in ODA per capita, inflation, and cell phone penetration are very similar and have identical signs as the fixed effect model, reinforcing the consistency between their estimators. In the random two way model, the M-statistic becomes very large. We would thus reject the null, and be required to default to the fixed effect model. Thus the random one-way model would be most appropriate.

What is clear from these initial regression analyses is that the effect of changes in foreign aid does not have the expected sign. Regardless of model or measure of unobservable factors, the estimators for change in ODA per capita are consistent. And consistently negative. In expanding the regression to include additional variables I will attempt to clarify this point.

Random Two-Way:

M-Value: 321.49	R-Squared: 0.0468
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	7.359	0.154	47.93
loda	-0.062	0.026	-2.38
inflation	0.00001	0.000031	0.37
cellpenetration	0.0019	0.0007	2.62

Model 2

Building upon the previous model, I include a number of variables that the literature suggests are common and significant in the growth model.

$$lgni = \beta_0 + \beta_1 loda + \beta_2 cellpenetration + \beta_3 policy + \beta_4 lcellpen + \beta_5 cellpensq + v_{it}$$

Where the log GNI per capita acts as the dependent variable and is dependent on:

loda = The change in net Official Development Assistance received per person

cellpenetration = Cell phone penetration, measured as subscriptions per 100 people

policy = The interaction of cell phone penetration and ODA per capita

lcellpen = The change in cell phone penetration

lcellpensq= The change in cell phone penetration squared

Here I've added factors to account for change in total aid receipts (loda), a proxy value for telecommunications infrastructure in subscriptions per 100 people (cellpenetration), the interaction between cell phone penetration and net development assistance per person as a measure for policy

effectiveness (policy), the change in cell phone penetration (lcellpen), and the quadratic measurement of the change in cell phone penetration (lcellpensq).

I chose to exclude the measure of monetary policy (inflation) as in each regression analysis it failed to achieve statistical significance. I added logs of cell phone penetration as they are far easier to interpret. I included the quadratic for changes in cell phone penetration under the suspicion that once maximum cell phone penetration is achieved, each additional cell phone purchased may in fact take resources away from other items, thus damaging the local economy, eliciting a quadratic relationship.

The addition of a measure for telecommunications infrastructure, while not included in any foreign aid studies prior, comes from a continuation of literature suggesting significant spillover effects of this type of investment. As more and more individuals around the world become connected through cellular phone technology, the transaction costs for conducting business falls, and the ease of business relationships improves. Communication breaks down barriers, and allows individuals to more freely and rapidly contribute in the local economy. With increased ease of transaction, a country can minimize opportunity for corruption. This increased transparency has the opportunity to boost the effectiveness of foreign aid assistance, thus improving the effectiveness.

While not exclusive in their ability to improve business transaction, cell phone transfer programs have benefited consumers in many markets around the globe. For programs like Mobile Money, users in Africa no longer need a bank account to transfer or withdraw money. (Afful, 1) Payments and transactions with government or other business lenders only require a cell phone and SIM card, allowing even the poorest individuals to leapfrog traditional technologies into the business world. (Mobile Money in Africa, 1) Countries embracing this type of technology will increasingly reap rewards in the form of higher per capita GNI.

Hypothesis

Similarly to the previous model, I will assume that changes in foreign aid (β_1) will have a positive effect on GNI per capita. I will also assume that greater advances in telecommunications (β_4) will have a positive effect on GNI per capita.

H0: $\beta_1>0$, $\beta_4>0$

H1: $\beta_1\leq 0$, $\beta_4\leq 0$

Results

Fixed One-Way:

F-Statistic: 117.52	R-Squared: 0.9756
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	6.265	0.126	49.77
loda	-0.057	0.025	-2.33
cellpenetration	0.002	0.001	1.22
policy	-0.00001	0.000001	-0.66
lcellpen	0.044	0.007	5.99
cellpensq	-0.00001	0.00001	-0.21

When adding additional factors, the fixed effects model keeps its high explanatory power and F-value. As with previous models, change in foreign aid per capita is negative and statistically significant. Interestingly enough, with the addition of change in cell phone penetration, the non-log measurement

of telecommunications infrastructure loses statistical significance. All other parameter estimates fail to achieve statistical significance.

Fixed Two-Way:

F-Statistic: 110.11	R-Squared: 0.9760
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	6.325	0.165	38.32
loda	-0.064	0.025	-2.55
cellpenetration	0.0003	0.002	0.15
policy	-0.00001	0.000001	-0.62
lcellpen	0.054	0.014	3.70
cellpensq	0.00001	0.00001	0.23
TS1	0.013	0.156	0.08
TS2	-0.044	0.121	-0.36
TS3	-0.067	0.090	-0.74
TS4	-0.027	0.053	-0.50

When adding the additional factor of time dummies in the fixed two model, the explanatory power of the R-squared value increases ever so slightly. That said, none of the time dummies achieves statistical significance, indicated that a fixed one model is more appropriate. Furthermore, none of the parameter estimates changes significantly with this new model.

Random One-Way:

M-Value: 49.30	R-Squared: 0.4258
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	7.306	0.151	48.55
loda	-0.061	0.024	-2.56
cellpenetration	0.0017	0.001	1.16
policy	-0.000001	.00000001	-0.53
lcellpen	0.044	0.007	6.09
cellpensq	-0.0000002	0.00001	-0.15

In an interesting turn of events, it appears as if one of the additional parameter estimates calls into question the assumption that the covariance of the unobserved factors and the independent variables does not equal to zero. Because of the high M-value, we reject the null presented in the Hausman Test. As such, the fixed effects model would be the only model with consistent parameter estimates. Despite this fact, I do believe it is interesting to point out that the expected sign and statistical significance of the parameter estimates does not change between fixed and random effect models. Going forward, I will drop the statistically insignificant variables and reexamine the results.

Model 3

Due to my contradictory initial findings, I will now build a model that drops statistically insignificant variables. I thus am left with a very simple growth model with the following variables:

$$lgni = \beta_0 + \beta_1 loda + \beta_2 lcellpen + v_{it}$$

Where the log GNI per capita acts as the dependent variable and is dependent on:

loda = The change in net Official Development Assistance received per person

lcellpen = The change in cell phone penetration

Hypothesis

Despite findings in the other two models, I will still begin with the assumption that both change in ODA per capita (β_1) and change in cell phone penetration (β_2) will be positive.

H0: $\beta_1 > 0$, $\beta_2 > 0$

H1: $\beta_1 \leq 0$, $\beta_2 \leq 0$

Results

Fixed One-Way:

F-Statistic: 119.88	R-Squared: 0.9747
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	6.307	0.126	50.12
loda	-0.068	0.024	-2.82
lcellpen	0.056	0.004	12.98

Beginning once again with the fixed effects one way model, I find my conclusions from previous regressions hold. Change in ODA per capita and cell phone penetration remain statistically significant. Change in ODA per capita remains negative, suggesting that increases will actually hinder economic growth. Increases in cell phone penetration have the expected positive effect on economic growth.

Fixed Two-Way:

F-Statistic: 116.19	R-Squared: 0.9759
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	6.381	0.133	48.00
loda	-0.068	0.025	-2.79
lcellpen	0.051	0.014	3.66
TS1	-0.046	0.108	-0.43
TS2	-0.095	0.070	-1.35
TS3	-0.109	0.048	-2.29
TS4	-0.052	0.036	-1.45

As in previous regression analyses, I find that adding time dummies does not prove to be statistically significant. That said, there is almost no change on either the parameter estimates or the statistical significance of the independent variables.

Random One-Way:

M-Value: 0.44	R-Squared: 0.4078
Number of Cross-Sections: 62 Time Series: 5	

Variable	Parameter Estimate	Standard Error	t Value
Intercept	7.362	0.149	49.33
loda	-0.072	0.024	-3.04
lcellpen	0.057	0.004	13.14

Once I eliminated the statistically insignificant variables from the equation, I find yet again that the Hausman Test is relevant. That is to say, I fail to reject the null hypothesis that the covariance of unobserved factors and the independent variables are zero. Without the statistically insignificant variables, the random effects model is the more appropriate. As it remains, both models are consistent estimators of the model, and give similar results in their statistical significance, sign, and magnitude for the parameter estimates. As in previous models, these findings cause me to reject my null hypothesis that increases in foreign aid are beneficial to a country's economic growth.

Conclusion

In the years since the collapse of the Soviet Union, foreign aid continues to be allocated. Whether it be in response to political motivations, humanitarian aid, or infrastructure development projects, the flow of funds has not stopped. Debate surrounds the issue, and considerable time has been

exhausted to prove or disprove the merit of such aid. What is clear from my studies is that general sources of foreign aid are detrimental to the economic well-being of a country's citizenry.

There are many reasons why this might be a result. Often times aid is given to alleviate severe humanitarian crises. However in a nature of political aid, it appears as if net ODA per capita acts as a substitute for local government investment in pro-growth policies. The train of thought would suggest that when governments receive funding elsewhere, they have less of an incentive to develop revenue generation themselves.

Regardless of regression model, number of variables included, or transformation of variables, change in ODA per capita always resulted in a negative and statistically significant parameter estimate. Policy never achieved statistical significance, nor did measures of inflation. That said, there is one positive take-away from my research. Changes in cell phone penetration as a measure of telecommunications infrastructure are resoundingly positive and statistically significant throughout. I did not find any indication of diminishing returns to cell phone penetration.

Do these findings suggest foreign aid should be abandoned? I feel like this is hardly the case. The measure of Net ODA per capita is a very broad measure with a multitude of components. When combined in aggregate, they appear detrimental to the economy. However as pointed out by the positive effects of cell phone penetration, targeted foreign aid in the form of infrastructure development can reap significant benefit. Furthermore, economic growth is not the sole purpose of foreign aid. Often allocation of capital and goods is a response to dire humanitarian conditions. Foreign aid often fits well in the tool belt of diplomacy, "sweetening the deal" of otherwise difficult strategic partnerships. Indeed, limiting the ability to allocate foreign aid could severely hinder the bargaining position of diplomats in aims to bring about political or policy reform.

Burnside and Dollar (2000) seem to have yet again been fundamentally challenged in their findings. Evaluating my results, it would appear that foreign aid should not be conditional, but targeted.

Foreign aid allocation is about more than just economic gains. Often, it can mean the difference between life and death, survival or starvation. As Dalgaard and Hansen say it is “premature to apply policy selectivity rules in future aid allocations.” I agree with this statement, and believe my research supports such a conclusion.

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