ERASMUS UNVERSITY ROTTERDAM

Are we wasting our tax money on corrupt countries?

What is the influence of corruption on the effectiveness of foreign aid in Sub-Saharan Africa?

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Abstract

Over the past decades, no consensus has been found on the effectiveness of foreign aid: does foreign aid spur economic growth? This thesis investigates the effectiveness of foreign aid in 44 Sub-Saharan countries in a time period from 1998 up to and including 2011, using a fixed effect least square regression model. An interaction term between foreign aid and the recipient country's degree of corruption, measured by the Corruption Perceived Index, is added to the regression to measure its influence on the effectiveness of aid. The investment output ratio is added to the regression as well, to measure the effect of aid on economic growth through investment in capital.

This thesis neither finds evidence for any influence of foreign aid on economic growth, for the influence of corruption on the effectiveness of foreign aid, nor for the existence of diminishing returns on foreign aid. Also, it does not provide evidence for the influence of foreign aid on economic growth through investment in capital.

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1. Introduction

The effect of foreign aid on economic growth has been a topic of great controversy since Rosenstein-Rodan invented the idea of foreign assistance and advocated for aid to Eastern Europe in 1943 (Dalgaard, Hansen & Tarp, 2004). The effectiveness of foreign aid has recently been questioned again, due to the approaching deadline of the UN's millennium goals in 2015. One of these goals aims to halve extreme poverty and hunger since 1990, and foreign aid was expected to contribute largely to meet this goal (UN, 2000). Now that the deadline is approaching while the goal has not been met yet, criticism on foreign aid's effectiveness rises again.

At the same time the millennium goals were set, in 1990, governments of developed countries became disappointed with the lack of progress in economic growth in developing countries, despite the disbursement of significant foreign aid. Researchers started to investigate its effectiveness, but have not reached consensus on whether or not aid has an impact on growth (Hansen & Tarp, 2000). These papers focused on the effect that foreign aid has on economic growth through capital formation. Some studies that did find a relationship between foreign aid and growth also investigated the prevalence of diminishing returns on foreign aid (Lensink & White, 2001; Dalgaard & Hansen, 2001). However, these studies are scarce, since most research uses a model that implies a linear relationship between aid and growth.

In 1997, Burnside and Dollar published what can be called the most influential paper on the relationship of foreign aid on economic growth at the time: "Aid, policies and growth". They introduced economic policies in their growth regression and showed that aid only boosts growth in countries that have reasonable policies. Many academics have challenged Burnside and Dollar's conclusions in their own research. Some of them have affirmed their conclusions regarding the importance of the recipient country's environment (Collier & Dollar, 1999; Worldbank, 1998); others have provided evidence that aid raises growth regardless of a country's policies (Guillaumont & Chauvet, 2001; Akhand & Gupta 2002; Roodman, 2004). Simultaneously, researchers started to investigate the influence that the recipient country's institutions, such as the degree of corruption, have on the effectiveness of foreign aid. Most researchers used instrumental variables such as the efficiency of government bureaucracy to measure the quality of institutions indirectly (Easterly, 2003).

This paper aims to add to the literature on this topic through replacing these instrumental variables with the Corruption Perceived Index, to measure the quality of institutions directly. Also, this paper will investigate whether diminishing returns on aid exist. Diminishing returns on aid is becoming an

important subject, since in the last decades the amount of countries receiving 'high aid' (more than 20% of GNP) is more than doubled (Lensink & White, 1999).

The dataset only includes Sub-Saharan African countries. According to the World Bank's Poverty and Inequality Database (2013), this region is the poorest region in the world despite the large aid inflows this region receives. Therefore, this thesis investigates the following research question:

What is the influence of corruption on the effectiveness of foreign aid in Sub-Saharan Africa?

The hypotheses are the following: (I) foreign aid has a positive effect on economic growth; (II) the degree of corruption influences the effect of foreign aid on economic growth; (III) diminishing returns on foreign aid exist; and (IV) foreign aid influences economic growth through investments in capital.

The effectiveness of foreign aid is measured in terms of per capita GDP growth rates, while the Corruption Perception Index (CPI) is used to indicate the degree of corruption. The research question is researched using a fixed effect least squares dummy variable (LSDV) method of the dependent variable GDP growth. In the first regression, economic growth is regressed on foreign aid, the degree of corruption, an interaction term between aid and corruption, a country's openness and foreign aid squared. With the results of this regression, hypothesis (I) till (III) can be either confirmed or rejected. Whether hypothesis (II) is confirmed or rejected depends on the coefficient and the significance of the interaction term, whereas the confirmation of hypothesis (III) depends on the term 'aid squared'. Last, a second regression including an investment-output ratio is ran, to investigate the effect that aid has on economic growth through investment in capital. With the results of this regression, hypothesis (IV) can be rejected or confirmed. Data are retrieved from the World Bank's African Development Indicators Databank (2013), Penn's World Tables (2012) and Transparency International (2014).

This paper distinguishes itself from the existing body of literature on this topic not only by its investigation in the effect of CPI and diminishing returns of aid, but also by its dataset that includes data from 1998-2011. Starting from 1998, recipient countries had to fulfil certain conditions before receiving foreign aid (IDA, 2010). Also, the Corruption Perceived Index has only been constructed from 1998 and there on. Therefore, only empirical data after 1998 is taken into account.

The remainder of this thesis is structured as follows. Chapter 2 supplies the theoretical framework for this thesis, consisting of an explanation of traditional growth models and an overview of the existing literature on this subject. Three existing views on the effectiveness of foreign aid are discussed: aid has no impact on economic growth, aid does have an impact on economic growth,

and aid has an impact on economic growth depending on the recipient country's policies. In chapter 3 the empirical data is described and the fixed effect LSDV method explained; the results of these regressions can be found in chapter 4. Finally, chapter 5 encompasses this study's conclusions, its implications and recommendations for future research.

2. Theoretical Framework

2.1 Growth models

In 1956, Robert Solow developed an exogenous growth model, focusing on three variables that influence economic growth: capital (K), labour (L) and the effectiveness of labour (A). Solow described a production function in the following form:

$$Y_{(t)} = F\,(K_{(t)}, A_{(t)}\,L_{(t)}) \tag{1.1}$$

Where Y denotes GDP or output and t denotes time. It is important to notice that time only enters the production function indirectly, through the input variables K, L and A (Romer, 2012). This implies that a change in Y over time can only occur through increases or decreases in K, L and A. Also, whereas in Solow's model A denotes the effectiveness of labour, others have argued that A should represent and overall efficiency factor (Kabete, 2008).

In the 1990's, the influence of human capital on economic growth gained importance. Mankiw, Romer and Weil (1992) conclude that including physical as well as human capital in an augmented Solow model provides an excellent description of the data:

$$Y_{(t)} = F\,(K_{(t)}, H_{(t)}, A_{(t)}\,L_{(t)}) \tag{1.2}$$

This thesis focuses on GDP growth, instead of on GDP itself. One can easily derive the growth rates of the variables included in (1.2), by taking its natural logarithm (1.3) and differentiating it (1.4):

$$\ln Y_{(t)} = \ln K_{(t)} + \ln H_{(t)} + \ln A_{(t)} + \ln L_{(t)} \tag{1.3}$$

$$y_{(t)} = k_{(t)} + h_{(t)} + a_{(t)} + l_{(t)} \tag{1.4}$$

In which the lower case letters represent the growth rates of respectively GDP, physical capital, human capital, technology and labour. From equation (1.4) one can conclude that an increase in one of the variables on the right hand side will spur GDP growth. This thesis focuses on the influence of foreign aid on economic growth through investment in capital, $k_{(t)}$. In paragraph 2.2.1 the existing literature on the influence of aid on physical capital is examined.

2.2 Literature review

For decades, developed countries have wanted to know if the money they spend on foreign assistance is used properly and contributes to its intended goal: growth and development in third world countries (Dalgaard, Hansen & Tarp, 2004). This has led to a large body of research on the topic of foreign aid and economic growth, especially on how aid influences the determinants of GDP growth. A literature review by Hansen and Tarp (2000) summarizes the most important studies on this topic, ranging from the 1960's up till 1999.

Despite the large body of research on the impact of foreign aid on economic growth, consensus is yet to be reached. Early studies focus on how foreign assistance affects the determinants human capital and physical capital. Other studies haven't found any impact of aid on economic growth at all. However, since the publication of a working paper by Burnside and Dollar in 1997, researchers on foreign aid shifted their focus towards the recipient countries' policies and their influence on the effectiveness of aid. According to academics that followed this view, the effect of aid on growth would be dependent on a recipient country's policies and institutions, such as a corruption-free environment (Easterly, 2003). The diagram below shows how in this view foreign aid, given institutions, can influence economic growth.

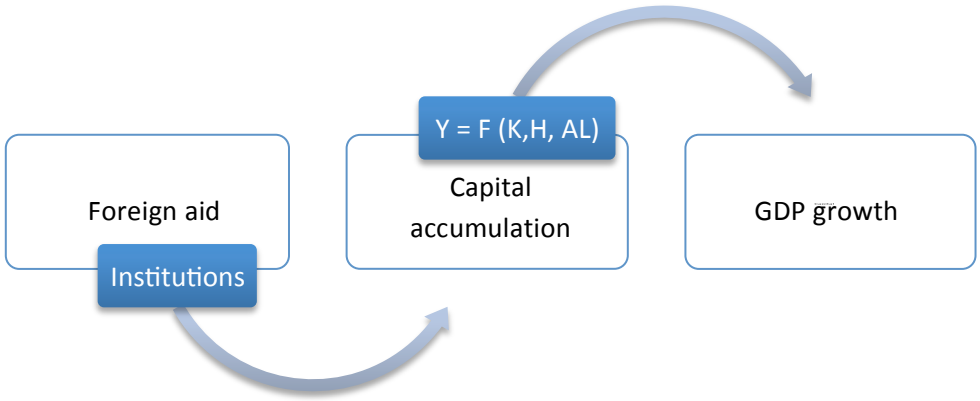

Diagram 1: Foreign aid, institutions, capital & GDP growth; a schematic causality diagram.

2.2.1 Positive impact on growth

Early literature has focused on three main channels through which aid influences economic growth positively: through the physical capital stock, by increasing human capital and through transferring new technologies to the developing countries (Morrissey, 2001).

(I) Through physical capital; the two gap model

When the idea of foreign aid gained importance in the aftermath of World War II, academics assumed that foreign aid would raise the capital stock through incremental savings and an increase in investment. In 1966, Chenery and Stout created a theoretical model that incorporated this

assumption. Their model is known as the two-gap model and became the most important model in assessing the effectiveness of foreign aid until the 90's. A literature review on the effectiveness of foreign aid would not be complete without an elaboration on this model.

The two-gap model describes, as its name indicates, two gaps that indicate a lack of resources to attain a certain level of growth: the saving and the trade gap. Foreign aid can contribute to closing these gaps and therefore contribute to economic growth. The saving gap indicates a lack of domestic savings that is needed to invest; the trade gap denotes a foreign exchange deficit (Chenery & Stout, 1966). The two-gap model assumes that recipient countries use aid for investment rather than for consumption, and that a constant linear relationship between investment and growth exists. According to this model, foreign aid influences economic growth by raising the physical capital stock.

Robinson (1971) added the trade balance to a growth regression and found that foreign exchange can limit economic growth; thereby providing evidence on the existence of the trade gap. Around the same time, in 1970, Chenery and Eckstein had already provided empirical evidence on the existence of the saving gap in Latin America.

However, the two-gap model has been challenged by different academics in the past twenty years. Easterly (2001) for example provides evidence against the existence of the saving gap using time-series analysis for 88 countries. Most criticism is pointed at the model's assumption that increased foreign aid will match incremental investment in a one-on-one relationship. These critics emphasized that aid could have diminishing returns on growth (Lensink & White, 2001). This critique will be evaluated in paragraph 2.2.4.

(II) Through human capital and the overall efficiency factor

Human capital can be seen as competencies that increase a worker's quality of labour. Education and health are two major contributors to human capital (Schultz, 1961). Both can be influenced largely by foreign aid through financing health and education projects. Bloom, Canning & Sevilla (2004) have indicated that health has "a positive, sizable and statistically significant effect on aggregate output", through health's positive influence on physical and mental capabilities. Empirical research on education has provided evidence that a population's cognitive skills are positively related with economic growth (Hanushek & Wößmann, 2007). When aid is used to improve the health status or people's cognitive skills, it contributes to growth.

Aid can also influence the overall efficiency factor "A" in the traditional growth model, by transferring new technologies into a country. Also, developed countries can contribute to this determinant of growth by giving assistance on how to use physical capital, such as machinery. In the

20th century, about 30% of all foreign aid to Sub-Saharan Africa was directed at technological co-operations (Tarp, 2002).

2.2.2 No impact on growth

For decades, researchers have tried to provide empirical evidence that foreign aid does not have a positive influence on economic growth. Peter Bauer became world's first persistent critic of foreign aid in 1972. Before this time, critics on the effectiveness of foreign aid were believed to be inhumane and insensitive to the developed countries' duty to help the poor. Bauer did not only imply that foreign aid has no positive influence on growth; he even saw the assistance as hurting economic development (Bauer, 1972). Countless empirical studies following Bauer's failed to find a positive relationship between foreign aid and economic growth (Shleifer, 2009). These studies provided three possible reasons why aid and growth are not positively related.

A popular reason that is often cited by newspapers when criticizing foreign aid is that aid is simply wasted by the recipient country's government. Last year, Forbes headlined: "Foreign aid: money down a rat hole?" and suggested that taxpayers' money would be used to benefit the corrupt members of the recipient country's government (Forbes, 2013). This popular view is backed up by Kasper's research on Sub-Saharan countries (2006).

Another reason why aid doesn't always show a positive relationship with growth is that aid may mimic the symptoms of "Dutch Disease" (Levy, 1988). Foreign aid increases domestic income and therefore raises the demand for traded and non-traded goods. Since the developed country is assumed to be a price taker, the increased demand for both kinds of goods only leads to a rising price for non-traded goods. An increasing price for non-traded goods relative to the price for traded goods, leads to the appreciation of the real exchange rate, a loss of the country's competitiveness and therefore less economic growth (Adenauer & Vagassky, 1998).

Guillaumont and Guillaumont Jeanneny brought forward the third reason why some studies failed to find a relationship between aid and growth (2007). They suggest that diminishing returns on foreign aid exist: behind a certain amount of aid, its effects on growth will increase at a decreasing rate. Their reasoning implies a lack of 'absorptive capability' of recipient countries to put aid flows to good use: weak infrastructure and labour's limited capabilities. The existence of diminishing returns will be investigated in this thesis.

2.2.3 Impact on growth depending on policies

As mentioned above, Burnside & Dollar (1997) were the first ones to come up with the idea of the influence of recipient countries' policies on the effectiveness of foreign aid. In their cross-country

analysis, they introduced an aid-policy interaction term to assess the influence of policies on the effectiveness of foreign aid. They created a policy index encompassing the recipient country's inflation rate, its budget surplus/deficit and its trade openness. In their research they conclude that aid has had a more positive impact on growth in environments with good fiscal, monetary and trade policies (Burnside & Dollar, 1997). The World Bank confirmed this conclusion it in its working paper "Assessing Aid" (World Bank, 1998). This paper advised donor countries to examine the policies of recipient countries before donating foreign aid, since their money would be best spent on developing countries with 'good policies'. The World Bank incorporated this view in its Performance Based Allocation System for allocating foreign aid in 1998 (IDA, 2010), and donor countries started to take policies into account when allocating their money to developing countries.

However, academics started to challenge Burnside & Dollar's conclusions. Lensink and White (2001), Guillaumont and Chauvet (2001), Akhand and Gupta (2002), Easterly (2003) and Roodman (2004), to name a few, provided evidence opposing Burnside and Dollar's conclusions. They found that foreign aid influences economic growth regardless of the recipient country's policies. Their main critic on Burnside and Dollar's publication focuses on the interaction variable between policy and aid, which they find extremely data dependent (Dalgaard & Hansen, 2001).

Since Burnside and Dollar's publication, researchers started to add recipient country's characteristics to the growth recession. For example: geographical locations, such as a location in the tropics (Dalgaard, Hansen & Tarp, 2004), climate related variables (Guillaumont & Chauvet, 2001) and the degree of democracy (Capita, 2013).

The view that the effectiveness of foreign aid is dependent on the recipient country's characteristics is widely incorporated by donor countries when allocating their money reserved for foreign aid.

2.2.4 Diminishing returns

The existence of diminishing returns on foreign aid was first assumed by the World Bank in its working paper "Assessing aid", which is mentioned before (1998). Lensink and White (1999) came up with a rather complicated endogenous growth model that illustrates the possible existence of diminishing returns on aid: an aid laffer curve. Their empirical research that followed the model indicates that there is evidence for the existence of an aid laffer curve. Two years later, Lensink and White (2001) repeated their research on diminishing returns on an updated dataset and concluded that foreign aid exhibits diminishing returns on capital accumulation. However, they notice that the results were sensitive to the countries and years included in the research.

3. Data and methodology

This chapter elaborates on the data used for this research and the methods applied to find support for the four hypotheses stated in this thesis' introduction. Per capita GDP growth is regressed on the log of foreign aid, the corruption index, a country's openness, an interaction term between the log of foreign aid and the corruption index, and log foreign aid squared to indicate diminishing returns. I am aware of the fact that other academic papers have used more complex econometric tools, and sometimes used a larger dataset. However, since no consensus has been found amongst the results of these different studies, and no recent data have been investigated, this thesis may still be able to add to the discussion.

3.1 Data

This study covers a 14-year period: empirical data ranging from 1998 up until 2011. Starting from 1998, donor countries required developing countries to fulfil certain conditions before donating foreign aid (Easterly, 2003). This huge change in the allocation of foreign aid was a response to the Burnside and Dollar's publication on the influence of good policies on the effectiveness of aid. This paper only analyses data after this publication.

The dataset covers all 48 Sub-Saharan African countries, except Sao Tome & Principe, Seychelles, Somalia and South Sudan due to a lack of data availability[1]. Data available at the World Bank's website indicates that Sub-Saharan Africa has received far more foreign aid than any other region in the world. However, with more than 300 million people living below $1 per day this region is considered to be the poorest region in the world (World Bank's Poverty and Inequality Database, 2013). Therefore, this study only looks at Sub-Saharan Africa.

In total, this panel data set covers 44 countries in the period 1998-2011. Empirical data on GDP growth and net Official Development Assistance are retrieved from the World Bank, whereas data on CPI and openness is retrieved from Transparency International and Penn World Tables respectively. Table 1 shows the descriptive statistics of the most important variables. The different N for all variables means that this panel data set is unbalanced. The choice for these variables and their origin are explained in the following paragraphs.

[1] These 44 countries are: Angola, Benin, Botswana, Burundi, Cameroon, Cape Verde, Central African Republic, Chad, Comoros, Congo RDC, Republic of Congo, Cote d'Ivoire, Djibouti, Equatorial Guinea, Eritrea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Sierra Leone, South Africa, Sudan, Swaziland, Tanzania, Togo, Uganda, Zambia & Zimbabwe

	N	Mean	Standard Deviation
GDP per capita Growth (%)	614	2.17	5.88
Aid (% GDP)	614	0.18	0.17
CPI	423	2.92	1.06
Investment (% GDP)	570	20.75	10.10
Openness (% GDP)	559	72.62	36.60

Table 1: Individual samples descriptive statistics

Dependent Variable

This study uses GDP per capita growth as a dependent variable to test its hypotheses. Measurements of GDP growth have been widely accepted as great indicators of economic growth. Data are obtained from the World Bank, specifically from its African Development Indicators Databank from 2013. GDP per capita growth measures the expansion or contraction of a country's output of goods and services, divided by the country's population, in percentages:

$$GDP\ per\ capita\ growth: \frac{GDP\ per\ capita_t - GDP\ per\ capita_{t-1}}{GDP\ per\ capita_{t-1}}$$

Independent Variables

The choice for the independent variables is partially based on the model used by Burnside and Dollar. In their research, GDP per capita growth is regressed on: initial GDP, aid receipts, a policy index (a weighted sum of the budget surplus, inflation and openness), institutional variables (ethno-linguistic fractionalization, security of property rights and efficiency of government bureaucracy), total government expenditure and money supply M2 (Burnside & Dollar, 1997). Due to a lack of data availability for some of these variables and for simplicity, only the Burnside & Dollar's variables aid receipts and openness are used in this thesis. The institutional variables they used are replaced by the degree of corruption, measured by the Corruption Perceived Index.

Foreign aid

Previous research used two different measurements of aid. Burnside and Dollar (1997) for example defined aid as the Effective Development Assistance, whereas Roodman (2004) uses Official Development Assistance. Since empirical data is limited, in this paper the aid is defined as ODA. The variable Aid is the net official aid received in the previous period, t-1, in constant 2011 US$. Aid is lagged, because it usually takes some time before received aid is invested in capital. Also, the variable AID is the log of total ODA. The term aidsquared is also a logged variable. Data is retrieved from the African Indicators Databank (2013).

Corruption Perceived Index (CPI)

The CPI indicates the perceived levels of public sector corruption in almost all countries of the world. CPI is a weighted index of 13 different surveys on corruption developed by 11 independent institutions. Wilhelm (2002) showed that a highly significant correlation exists between the Corruption Perceived Index and GDP per capita. The index ranges from zero to ten. A score of zero implies the highest level of perceived corruption; a score of ten means there is no perceived corruption at all. The mean of CPI in Sub-Saharan Africa over 1998-2011 is 2.92 and therefore indicates relatively high levels of corruption. The interaction term CPI*AID is the CPI value times the log value of Aid.

Openness

While Burnside & Dollar use an index to measure policies, consisting of the budget surplus/deficit, the inflation and openness, this study only uses a country's openness to measure a country's policies. Openness is defined by exports plus imports, divided by GDP, and thus indicates total trade as a percentage of GDP. According to Sachs & Warner (1995), openness contributes largely to long-term growth, through various channels. For example, the bigger a country's openness, the more competitive and therefore efficient the domestic market will become, and the more access it has to foreign technologies and different production inputs. The index for openness is retrieved from Penn World Tables (2013).

Investment

A country's capital at time t includes its capital in the previous period t-1, times one minus the depreciation rate (d) plus the amount of money invested in capital:

$$K_t = K_{t-1}(\,1 - d\,) + I \qquad (3.1)$$

This study however, does not take the depreciation rate into account for two reasons. The first reason is the lack of data availability of the depreciation rate in most Sub-Saharan African countries. Second, this study is interested in the effect of foreign aid on economic growth through capital accumulation. Aid might affect economic growth when it is used to invest in capital. Therefore, the amount of money invested in capital is only taken into account.

To retrieve a country's change in capital in real terms when the depreciation rate is not taken into account, formula (3.2) is created from (3.1) by subtracting $K_{t-1} + d$:

$$\Delta K_t = \; K_t - K_{t-1} = I_t \qquad (3.2)$$

Investment (I) consists of additions to the net changes in the level of inventories and to the fixed assets. Inventories include stocks of goods held by firms, whereas fixed assets include plant, machinery and equipment purchases, land improvements and the construction of infrastructure, hospitals, schools, commercial and industrial buildings and offices (African Development Indicator Database, 2013). For this study, the investment/output ratio is needed: I_t/Y_{t-1}. Data on this variable is retrieved from the African Development Indicator Database (2013).

3.2 Methodology

The data described above are used to perform a cross sectional analysis, using least squares regressions. Two models are used to describe the effect of foreign aid on growth directly and the effect of aid on growth through the investment output ratio.

$$GDP_{i,t} = \beta_0 + \beta_1 Aid_{i,t-1} + \beta_2 CPI_{i,t} + \beta_3 OPEN_{i,t} + \beta_4 Aid^2_{i,t-1} + \beta_5 Aid_{i,t-1} CPI_{i,t} \quad (3.3)$$

This regression is used to test the effects of foreign aid, the degree of corruption, a country's openness and diminishing returns on aid (Aid^2). The term (i) indicates the Sub-Saharan African country. Also, the last term in the regression, the interaction term between Aid and CPI gives us the chance to assess the influence of CPI on the effect that aid has on growth. One would expect that if the term Aid*CPI rises, indicating less corruption or higher aid, economic growth will be positively affected. Therefore, I expect the coefficient of this interaction term to be positive.

Regression (3.4) is used to assess whether foreign aid affects economic growth through the investment/output ratio (INV). This regression is similar to (3.3), except for the extra independent variable INV. When adding this term decreases the coefficient of aid compared to its coefficient in regression (3.3), this can be seen as an indication that aid influences economic growth through this investment ratio.

$$GDP_{i,t} = \beta_0 + \beta_1 Aid_{i,t-1} + \beta_2 CPI_{i,t} + \beta_3 OPEN_{i,t} + \beta_4 Aid^2_{i,t-1} + \beta_5 Aid_{i,t-1} CPI_{i,t} + \beta_6 INV \quad (3.4)$$

Augmented Dickey-Fuller test

First, we have to perform a unit root test on our data. According to Hill et al. (2012), one has to use the Augmented Dickey-Fuller test (ADF) when testing for unit roots in an unbalanced database. The null hypothesis states that not one panel is stationary, such that a random walk exists. The ADF test takes three forms: (I) no constant, indicating that the dependent variable fluctuates around 0, no trend; (II) a constant, indicating that the dependent variable does not fluctuate around 0, no trend; and (III) both a constant and a trend, indicating that the variable fluctuates around a linear trend. One can establish which form to use by plotting the dependent variable, GDP per capita growth. In this plot one can see whether GDP per capita growth has a constant or a trend, or both.

Pooled, fixed or random models

One has to keep in mind that this study uses panel data. This panel data set contains both a cross-sectional variable (country) and a time-series variable (year). The linear relationships that this study may find between aid and growth, might be dependent on the countries included and on the years studied. For example, being Sudan instead of South Africa, or it being 2000 instead of 2001, might affect the effect aid has on growth. Therefore, using a fixed effect model for this study results in more reliable results than a pooled model.

A pooled model is a model that does not take a subject's individual coefficients into account. In this case, the subject is one of the 44 Sub-Saharan countries included in this study. The regression would look like the following:

$$y_{i,t} = \beta_0 + \beta_1 x_{i,t} + e_{i,t} \quad (3.5)$$

In which $y_{i,t}$ is the dependent variable for country *I* at time t; β_0 is the aggregate constant, that does not take a country's individual constants into account; $\beta_1 x_{i,t}$ is the independent variable with its coefficient of country *i* at time t; and $e_{i,t}$ is the regression's error term.

A fixed effect model, however, controls for heterogeneity between countries by including country's characteristics in the intercept. Also, this study controls for yearly variations. During the investigated period, 1998-2011, a financial crisis occurred. This crisis is assumed to negatively affect our dependent variable GDP growth. These yearly variations are corrected for by using a year-fixed effect model. Therefore, to correct for country variations as well as for yearly variations, this model uses a fixed effects least squares method (LS). A fixed model looks like this:

$$y_{i,t} = \beta_{0,i} + \beta_1 x_{i,t} + e_{i,t} \quad (3.6)$$

Compared to the pooled model in (3.5), the constant term has changed. $\beta_{0,i}$ in(3.6) indicates the regression's constant that changes dependent on country *i.* This allows for countries to have different constants in their GDP growth regression. In the fixed effect model there is no correlation between the countries' error terms. Also, the error terms have a zero-mean and a constant variance. The specific country effects may be correlated with other independent variables (Hill, Griffiths & Lim, 2012).

Testing the assumptions

When using a least squares regression, the assumptions of Ordinary Least Squares (OLS) regressions have to be satisfied: (I) no heteroscedasticity or (II) serial correlation, (III) error terms uncorrelated with the independent variables and (IV) with mean zero and (V) no multicollinearity (Hill, Griffiths, &

Lim, 2012). The fixed effect model corrects for violations of assumptions (III) and (IV). To check for assumption (I), (II) and (V), statistical tests are performed.

To test for the assumption of no multicollinearity, the correlations between variables are constructed. The absence of heteroscedasticity and serial correlation is usually assessed through a White test and a Durbin-Watson test respectively. Unfortunately, Eviews does not offer a White test for heteroscedasticity. Therefore the residuals will be plotted against time to see if the error term has a constant variance, and is therefore homoscedastic.

4. Results

First, the regression with the investment ratio is investigated. Its compliance with the OLS assumptions will be tested and the regression will be performed. The regression's results are discussed, and hypothesis (I) till (III) are either rejected or confirmed. In the last section of this chapter, the investment ratio variable will be added to the regression.

To determine which form of the Augmented Dickey Fuller test has to be used, the dependent variable GDPGROWTH, GDP growth per capita, is plotted against time. From graph A in the appendix follows that GDPGROWTH fluctuates around zero, with no trend. Therefore the first form of the ADF test is used: no constant, no trend. The results can be found in table A in the appendix. Both the Fisher Chi-square and the Choi Z-statistic show a probability of 0.000. Therefore we reject the null hypothesis that the panel is non-stationary.

4.1 Regression without the investment ratio

Now that the stationarity of the panel data is confirmed, one can take a look at the fixed effect model. The OLS assumptions are tested, the regression is run and hypothesis (I) till (III) will be either confirmed or rejected.

Assumptions

To test for multicollinearity, a correlation table has been constructed in table B in the appendix. The correlations table indicates that Aid^2 is highly correlated with both Aid/GDP and Aid*CPI (0.78 and 0.81 respectively). To evade multicollinearity, Aid squared and therefore the existence of diminishing returns on aid cannot be tested in the same regression as the influence of Aid/GDP and Aid*CPI on economic growth. We proceed without the variable Aid squared, and assess the existence of diminishing returns on aid later on.

A Durbin-Watson test is performed to look for serial correlation. The test is inconclusive[2]. Therefore, we are not sure if we can reject the null hypothesis of non-autocorrelated errors. To make sure that the errors aren't autocorrelated, a lagged variable of GDPGROWTH is added to the equation. A second Durbin-Watson test shows us that there is no evidence that the errors are auto-correlated.[3]

From figure B, in which the residuals are plotted against time, one can see that there is no heteroscedasticity.

Results

We can now run the regression, using the fixed effects model. The results can be seen in table C in the column "Model 1" in the appendix. The first thing that catches one's eye is that only the lagged value of GDP Growth has a significant positive effect on the current value of GDP Growth, considering a p level smaller than 0.1. Also, the R^2 value is relatively low: only 40.37% of the variation in GDP Growth is explained by the five independent variables included in the fixed effect regression.

When we relax our significance threshold from 10% to 20%, we can at least interpret our results with great caution. One has to keep in mind that lowering the significance threshold indicates that more type I errors will occur: wrongly rejecting the null hypothesis of no influence of the independent on the dependent variable. 20% is a very low threshold, and therefore the conclusions made based on these quasi-significant coefficients should be interpreted with great caution.

We see that both Aid as a percentage of GDP and a country's openness have a positive influence on GDP growth, with a significance of 0.19 and 0.14 respectively. This indicates that foreign aid, divided by GDP per capita, positively affects economic growth. The shown effect is quite large. The coefficient indicates that a 1% increase in aid to GDP leads to a 4% increase in GDP growth. However, this model does not provide evidence to confirm hypothesis (I), foreign aid has a positive effect on economic growth, since a p-level greater than 10% cannot be called significant.

Surprisingly, we do not find any evidence that the degree of corruption has significant influence on economic growth, not even on the $p<0.2$ level. Also, the coefficient of the interaction term between Aid and CPI does not provide significant evidence that the degree of corruption influences the effect of foreign aid on economic growth. We have to reject hypothesis (II) that stated that the degree of corruption influenced the effect of foreign aid on GDP growth.

[2] Durbin Watson statistic: 1.643227, with n>200, k=5 and p<0.01 lower and upper bound are 1.623 and 1.725 respectively.
[3] Durbin Watson statistic: 1.876008, with n>200, k=6 and p<0.01 lower and upper bound are 1.613 and 1.735 respectively.

In order to either confirm or reject hypothesis (III), Aid/GDP and Aid*CPI are replaced with the variable Aid squared. The results can be found in table C, in the column "Model 2". It is interesting to notice that the R^2 hardly changes: model 2 does not explain the variations in GDP Growth any better or worse than model 1 does. Also, the influence of lagged GDP Growth stays the only coefficient that is significant at a $p<0.01$ level and openness has a positive influence on GDP Growth at a $p<0.2$ level. Lastly, this regression does not provide evidence that diminishing returns on foreign aid exist for this panel dataset: the variable Aid^2 does not have a significant influence on growth. Therefore, hypothesis (III) cannot be confirmed either.

4.2 Regression including the investment ratio

We have established that aid has positive influence on GDP growth at a significance level of $p<0.2$. According to the Solow growth model, explained in the theoretical framework, foreign aid may affect economic growth through the investment ratio. When foreign aid is invested into capital, this will stimulate economic growth. Therefore, the investment ratio is added to the regression. Its results, especially on the coefficient and the significance of the aid variable, will be compared with the previous regression's results.

Before we run this regression, the OLS assumptions have to be tested again. Again, due to multicollinearity, aid squared cannot be used in the same regression as Aid*CPI or Aid/GDP. The results can be found in the column "Model 3" in table C in the appendix.

The first thing that stands out from these compared regressions are the increase in the R^2, indicating that adding the investment ratio to the model increases the percentage of the variation in GDP Growth that is explained by the model. Also, one notices the decrease in the coefficient of aid, while the significance does not change. In the third model, where the investment ratio is included as a controlled variable, this indirect influence of foreign aid on growth is controlled for. This indicates that foreign aid partially influences economic growth through investment. However, the coefficient of Aid/GDP is not significant at a $p<0.1$ level and could therefore as well be zero. A decrease in the coefficient is therefore not enough to confirm hypothesis (IV).

It is interesting to see that when the variables Aid/GDP and CPI*Aid are replaced with the Aid squared term; that there seems to be evidence that diminishing returns on aid exist; however with a chance of 20% on a type I error to occur. We still reject hypothesis (III) that implies that diminishing returns on aid exist, since a 20% chance on a type I error is huge.

5. Conclusion

Since the introduction of the idea of foreign aid in 1943, foreign aid's effect on economic growth has been a topic of great controversy. A lot of researchers have examined this topic, but no consensus has yet been reached. The results seem to be dependent on the dataset used (Dalgaard & Hansen, 2001). This study uses a dataset consisting of 44 Sub-Saharan countries, in the time period 1998-2011.

This paper examined the influence of corruption on the effectiveness of foreign aid in Sub-Saharan Africa, using the following hypotheses: (I) foreign aid has a positive effect on economic growth; (II) the degree of corruption influences the effect of foreign aid on economic growth; (III) diminishing returns on foreign aid exist; and (IV) foreign aid influences economic growth through investments in capital.

Unfortunately, none of these hypotheses can be confirmed in this thesis. The first hypothesis, stating that foreign aid has a positive effect on economic growth, can't be confirmed when a reasonable significance level is taken into account. This is in line with Bauer (1972), Shleifer (2009) and Guillaumont and Guillaumont Jeanneny (2007). Although this study did not find a relationship between foreign aid and economic growth in Sub-Saharan countries, directly nor indirectly, this doesn't mean that foreign aid is useless. Other papers, using different methods and different datasets did show a positive relationship. Therefore, more research is suggested to reach consensus on the effectiveness of foreign aid.

The hypothesis stating that the degree of corruption influences the effectiveness of foreign aid (II) cannot be confirmed either. The interaction term between foreign aid and policy is not significant, such that we aren't able to reject the null hypothesis that the interaction term has zero influence on economic growth. This implies that developed countries should allocate their foreign aid regardless of the recipient countries' institutions.

The same goes for the existence of diminishing returns: despite the increased significance when adding the investment output ratio into the regression, this study does not provide evidence that diminishing returns on aid exist. Therefore, developed countries do not have to worry about allocating foreign aid to a recipient country that already receives a lot of aid.

Regarding the hypothesis (IV), this study does find a decrease in the Aid/GDP coefficient when adding the investment output ratio as a control variable into the equation. This indicates that part of the received foreign aid influences economic growth through investment. However, again, both coefficients are only true for a significance level greater than 0.1. Therefore, we have to reject

hypothesis (IV) as well. We can not say whether foreign aid might effect growth through the amount invested in capital.

Limitations & recommendations

First of all, the total official development assistance (ODA) divided by GDP was used as the indicator of the amount of foreign aid. ODA, however, includes different sorts of foreign aid, which are not all directed at increasing economic growth. For example, ODA also includes humanitarian aid that countries receive after a natural disaster. This natural disaster will most probably decrease economic growth in these countries, while the amount of aid increases. If data on these different kinds of aid becomes available, the effectiveness of foreign aid that is directed at economic growth can be assessed separately from aid that does not have growth as its main objective.

Furthermore and most importantly, this study uses a lagged variable, GDP Growth (t-1), in a fixed effect least squares model, while the studies period only consists of 14 years. The lagged dependent variable will be correlated with the error term and therefore bias the coefficients of all the dependent variables (Arellano & Bond, 1991). This bias, called the Nickell-bias, has to be taken into account when interpreting the coefficients. In a next study, this Nickell-bias can be solved by using GMM/IV estimators (Sandler & Sul, 2013).

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Appendices

Tables

Table A: ADF test

	Statistic	Probability
Fisher Chi-square	209.818	0.0000
Choi Z-statistic	-7.53376	0.0000

Table B: Correlations table

	GDP Growth	Aid/GDP	CPI*Aid	Openness	CPI
GDP Growth	1				
Aid/GDP	0.062	1			
CPI*Aid	-0.006	0.572	1		
Openness	0.094	-0.126	-0.220	1	
CPI	0.210	-0.196	-0.780	0.170	1
Aid^2	0.021	0.784	0.811	-0.247	-0.330

Tabel C: Results regressions

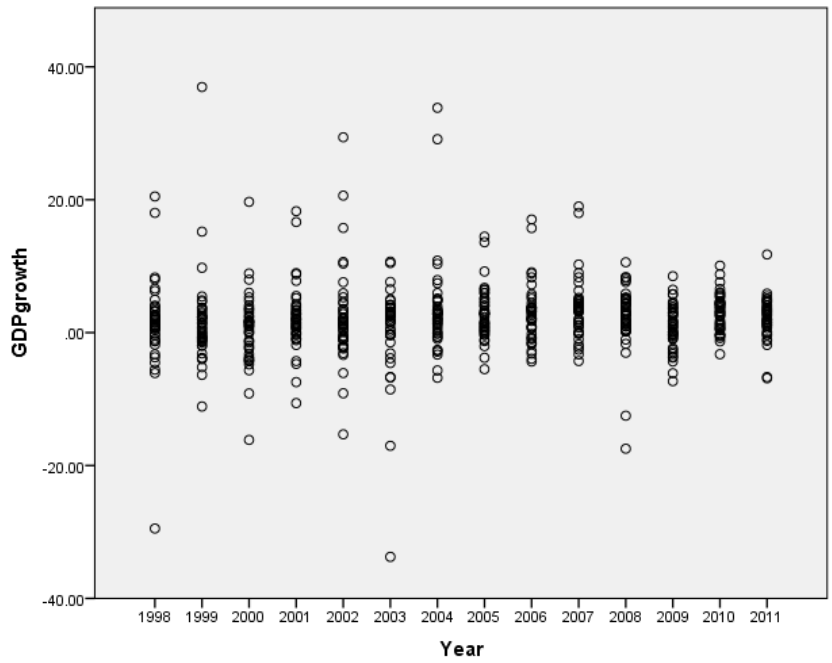
	Model 1	Model 2	Model 3	Model 4
Constant	-1.432 (2.284)	0.604 (2.490)	-1.556 (2.632)	1.008 (2.745)
CPI	-0.018 (0.753)	0.168 (0.634)	0.002 (0.817)	0.212 (0.682)
Aid/GDP	4.432* (3.449)		4.050* (2.567)	
CPI*Aid	-0.116 (0.179)		-0.096 (0.188)	
Openness	0.025* (0.017)	0.026* (0.018)	0.026* (0.019)	0.027* (0.019)
GDP Growth (-1)	0.137*** (0.051)	0.142*** (0.051)	0.152*** (0.054)	0.157*** (0.053)
Aid squared		0.214 (0.320)		0.364* (0.252)
Investment output ratio			0.003 (0.057)	0.004 (0.057)
R^2	0.4037	0.4024	0.506	0.5061

Dependent variable: GDP per capita growth (%)

Note: * and *** respectively indicate a p-value <0.2 and <0.01

Figures

Graph A: GDP growth/capita plotted against time to determine the form of the ADF test



Graph B: Residuals plotted against time to show homoscedasticity