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Aid and Capital Investment

Effects of sector allocated aid on firm-level investment in the Least Developed Countries.

Bachelor Thesis in Economics

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Abstract

This paper explores the impact of foreign aid on firm investment in physical capital using a dataset of 10 783 firms in 21 of the least developed countries. Using data from the World Bank Enterprise Surveys combined with sector allocated Official Development Assistance obtained from OECD CRS, no significant effect of aid was found. Fixed effects for country, sector and year did not change this result, nor did country clustered standard errors. The result is robust to various checks and the benchmark logit model passed both the linktest and the Hosmer-Lemeshow test for model specification and goodness-of-fit. Possible indirect effects of aid were investigated and aid was found to neither affect institutional quality nor infrastructure. The failure to find indirect effects of aid on firm capital investment by positively or negatively affecting investment climate through institutions and infrastructure supports the result of the benchmark regression, that aid does not have a significant effect on firm capital investment.

Keywords: Foreign aid, Official Development Assistance, Firm capital investment, Constraints to private sector, Least Developed Countries.

Table of Contents

1. Introduction

The effect of aid has been highly debated over the last decades. Despite numerous papers and studies written on the subject no general consensus has emerged. Some economists argue that aid has a positive effect on capital investment by relieving different constraints firms face by lowering financial constraints, improving infrastructure and contribute to better market access (Chauvet & Ehrhart, 2014, pp. 5-6; Dollar & Easterly, 1999). On the other hand some argue that it has a negative effect by distorting incentives, weakening institutions and encouraging rent-seeking activities (Economides, Kalyvitis, & Philippopoulos, 2008, pp. 1-2; Herzer & Grimm, 2012). Since foreign aid is primarily targeted at countries most studies have been conducted at an aggregated level and thereby paying little attention to the effects of aid on the real engine of growth; individual firms and the private sector.

There are many theories behind the lack of consensus on the effect of aid, most of which are related to country specific characteristics. Infrastructure, macroeconomic policies, institutions and exposure to external shocks are just some of these. Most studies concerning this topic are made on an aggregate level and this can create problems related to reversed causality or simultaneity. Aid is often targeted at countries with low growth or low investments, hence countries with low growth and low investment typically receive more aid. By studying the effect of aid on a disaggregated level this significantly reduces the risk of simultaneity. (Chauvet & Ehrhart, 2014, pp. 1-2)

In this paper the effect of aid in form of Official Development Assistance will be investigated on a disaggregated level. Instead of looking at capital investment made in a country I will look at the capital investment being made by individual firms in a number of sectors. Since private business is often referred to as the engine of growth it should be of interest to study aid efficiency using firm level data. This paper aims to study if the firms' choice to invest in physical capital is correlated with aid. By looking at firm and sector level data the risk of reverse causality or simultaneity is considerably lower. In this paper I build upon the existing literature on aid efficiency but rely on sector disaggregated aid-data to study the effect of aid on private firm capital investments. The effect of aid on firm capital investment is examined in a pooled cross-sectional dataset consisting of 10 783 firms in 21 of the world's least developed countries (LDCs). The LDCs are the biggest recipients of aid and are also the ones that need it the most. Studying the effects of aid in these countries is therefore especially important and that is why the focus of this paper lies on these countries.

The study is conducted by using firm-level data obtained from World Bank Enterprise Surveys (WBES) and combining that with the Official Development Assistance (ODA) the respective countries receive and how it is allocated between different sectors. This approach is very different from the majority of the previous research made on this topic. Chauvet and Ehrhart (2014) use a similar dataset and method in their paper about aid and firm sales-growth but as far as I can tell it has not yet been used to investigate firm capital investment. The model will, besides variables for aid and firm specific characteristics include variables for how infrastructure and institutions are perceived by the respective firms. Fixed effects for country, sectors, and year will be used to control for heterogeneity related to unobservable country-, sector-, and year-varying characteristics that would otherwise induce an endogeneity bias. Country clustered standard errors will be used because observations within countries are likely to be correlated and this controls for heteroscedasticity.

The main research question of this study is: "Does sector allocated aid in form of Official Development Assistance affect the likelihood of firm investment in physical capital in the Least Developed Countries?" Two hypotheses are stated below.

H_0: Aid significantly affects the likelihood of firm capital investment

H_1: Aid does not affect the likelihood of firm capital investment

This paper finds no significant effect of aid on firm capital investment and this result is robust to various checks for endogeneity, multicollinearity and model specification. Further, aid does not appear to affect the investment climate the firm operates in. This was examined with regressions using infrastructural and institutional proxies as dependent variables. This means that this paper finds neither a direct nor indirect effect of aid on firm capital investment hence the null hypothesis is rejected.

The rest of the paper is structured as follows: first a review of the literature is presented in Section 2 followed by some background (Section 3). Theory is presented (Section 4) and Data and method is described (Section 5). Benchmark results are presented in Section 6 and are followed by robustness checks, result diagnostics and an assessment of the indirect effects of aid (Section 7). Finally, Section 8 concludes the paper.

2. Literature review

A large body of literature on aid efficiency has emerged over the last decades, most of which study the effect of aid on aggregate, country-level investment. The results vary greatly depending on which methods and countries used. Several authors found a positive relation between aid and investment under certain conditions (Hadjimichael, Ghura, Muhleisen, Nord, & Ucer, 1995; Dollar & Easterly, 1999). Others found a significant negative relation (Herzer & Grimm, 2012; Munemo, 2011). The results of previous research conducted on this topic have been largely criticized for the lack of robustness of the results, on two grounds (1) endogeneity has not always been addressed properly; (2) effects of aid are studied at an aggregate level which makes the real effects of aid difficult to assess, in other words, it is unclear exactly what is being affected by aid and how it is tied to investments. (Chauvet & Ehrhart, 2014, p. 4). Endogeneity is a well-recognized problem, as mentioned before aid is often targeted at countries with low growth or low investments hence countries with low growth and low investment typically receive more aid. Some authors like Munemo (2011) and Herzer & Grimm (2012) have tried to tackle this problem with complex instrument variables for aid and have both found negative effects of aid on private investment. The second type of critique has been addressed by disaggregating the effects of aid and look on how specific investment related factors are affected and in which conditions aid is effective. Economides et al. (2008) found that aid has a direct positive effect on investment by improving access to finance but also that aid indirectly distorts incentives to invest by encouraging rent-seeking and corruption. Dollar & Easterly (1999) found that aid has a positive effect on investment if the economic policy environment is good but that too much aid over a long period of time has the reversed effect.

Table 1 Previous Research

Author	Method	Dependent variable	Independent variable	Result
Mahdavi (1990)	OLS. Cross-section data for 8 countries	Private investment	Aid	Finds a positive but insignificant relation between aid and private investment
Hadjimichael et al. (1995)	Multiple regression for 41 Sub Saharan African countries 1986-1993	Private investment	Aid	Finds positive impact for countries under structural adjustment and negative for countries with negative per capita growth

Dollar and Easterly (1999)	Pooled cross-section data OLS regressions for 49 countries	Private investment	Aid and policy	Finds a positive effect of aid on private investment in a good economic policy environment, but this effect is subject to diminishing returns; the marginal impact of aid declines and becomes negative at high volumes of aid.
Economides et al. (2008)	Multiple regressions on pooled cross-section data of 75 aid-recipient countries 1975-1995	Private investment, growth, rent-seeking	Aid and rent-seeking	Finds a positive effect of aid on growth and investment but the effect is mitigated by a positive effect of aid on rent-seeking
Munemo (2011)	General equilibrium model of international trade and using instruments for aid. Focus on Africa	Domestic private investment	Aid, price of international goods imported, government policies and regulations	Finds a negative relation between aid and domestic private investment
Herzer and Grimm (2012)	Bivariate Panel co-integration and causality technique for 39 countries 1970-1999	Private investment	Aid	Finds a significant negative effect of aid on private investment.

This paper uses firm-level data combined with sector allocated aid and therefore takes a very different approach compared to most previous research. By looking at firm-level data the effects of aid are easier to assess compared to country-level data. Endogeneity bias is also a smaller issue when working with firm-level because simultaneity and reversed causality is less likely compared to country-level data but can of course still not be ignored as a potential problem.

3. Background

The least developed countries are identified using three criteria: gross national income per capita, human assets index and economic vulnerability index (United Nations, 2015). The least developed countries generally have insufficient domestic resources to finance their investment and development projects. Richer countries have for various reasons decided to help these countries whether they may be humanitarian, economic or political. (Herzer & Grimm, 2012, p. 1)

Private businesses in the least developed countries face three main constraints to investment: (1) financial constraints, (2) the macroeconomic and institutional environment and business climate, (3) and infrastructure (Chauvet & Ehrhart, 2014, p. 5). The private sector in the least developed countries is characterized by informality and generally lack institutions required for a functioning market economy. Private firms have to deal with excessive government bureaucracy and have limited access to the capital and technology needed to be competitive in a globalized economy. The various taxes imposed on the private sector are believed to discourage investments and private firms often face more opposition than support by the governments in these countries. The banking system is not well-developed hence liquidity cannot be allocated efficiently within the private sector (Brazilian agency for cooperation / Ministry of foreign affairs, 2000, p. 4). Building a sound private sector requires strong foundations in the global and domestic macro environments, physical and social infrastructure and rule of law. An open exchange of goods, capital and technology stimulates the development of the private business sector. Many developing countries have excessive anti-competitive policies in place to "protect" domestic firms even though there is a broad consensus that a more open market supports economic growth and productivity. Access to imported goods could make capital investments cheaper and increase the productivity of domestic firms. The domestic macro environment is poor in the LDCs; hence provides a weak foundation for the private sector. These countries are often plagued with political instability and bad governance. They also generally experience poor physical and social infrastructure. Their legal system is often ill-functioning making transactions riskier and gives rise to corruption and rent-seeking activities which disturb prices and makes the market less efficient. (United Nations, 2004, pp. 13-18)

Official Development Assistance (ODA) is a form of foreign aid aimed at promoting economic development and welfare. The Development Assistance Committee (DAC) defines ODA as:

"those flows to countries and territories on the DAC List of ODA Recipients and to multilateral institutions which are:

(i) Provided by official agencies, including state and local governments, or by their executive agencies; and

(ii). each transaction of which (a) is administered with the promotion of the economic development and welfare of developing countries as its main objective; and (b) is concessional in character and conveys a grant element of at least 25 per cent." (OECD, 2016)

ODA is received by many countries and has had a real positive impact on many, however those countries where the effects are seen the least are also the countries that need it the most, the least developed countries. The effects in the LDCs have also been uneven and difficult to determine beforehand. (OECD, 2014)

4. Theory

Previous research is divided when it comes to the effect of aid and so is the theory. Basically, there are three different theoretic approaches to the efficiency of aid. The aid positivist approach is based on the importance of funds available for investment and how aid can in a good investment climate help relax constraints to investment. The aid pessimist approach argues that aid deteriorates the investment climate of countries by encouraging corruption and decrease incentives to invest. The aid conditionality approach argues that country specific characteristics, like the quality of institutions play a crucial role of aid efficiency.

4.1 Aid positivist approach

Capital accumulation is of vital importance to economic growth. Capital is accumulated when some proportion of present income is saved and invested in order to augment future output and income (Todaro & Smith, 2015, p. 149). The capital stock of firms is used for production and also allows for investments in new physical capital that will in turn generate future growth and increased output.

In very poor countries most income is spent on meeting current needs, thereby leaving little left for investment. With a lack of investments in physical (and human) capital production cannot be increased and incomes cannot be raised. This process is commonly referred to as the "vicious circle of poverty" (Soubbotina, 2000, p. 33). Several factors are known to increase domestic savings and investments; political and economic stability, good government policies, institutions and a functioning and reliable banking system are some examples. However, these factors are generally not present in the least developed countries. (Soubbotina, 2000, pp. 32-34)

Since the domestic savings rate in developing countries is usually low the amount of investments are relatively small. Foreign aid could fill the savings gap. Financing investments with aid money instead of savings should increase the capital available for production and investment in the developing country and thereby increase its growth. (Dollar & Easterly, 1999, pp. 546-548)

The two-gap model is a model of foreign aid comparing savings and foreign exchange gaps to determine which the binding constraint on economic growth is and how foreign aid can help fill this gap. Developing countries face either a shortage of domestic savings to match investment opportunities or a shortage of foreign exchange to finance needed imports of capital for investments. (Todaro & Smith, 2015, pp. 751-752)

Derivation of the Two-Gap Model:

Y=C+I+(X-M) **Y=GDP; C=Consumption; I=Investment; X=Exports; M=Imports**

Y+M (Source of resources used in the economy) = C+I+X (Uses of resources in the economy)

Y-C+M=I+X **Y-C=S and S=Savings → S+M=I+X → M-X=I-S**

I-S (Savings Gap) = M-X (Foreign Exchange Gap)

I=S+ (M-X)

(Mossie, 2014, p. 7)

The first gap in this model is the saving gap, the gap between the amount of investment necessary to attain a certain rate of growth and the available domestic savings. The second gap is the foreign exchange gap occurring when there is a gap between the required imports for a certain production and foreign exchange earnings in form of exports. Even if one gap is small the country still faces a binding constraint on growth by the other gap since investment is a function of both savings and net exports. However, foreign aid can only effectively close these gaps if the country in question is only constrained by liquidity and the incentives to invest are high (Kabete, 2008, p. 20). If the incentives for investment are low, for example due to a poor investment climate in form of ill-functioning infrastructure, the aid will instead be used to finance consumption.

Aid is commonly given to governments. The aid the government receives should relax the financial restrictions they face and thereby create incentives for lowering taxes. Aid can

replace taxes for public expenditures. Reduced taxes imply that more resources are available for investments in the private sector. Aid could also be used by the government to finance investments in infrastructure and other factors which promotes private sector investments. (Herzer & Grimm, 2012, p. 10)

4.2 Aid pessimist approach

A prevalent explanation for the common failure of aid is that foreign aid is often misused and misappropriated. It can foster rent-seeking and corruption in recipient countries. Aid inflows can reduce the government accountability, encourage corruption and weaken institutions. The idea behind this is that foreign aid transfers increase the size of the prize that interest groups fight over (Economides, et al., 2008, pp. 1-2). Economides et al. found a significant effect of aid on rent-seeking and also found that a large public sector increases this effect.

Cambodia is an example of how aid has been misused. According to the World Economic Forum, foreign aid has had the reverse effect on development in Cambodia over the last two decades and Cambodia has among the highest corruption indexes in the world. It has been found that Cambodia has the resources to develop on its own but due to the extreme corruption partly fueled by foreign aid it fails to do so. (Ear, 2012)

4.3 Aid conditionality approach

When attempts have been made trying to determine why aid is more effective in some countries than others research has pointed towards the difference between country specific characteristics of the recipient countries. Research by Burnside and Dollar argues that foreign aid is effective in a good policy environment and says that without good macroeconomic policies and institutions aid is meaningless. (Burnside & Dollar, 2000, p. 1)

Functioning institutions are important for the private sector to operate effectively. Institutions lower transaction costs by reducing uncertainty and establishing a stable economic structure to facilitate interactions, thus helping to allocate resources effectively and provide a good investment climate. If the institutions are not functioning the incentives for investments are lower (Herzer & Grimm, 2012, pp. 10-11) and as previously stated the incentives to invest are of vital importance for the effectiveness of the Two-gap model.

5. Data and Method

This paper uses a pooled cross-sectional dataset consisting of firm and aid data for different countries and different years. Pooled cross-sectional data should not be confused with panel data which would contain observations of the same country or firm for multiple time periods.

The World Bank Enterprise Surveys collects information about a country's business environment, how it is experienced by individual firms as well as information about firm performance and their current situation regarding capital, sales, infrastructure, sector etc. In this paper, the World Bank standardized data from year 2006 to 2014 is used. This data consists of multiple surveys conducted between 2006 and 2014 using the same standardized questionnaire and methodology for all countries included (The World Bank, 2014). It is worth noting that because this is survey based data some measurement errors should be expected. When cleaning up the dataset surveys conducted before 2010 were removed to make the data easier to work with. Since the dataset contains data on countries beyond the scope of this paper these were also removed. The countries left were those that the United Nations classifies as the least developed countries (LDCs). Further, some of these countries were also removed because of incomplete or missing data, this resulted in a total of 10 783 firms in 21 countries.

Because several variables in the dataset were valued in local currency units and the surveys were conducted in different years for different countries these values were converted to 2011 US-dollars and adjusted for purchasing power using the PPP-conversion factor available on the World Bank website (The World Bank, 2016).

The aid data used in this paper comes from the OECD Creditor Reporting System (CRS) and is classified as Official Development Assistance (ODA) (OECDstat, 2016). The CRS contains data on aid targeted at different sectors within different countries. It should however be noted that the CRS sector definition is slightly different from the sector definition in the WBES. This problem has been solved by grouping several CRS defined sectors into one in order to fit the WBES dataset, this resulted in 11 sectors. The appendix contains further information about the sector definitions. The aid data in the CRS is valued in 2014 US-dollars but have in this paper been converted into 2011 US-dollars and adjusted for purchasing power in respective country.

Most of the survey questions that are of interest in this paper, particularly the question about capital investment, are asked in a way that the respondent answer based on the firm’s situation

the year before the survey was conducted. For example, the question about whether the firm invested in capital is asked whether the firm invested in capital last year. Because of this the aid flows have also been connected to the year before the survey was conducted so that the aid flows and capital investments are for the same year. All missing observations and survey questions answered with “Don’t know” or “Does not apply” have been excluded when constructing the variables to achieve a balanced dataset for the regressions. This could potentially lead to a sample selection bias due to a non-random observation selection which could make some type of firms more likely than others to be included in the sample. However, keeping these missing observations would not make sense because the answers “Don’t know” and “Does not apply” would influence the result in an unpredictable way. If for example a firm does not know if it invested in capital the previous year this could not be assigned as a number in the variable and included it in the regression. The variable for capital investment is binary and either takes the value 1 or 0 depending if the firm invests or not.

The effect of aid on firm capital investment will be investigated using a logistic regression. The logit model is used to estimate the probability of firm capital investment based on several independent variables. The logistic regression is commonly used when the dependent variable is binary; meaning it only takes the values 0 and 1. When the event is occurring, in this case when the firm invests in capital, the dependent variable takes the value 1. The independent variables are chosen based on what is believed to affect the probability of the firm’s choice to invest in capital. The regression will use aid as the main independent variable and investigate how aid affects the probability that a firm will invest in capital. A probability always embodies uncertainty and this uncertainty comes from the variables not included in the model. A relatively large number of control variables have been included in the model to decrease the uncertainty but since capital investment is determined by so many factors this uncertainty can never be completely eliminated. Binary regression models like logit are less powerful than the OLS according to the Gauss-Markov theorem and require larger samples sizes (StatisticsSolutions, 2015) . Luckily, this paper works with a very large sample consisting of more than 10 000 observations.

5.1 Endogeneity and unobserved heterogeneity

As with all research using econometric tools the potential problem of endogeneity must be addressed. Endogeneity arises when there is a correlation between an explanatory variable and the error term. There are several reasons endogeneity might arise but two of the most common are omitted-variable bias and simultaneity. Omitted-variable bias occurs when there is a

variable correlated to the dependent variable that is missing from the model. This leads to a bias due to the fact that the model "compensates" for the missing variable and this will lead to an over- or underestimation of the effect of another explaining variable. A model suffers from simultaneity when an explanatory variable is correlated with the dependent variable but the dependent variable is also correlated with the explanatory variable, this is a serious problem and cannot be solved by adding more control variables (Simcoe, 2012).

A firm's choice to invest in capital depends on countless factors and no dataset could possibly contain all factors that influence this choice. Therefore, omitted-variable bias is a very present problem in these types of studies. Proxy variables can mitigate omitted-variables bias (Woolridge, 2002, p. 63) therefore several proxy variables aimed at capturing the investment climate the firms operate is included. These proxies are used to reflect obstructions related to infrastructure and institutions. There are however other unobserved variables we do not have proxies for that are likely to effect the result. An omitted variable may cause a heteroskedastic error because the portion of the omitted effect not represented by included explanatory variables may be absorbed by the error term.

Simultaneity is likely not an issue for this paper because aid and investments are not studied at an aggregate level. The investments are made by firms and the aid is allocated to sectors. The individual firm's choice to invest should not affect the aid allocated to a sector because when aid is given by the donor countries they do not take individual firms' investment into account but rather look on the need for aid in entire sectors and investments are far from the only factor taken into account when providing aid. However, even if simultaneity is unlikely in this paper we can never be completely sure. Using an instrument variable for aid would take care of this problem but finding a suitable instrument for aid is not easy and is beyond the scope of this paper. Reversed causality between the dependent variable and the control variables is also unlikely.

Unobservable heterogeneity implies that there is one or more unmeasured characteristics of some observations that will induce endogeneity due to omitted-variable bias (Zohoori & Savitz, 1997). This paper uses fixed effects to control for unobservable systematic differences between countries, fixed effects for years to control for macro-shocks and fixed effects for sectors to control for example differences in risk and performance across different sectors.

5.2 Standard errors, Heteroscedasticity and Clusters

The correct estimation procedure of the standard errors is given by the underlying structure of the data. If the observations do not have a constant distribution of error terms the data suffers from heteroscedasticity. There could also be a phenomenon that affects observations individually, but they affect groups of observations uniformly within each group, this implies clustered data. Failure to control for within-cluster error correlation can lead to very misleadingly small standard errors, and consequent misleadingly narrow confidence intervals, and falsely low p-values (Cameron & Miller, 2013, pp. 1, 21-23). In this dataset there are unobserved effects related to all firms within one country but these effects are not transferred to firms in other countries, therefore it makes sense to assign countries the role of clusters. This means that we assume an independence of firms between countries but correlation between firms within the countries. The STATA command VCE (cluster) is used to assign the cluster in which the unobservable effects are allowed to correlate. The cluster command automatically corrects for heteroscedasticity (Miles, 2014). An argument could also be made for clustering the standard errors of the sectors but since the sectors are nested within the countries it is generally recommended to cluster at the highest level (Cameron & Miller, 2013, p. 21), countries.

5.3 Model specification

Below is the main model used in this paper. The model consists of 14 variables in total and aims to capture what determines a firm's likelihood of investing in capital.

$$CAPITALINVESTMENT_{i,k,j}=\beta_1+\beta_2 ODA_{k,j}+\beta_3 FOREIGN_{i,k,j}+\beta_4 SALES_{i,k,j}+\beta_5 LOAN_{i,k,j}+\beta_6 BANKACCOUNT_{i,k,j}+\beta_7 FIRMSIZE_{i,k,j}+\beta_8 TRUST\_IN\_LEGALSYSTEM_{i,k,j}+\beta_9 TAX\_OBST_{i,k,j}+\beta_{10} TRANSPORT\_OBST_{i,k,j}+\beta_{11} TRADE\_OBST_{i,k,j}+\beta_{12} ELECTRICITY\_OBST_{i,k,j}+\beta_{13} CORRUPTION_{i,k,j}+\beta_{14} INSTABILITY_{i,k,j}+\mu_j+\tau+\kappa_k+\varepsilon_{i,k,j}$$

The dependent variable $CAPITALINVESTMENT_{i,k,j}$ is binary and takes the value 1 when firm i in sector k and country j invest in physical capital. The main explaining variable $ODA_{k,j}$ is the aid allocated to sector k in country j. The fixed effects included in the model are μ_j for country fixed effect, τ for year fixed effect and κ_k for sector fixed effect.

5.4 Variables

Below is a description of the variables used in this paper. The variables have been chosen with the least developed countries in mind. All variables except ODA are constructed using the data available in the WBES.

5.4.1 Dependent variable

- $CAPITALINVESTMENT_{i,k,j}$. Capital investment is a dummy variable that tells us whether or not the firm invested in physical capital the year before the survey was conducted. The observations are binary; if the firm did invest the variable takes the value 1, if it did not invest it takes the value 0.

5.4.2 Independent variable

- $ODA_{k,j}$. This variable is the aid allocated to the different sectors and was gathered from OECD CRS. The variable has been specified as a percentage of the respective country's ppp-adjusted GDP. This was done because the absolute value of aid doesn't say much without the size of the recipient country's economy to compare with.

5.4.3 Control variables

Several control variables are used to investigate how firm specific variables as well as variables related to infrastructure and institutions affect capital investment.

Firm specific variables:

- $FOREIGN_{i,k,j}$. This dummy variable is used to determine whether foreign ownership has a significant effect on the likelihood of firm capital investment. Firms with foreign owners could be more prone to invest because the firm's financial restrictions might be lower. This is especially likely if the foreign owner is located in a richer country and can inject liquidity if needed.
- $SALES_{i,k,j}$. Higher sales imply higher revenue that could be used for investments in physical capital needed to expand the business or replace old physical capital like worn out machines. The local currency units were converted into ppp-2011 US-dollars and the variable was constructed as a logarithm to make the observations symmetrically distributed and thereby avoiding a result driven by outliers.
- $LOAN_{i,k,j}$. Whether or not the firm has a line of credit or a loan from a financial institution reflects the financial constraint the firm face. Firms that have this face less liquidity obstacles hence are more likely to invest.

- $BANKACCOUNT_{i,k,j}$. Having a bank account at a financial institution is necessary for easier transactions. Although alternative means of transaction like cash and mobile payments are available the lack of a bank account is likely to make business operations and investments more difficult.
- $FIRMSIZE_{i,k,j}$. This dummy variable has been constructed to observe whether the size of the firm determined by number of employees have an effect on capital investments. In the WBES the firm sizes are split into three categories: small firms with 5 to 19 employees, medium firms with 20 to 99 employees and large firms with over 100 employees. The real number of employees is not available in the dataset. The dummy variable has been specified as follows; Small firms are given the value 0 and large and medium sized firms are grouped together and given the value 1. Bigger firms engage in more production and are therefore more likely to invest in capital.

Firm specific variables regarding institutions and infrastructure:

- $TRUST\_IN\_LEGALSYSTEM_{i,k,j}$. This variable is constructed based on the survey question about the perceived quality of the legal system and whether it is considered fair, impartial and uncorrupted. The higher the value of this variable the more trust the firm has in the legal system. This variable is also a proxy for the quality of institutions and is expected to have a positive correlation with firm capital investments because higher trust implies better investment climate.
- $TAX\_OBST_{i,k,j}$. Taxes are believed to negatively affect investments as taxes decrease the firm's funds available for investment. The variable is constructed based on a survey question about how much of an obstacle tax is perceived to be. The higher value of this variable the greater is the perceived tax obstacle.
- $TRANSPORT\_OBST_{i,k,j}$. Poor infrastructure is believed to be a bottleneck to the private sector in many of the least developed countries. This variable captures to what degree transportation is an obstacle for the firms and act as a proxy for general infrastructure. The variable is constructed based on a survey question about how much of an obstacle transport is perceived to be.
- $TRADE\_OBST_{i,k,j}$. Trade obstacles in form of poor trade infrastructure, customs or import and export regulation are expected to decrease the likelihood of capital investments as they make foreign physical capital and production inputs less accessible and/or more expensive. The variable is constructed based on a survey

question about how much of an obstacle customs and trade regulations are perceived to be.

- $ELECTRICITY\_OBST_{i,k,j}$. This variable is constructed using the number of power failures the firm experience on average per month. This is another proxy for infrastructure. The lack of a well-functioning power grid should imply a lack of well-functioning infrastructure and an obstruction to the private sector.
- $CORRUPTION_{i,k,j}$. If the firm considers corruption as a present obstacle to its operation the firm is expected to invest less in capital. The motivation for this is that corruption is disturbing the market and resource allocation. The variable is constructed based on a survey question and takes the value 1 if corruption is perceived as an obstacle and 0 if it is not.
- $INSTABILITY_{i,k,j}$. Political instability implies weak institutions and is believed to discourage investments because it increases the risk of the transactions and operation. The variable is constructed based on a survey question and takes the value 1 if political instability is perceived as an obstacle to business operations and 0 if it is not.

With exception to the electricity variable, the rest of the variables for institutions and infrastructure are based on firms' perceptions of the institutional and infrastructural quality. This means that the quality of institutions and infrastructure are determined by how much of an obstacle these factors are considered to be by the individual firms and are not based on any country index for quality of institutions and infrastructure. The World Bank (2005) recognizes that when trying to measure institutions and infrastructure as factors affecting investment climate in a country you face several challenges. Some factors are inherently difficult to measure, for example corruption and the quality of the legal system. Secondly, the importance of certain institutions and infrastructure may differ and be more important to some firms than others. Firms engaged in exporting are likely far more affected by trade infrastructure and customs than others and firms operating in the manufacturing sectors may be more dependent on a functioning power grid than those that operate in the service sectors. The geographical location of the firm is also a factor that needs consideration. Even if a country as a whole provides good infrastructure some firms might be located in a region with a very poor infrastructure. The World Bank (2005) argues that using objective and perception based measures of investment climate have the advantage of allowing more precise and consistent benchmarking of conditions as the firm ultimately makes the decision whether to invest in

capital based on its own perception of its current situation and the obstructions it faces. (The World Bank, 2005, p. 269)

5.5 Descriptive statistics

Table 2 contains a summary of all the variables used in this paper, what type of variables they are, number of observations, mean and standard deviation as well as their respective minimum and maximum value.

Table 2 Descriptive statistics

Variables		n	Mean	S.D	Min	Max
$CAPITALINVESTMENT_{i,k,j}$	dummy	10670	0.36	0.36	0	1
$ODA_{k,j}$	% of GDP	8708	0.15	0.005	4.80e-06	3.97
$FOREIGN_{i,k,j}$	dummy	10783	0.13	0.34	0	1
$SALES_{i,k,j}$	logarithm	8675	17.43	3.07	-0.57	27.21
$LOAN_{i,k,j}$	dummy	10406	0.24	0.43	0	1
$BANKACCOUNT_{i,k,j}$	dummy	10658	0.80	0.40	0	1
$FIRMSIZE_{i,k,j}$	dummy	10783	0.49	0.50	0	1
$TRUST\_IN\_LEGALSYSTEM_{i,k,j}$		8446	2.26	0.98	0	4
$TAX\_OBST_{i,k,j}$		10557	1.64	1.27	0	4
$TRANSPORT\_OBST_{i,k,j}$		10402	0.19	0.40	0	4
$TRADE\_OBST_{i,k,j}$		9900	1.37	1.26	0	4
$ELECTRICITY\_OBST_{i,k,j}$		10734	19.56	31.35	0	551
$CORRUPTION_{i,k,j}$	dummy	10326	0.38	0.49	0	1
$INSTABILITY_{i,k,j}$	dummy	9732	0.20	0.40	0	1

6. Results

Table 3 illustrates the results for regression 1 and 2. Regression 2 should be considered the main regression and is the one that will be analyzed. Regression 1 is presented for comparison. Unlike regression 1 regression 2 is run using fixed effects for country, sector and year as well as clustered standard errors for country. The comparison between the models illustrates the importance of fixed effects for isolating unobserved differences between countries, sectors and years that affects the result. Regression 1 is very likely to suffer from

heteroscedasticity because the standard errors are neither robust nor clustered. Since coefficients are not easy to interpret in binary regressions they have been converted into marginal effects using STATA Delta-method and presented in Table 3. A table of the coefficients has been posted in the appendix.

Table 3 Benchmark results, Marginal effects

VARIABLES	(1) $CAPITALINVESTMENT_{i,k,j}$ Logit	(2) $CAPITALINVESTMENT_{i,k,j}$ Logit Fixed Effects
$ODA_{k,j}$	0.0200	0.00235
	(0.0178)	(0.0144)
$FOREIGN_{i,k,j}$	0.0425	0.0266
	(0.0285)	(0.0363)
$SALES_{i,k,j}$	0.0235***	0.0223***
	(0.00340)	(0.00678)
$LOAN_{i,k,j}$	0.180***	0.194***
	(0.0197)	(0.0169)
$BANKACCOUNT_{i,k,j}$	0.0325	0.0751***
	(0.0251)	(0.0245)
$FIRMSIZE_{i,k,j}$	0.0472***	0.0542**
	(0.0186)	(0.0234)
$TRUST\_IN\_LEGALSYSTEM_{i,k,j}$	0.00574*	0.00485
	(0.00937)	(0.0182)
$TAX\_OBST_{i,k,j}$	0.0174*	0.0182
	(0.00794)	(0.00854)
$TRANSPORT\_OBST_{i,k,j}$	0.0930	0.0829
	(0.0230)	(0.0277)
$TRADE\_OBST_{i,k,j}$	0.00747	0.0102
	(0.00801)	(0.00976)
$ELECTRICITY\_OBST_{i,k,j}$	-0.000938***	-0.000556**
	(0.000268)	(0.00233)
$CORRUPTION_{i,k,j}$	-0.0711***	-0.0617**
	(0.0202)	(0.0249)
$INSTABILITY_{i,k,j}$	-0.0474*	-0.0447***
	(0.0236)	(0.0163)
Constant	-2.725***	-2.815***
	(0.482)	(0.504)
Pseudo R2	0.064	0.089
Observations	3,306	3,306

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

When analyzing the results from regression 2 we observe several variables that significantly affect firm capital investment and also have the predicted sign of the marginal effects, however the main explanatory variable ODA is not significant and the Pseudo R-squared

value is very low (0.09). No significant relation between ODA and capital investment is found.

The result shows that firms that are to some degree owned by foreign corporations, individuals or organizations are not more likely compared to completely domestically owned firms to invest in capital; however the p-value (0,121) was close to showing a weak positive correlation. When looking at regression 1 the variable for taxes gives a surprising result. Theory suggests that taxes are an obstruction to investments but in this regression it is shows a positive relation with investment implying that higher taxes increase the likelihood of firm capital investment. A possible explanation for this is that countries with higher taxes generally have better functioning institutions and infrastructure that in turn promotes investments. This is confirmed in regression 2 when fixed effects are used for countries. When fixed effects are used taxes do not significantly affect investment.

SALES, LOAN and BANKACCOUNT are all significant with positive marginal effects and therefore in line with theory. These three variables are related to the financial restrictions the firm faces. High sales, access to a loan and a bank account are all believed to lower financial restriction hence make the firm more likely to invest. The LOAN variable shows a large positive marginal effect, suggesting that access to loans is strongly related to capital investment. FIRMSIZE is also significant with a positive marginal effect. Bigger firms are more likely to invest than smaller firms.

Transport and trade obstacles appear to not affect the firm's likelihood of investing in capital. This result is not very intuitive. It could be that the firms included in this dataset are not relying very much on good transportation infrastructure and might not engage in trade hence are not effected by customs and trade regulations. Looking at the electricity obstacle firms' face it is however clear that infrastructure does effect capital investment. More frequent power failures have a significant negative effect on capital investment. Institutional quality is shown to be an important factor regarding investments. Two out of three variables used to investigate the correlation between capital investments and institutions shows a significant effect. Corruption and political instability significantly decrease the likelihood of firm capital investment. Even though all the significant variables show the predicted signs the marginal effects are often small meaning that the economic significance of these variables is low. For example, ELECTRICITY_OBST is significant but due to the very small marginal affect it barely affects the likelihood of capital investment.

7. Robustness and Result Diagnostics

For the result to be considered robust the model must have some flexibility to its specification. If the model is very sensitive and generates a very different result when minor changes are made to it the result cannot be considered robust. Table 4 contains five variations of the original model used to test the robustness of the result obtained from regression 2.

Table 4 Robustness Checks, Marginal effects

VARIABLES	(3) *CAPITALINVESTMENT*$_{i,k,j}$ Logit FE	(4) *CAPITALINVESTMENT*$_{i,k,j}$ Logit FE	(5) *CAPITALINVESTMENT*$_{i,k,j}$ Logit FE	(6) *CAPITALINVESTMENT*$_{i,k,j}$ Logit FE	(7) *CAPITALINVESTMENT*$_{i,k,j}$ Probit FE
$ODA_{k,j}$	0.00319	-0.0147	0.00835	0.00508	0.00328
	(0.0144)	(0.00954)	(0.0177)	(0.0134)	(0.0138)
$FOREIGN_{i,k,j}$		0.0192	0.0189	0.0279	0.0265
		(0.0332)	(0.0346)	(0.0350)	(0.0361)
$SALES_{i,k,j}$	0.0273***	0.0205***	0.0236***	0.0234***	0.0219***
	(0.00764)	(0.00565)	(0.00656)	(0.00653)	(0.00679)
$LOAN_{i,k,j}$	0.196***	0.182***	0.191***	0.200***	0.192***
	(0.0162)	(0.0137)	(0.0161)	(0.0147)	(0.0181)
$BANKACCOUNT_{i,k,j}$	0.0819***	0.0774***	0.0870***	0.0784***	0.0712***
	(0.0238)	(0.0255)	(0.0252)	(0.0249)	(0.0242)
$FIRMSIZE_{i,k,j}$		0.0584***	0.0500**	0.0527**	0.0548**
		(0.0204)	(0.0226)	(0.0210)	(0.0227)
$TRUST\_IN\_LEGALSYSTEM_{i,k,j}$	-0.00599		-0.00693	-0.00212	-0.00434
	(0.0181)		(0.0178)	(0.0177)	(0.0179)
$TAX\_OBST_{i,k,j}$	0.0177		0.0235*	0.0138	0.0175
	(0.00868)		(0.00755)	(0.00875)	(0.00858)
$TRANSPORT\_OBST_{i,k,j}$	0.0820	0.0684*		0.0766*	0.0826
	(0.0277)	(0.0277)		(0.0249)	(0.0284)
$TRADE\_OBST_{i,k,j}$	0.0112	0.0229*		0.00800	0.00996
	(0.00969)	(0.00767)		(0.00986)	(0.00967)
$ELECTRICITY\_OBST_{i,k,j}$	-0.000554**	-0.000678**	-0.00626**	-0.000613**	-0.00051**
	(0.00242)	(0.000273)	(0.000250)	(0.000242)	(0.000231)
$CORRUPTION_{i,k,j}$	-0.0611**	-0.0448*	-0.0419*		-0.0592**
	(0.0249)	(0.0241)	(0.0259)		(0.0246)
$INSTABILITY_{i,k,j}$	-0.0453***	-0.0122*	-0.0368***		-0.0444***
	(0.0159)	(0.0976)	(0.0136)		(0.0160)
Constant	-2.981***	-2.779***	-2.936***	-2.941***	-1.701***
	(0.552)	(0.415)	(0.444)	(0.500)	(0.302)
Pseudo R2	0.087	0.083	0.082	0.091	0.089
Observations	3,306	3,714	3,497	3,509	3,306

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

By comparing regression 3, 4, 5, 6, 7 with regression 2 we observe only small differences in the marginal effects and the significance of the variables is in most cases identical hence the result of the original model appears robust. Regressions 3, 4, 5, 6 are all run using two variables less than the original model. Regression 7 uses the same variables as the original model but is specified as a probit instead of a logit model. Both the probit and logit are binary probability models but assumes different distribution of standard errors. Probit and logit normally produce almost identical results and this case is no exception. If the different models produced very different results this would have been a cause for concern.

7.1 Multicollinearity

The problem of Multicollinearity arises when there are two or more explaining variables that are highly correlated with each other. This would make it difficult to separate the effect of the individual variables (Westerlund, 2005, pp. 160-161). An easy way to get an initial idea whether multicollinearity is a problem or not is to create a correlation table and look for variables that have a very strong correlation with each other. From the correlation table included in the appendix it appears that none of the variables used in this paper suffer from this problem. The highest observed correlation between two independent variables is 0,408. This is not enough to raise an alarm and most other variables showed a significantly lower correlation than this, often below 0,10. The correlation table suggests that multicollinearity is not a problem; however the correlation table can only give an indication. To be properly sure multicollinearity is not an issue a test for multicollinearity using the STATA command "collin" is used. The collin command is commonly used to detect multicollinearity in a logit model.

Table 5 Collinearity Diagnostics

Variable	VIF	SQRT VIF	Tolerance	R-Squared	Eigenval	Cond Index
$CAPITALINVESTMENT_{i,k,j}$	1.09	1.04	0.91	0.08	7.85	1.00
$ODA_{k,j}$	1.02	1.01	0.97	0.02	1.16	2.59
$FOREIGN_{i,k,j}$	1.12	1.06	0.89	0.11	0.96	2.85
$SALES_{i,k,j}$	1.22	1.10	0.82	0.18	0.87	2.99
$LOAN_{i,k,j}$	1.13	1.06	0.88	0.11	0.73	3.26
$BANKACCOUNT_{i,k,j}$	1.11	1.05	0.90	0.09	0.66	3.43
$FIRMSIZE_{i,k,j}$	1.17	1.08	0.85	0.14	0.57	3.68
$TRUST\_IN\_LEGALSYSTEM_{i,k,j}$	1.06	1.06	0.94	0.05	0.51	3.91

$TAX\_OBST_{i,k,j}$	1.31	1.15	0.76	0.23	0.44	4.21
$TRANSPORT\_OBST_{i,k,j}$	1.15	1.07	0.86	0.13	0.41	4.36
$TRADE\_OBST_{i,k,j}$	1.34	1.16	0.74	0.25	0.31	4.99
$ELECTRICITY\_OBST_{i,k,j}$	1.15	1.15	0.86	0.13	0.22	5.88
$CORRUPTION_{i,k,j}$	1.28	1.13	0.78	0.21	0.14	7.43
$INSTABILITY_{i,k,j}$	1.21	1.10	0.82	0.17	0.08	9.57

All measures above are measures of collinearity but without going into detail about how this test works, a rule of thumb is that if the tolerance is lower than 0,1 or the VIF is higher than 10 this is a cause for concern (Institute of digital reasearch and education UCLA , 2015). The results confirm that there are no variables that suffer from problematic collinearity, hence multicollinearity is not an issue for this paper.

7.2 Linktest for model specification

Before a model is relied upon to draw conclusions or predict future outcomes, the specification of the model must be tested. Due to the low Pseudo R-squared value in regression 2 the model appears to give a low explanation to what determines firm capital investments. The Stata command linktest is commonly used after binary regressions to detect specification errors related to the model. If the model is properly specified, one should not be able to find any additional predictors that are statistically significant except by chance. In short, Stata uses the linear predicted value (_hat) and linear predicted value squared (_hatsq) as the predictors to rebuild the model. The variable _hat should be a statistically significant predictor. This is usually the case unless the model has a completely wrong specification. On the other hand, if the model is properly specified, variable _hatsq shouldn't have much predictive power except by chance, so _hatsq shouldn’t be significant if the model is good and should preferably be as far from significant as possible. (Institute of digital reasearch and education UCLA , 2015)

The result of the linktest is illustrated in Table 6 and shows a significant value of _hat as it should and an insignificant value of _hatsq. This means that the model passes the linktest and the model specification appears to be okay.

Table 6 Linktest

CAPITALINVESTMENT	Coef.	Std. Err.	z	P>|z|
_hat	1.060	0.077	13.79	0.000
_hatsq	0.065	0.057	1.14	0.254
_cons	-0.018	0.046	-0.36	0.716

7.3 Goodness-of-fit test

Another commonly used test of model specification is the Hosmer and Lemeshow's goodness-of-fit test. The idea behind the Hosmer and Lemeshow's goodness-of-fit test is that the predicted frequency and observed frequency should match closely, and that the more closely they match, the better the fit. (Institute of digital reasearch and education UCLA , 2015). The test generates a p-value and if this p-value is significant ($p<0.05$) the model specification is rejected; if it is higher the model passes the test. With the model used in this paper the test generated a p-value of 0.24. This means the model passes the test meaning and the specification is not poor. The complete results from the Hosmer-Lemeshow test are presented in the appendix.

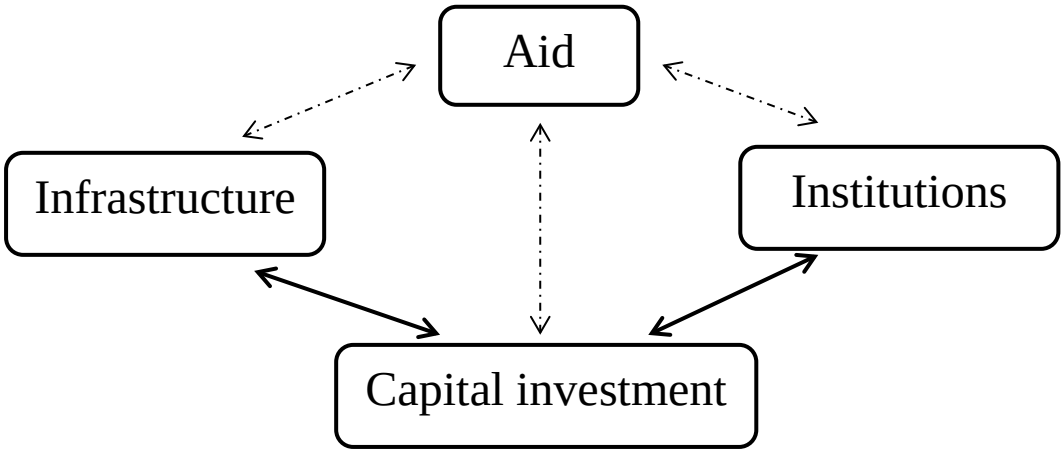
7.4 Indirect effects of aid

As previously stated, there are arguments both for and against aid. The theory goes two ways and so does previous research. The aid positivist approach suggests a positive relationship between aid and investment by relaxing financial and infrastructural constraints. On the other hand, the aid pessimist approach argues that aid distorts incentives and fuels corruption. If aid directly affects infrastructure and institutions and these in turn affect capital investment aid can be said to indirectly effect capital investment. It is possible that the lack of a significant relationship between aid and capital investment found in regression 2 is due to that the positive relationship suggested by the positivist approach is largely mitigated by the negative relationship suggested by the pessimist approach. To determine the validity of this argument two regressions are run to investigate the relationship between aid and infrastructure and the relationship between aid and institutions. Another two regressions are run to investigate the relationship between infrastructure and capital investment and the relationship between institutions and capital investment. Aid is expected to positively affect infrastructure according to the aid positivist approach and is expected to affect institutional quality negatively according to the aid pessimist approach. Both institutional and infrastructural quality is expected to have a positive relationship with capital investment. By interpreting the

regression results posted in the appendix, aid was found to have no significant effect on either infrastructure or institutions when ELECTRICITY_OBST was used as a proxy for infrastructure and CORRUPTION as a proxy for institutions. In other words, no support is found for either the aid positivist or pessimist approach. The two regressions used to investigate the relationship between infrastructure and capital investment and institutions and capital investment both found significant positive effects of infrastructural and institutional quality on capital investment. A complete explanation of the models and results is presented in the appendix.

Below is an illustration of the relationships between aid, infrastructure, institutions and capital investment. Full arrows imply significant relationships and dotted arrows imply no significant relationship.

Figure 1



8. Conclusion and discussion

This paper explores the impact of foreign aid on firm investment in physical capital in 10 783 firms in 21 of the least developed countries. No significant effect of aid was found on capital investment. Fixed effects for country, sector and year did not change this result, nor did country-clustered standard errors. Despite a relatively low Pseudo R2 the model passed both the linktest and the Hosmer-Lemeshow test for model specification. Multicollinearity was tested for and was not an issue. Possible indirect effects of aid were investigated and aid was found to neither effect institutional quality nor infrastructure. The failure to find indirect effects of aid on firm capital investment by positively or negatively affecting the investment

climate through institutions or infrastructure confirms the result of the benchmark regression, that aid does not have a significant effect on firm capital investment.

During the course of this paper it was clear that the binary regression models like logit are not optimal for these types of studies and that OLS would have been preferable but due to the binary nature of the dependent variable this was not possible. Further, aid could have a delayed effect. This paper assumes that the aid will be used by the recipient country the same year it was received and it is unclear how realistic this assumption is. Another potential problem is the sector definitions. Since the CRS and WBES do not use the same sector definition the CRS sectors were grouped arbitrarily to fit the WBES definitions. In this paper, I have argued that simultaneity is likely not an issue and have assumed this throughout the paper, however, it cannot be confirmed that this is actually true. If simultaneity is in fact present it cannot be said that one variable effects another but rather that there is a relation between the variables. This is because it cannot be determined which variable affects which.

The lack of evidence of the aid positivist and pessimist approach found in this paper could potentially give support to the aid conditionality approach, that aid is meaningless without good institutions and macroeconomic policies that allows for efficient aid allocation, but since this paper focuses on the LDCs the dataset used in this paper only contains data from these countries and all these have poorly functioning institutions hence the aid conditional approach cannot be properly tested.

The results of this paper have empirical support. The private sector in most of the LDCs has not been significantly affected by aid and neither have their infrastructure and institutional quality. The efficiency of Official Development Assistance has been questioned for some time and, according to this paper, rightfully so. New ways to improve development in the least developed countries needs to be explored and aid must be made more efficient for these countries to achieve sustainable growth and escape poverty. The result showed that having a loan from a financial institution is strongly related to capital investment, therefore this paper suggest development of financial institutions and the banking sector as the main focus point for future development assistance.

Bibliography

Brazilian agency for cooperation / Ministry of foreign affairs, 2000. *Capacity-building in Selected Least Developed Countries.* New York: United Nations.

Brooks, C., 2008. *Introductory Econometrics for Finance.* 2 ed. New York: Cambridge University Press.

Burnside, C. & Dollar, D., 2000. Aid, Policies, and Growth. *The American Economic Review,* 90(4), pp. 847-868.

Cameron, A. C. & Miller, D. L., 2013. *A Practitioner's Guide to Cluster-Robust Inference,* s.l.: Department of Economics, University of California - Davis.

Chauvet, L. & Ehrhart, H., 2014. *Aid and Growth, Evidence from Firm-level Data,* Paris: Banque de France.

Dollar, D. & Easterly, W., 1999. The Search for the Key: Aid, Investment and Policies in Africa. *Journal of African Economies,* 8(4), pp. 546-577.

Ear, S., 2012. *Does Foreign Aid Fuel Corruption?.* [Online]
Available at: https://www.weforum.org/agenda/2012/12/does-foreign-aid-fuel-corruption/
[Accessed 10 May 2016].

Economides, G., Kalyvitis, S. & Philippopoulos, A., 2008. Does foreign aid distort incentives and hurt growth? Theory and evidence from 75 aid-recipient countries. *Public Choice,* 134(3), pp. 463-488.

Hadjimichael, T. et al., 1995. *Sub-Saharan Africa: Growth, savings, and investment,* s.l.: International Monetary Fund.

Herzer, D. & Grimm, M., 2012. Does foreign aid increase private investments? Evidence from panel cointegration. *Applied Economics,* 44(20), pp. 2537-2550.

Institute of digital reasearch and education UCLA , 2015. *Lesson 3 Logistic Regression Diagnostics.* [Online]
Available at: http://www.ats.ucla.edu/stat/stata/webbooks/logistic/chapter3/statalog3.htm
[Accessed 8 May 2016].

Kabete, C. N., 2008. *FOREIGN AID AND ECONOMIC GROWTH, THE CASE OF TANZANIA,* Hague: International Institute of Social Studies.

Miles, J., 2014. *Why do we use clustering in statistical analysis?.* [Online]
Available at: https://www.quora.com/Why-do-we-use-clustering-in-statistical-analysis-Can-you-give-an-intuitive-explanation-or-intuitive-examples
[Accessed 11 May 2016].

Mossie, T. D., 2014. *Effects of Foreign Aid on Domestic Private Investment Growth, The case of Eastern African Countries,* Hague: International Institute of Social Studies.

Munemo, J., 2011. *Foreign Aid, Domestic Private Investment, and Welfare in Africa,* s.l.: Salisbury University, USA.

OECD, 2014. *Successful modernization of aid.* [Online]
Available at: http://oecdinsights.org/2014/12/17/successful-modernization-of-aid/
[Accessed 6 May 2016].

OECD, 2016. *Official development assistance – definition and coverage.* [Online]
Available at:
http://www.oecd.org/dac/stats/officialdevelopmentassistancedefinitionandcoverage.htm#Definition
[Accessed 6 May 2016].

OECDstat, 2016. *Creditor Reporting System.* [Online]
Available at: https://stats.oecd.org/Index.aspx?DataSetCode=CRS1
[Accessed 5 May 2016].

Simcoe, T., 2012. [Online]
Available at: http://people.bu.edu/tsimcoe/code/Endog-PDW.pdf
[Accessed 6 May 2016].

Soubbotina, T. P., 2000. *Beyond Economic Growth, Meeting the Challenges of Global Development.* 1 ed. Washington DC: The World Bank.

StatisticsSolutions, 2015. *Assumptions of Logistic Regression.* [Online]
Available at: http://www.statisticssolutions.com/assumptions-of-logistic-regression/
[Accessed 17 05 2016].

The World Bank, 2005. *World Development Indicators 2005.* Washington DC: The World Bank.

The World Bank, 2014. *Enterprise surveys. Full survey data.* [Online]
Available at: https://www.enterprisesurveys.org/portal/elibrary.aspx?libid=14
[Accessed 6 May 2016].

The World Bank, 2016. *PPP conversion factor.* [Online]
Available at: http://data.worldbank.org/indicator/PA.NUS.PPP
[Accessed 5 May 2016].

Todaro, M. P. & Smith, S. C., 2015. *Economic Development.* Harlow: Pearson.

United Nations, 2004. *Unleashing Entrepreneurship: Making Business Work for the Poor,* s.l.: United Nations Development Programme.

United Nations, 2015. *Least Developed Country Category: 2015 Country Snapshots,* s.l.: United Nations.

Westerlund, J., 2005. *Introduktion till ekonometri.* Lund: Studentlitteratur AB.

Woolridge, J. M., 2002. *Econometric Analysis of Cross Section and Panel Data.* Cambridge: Massachusetts Institute of Technology.

Zohoori, N. & Savitz, D., 1997. Econometric approaches to epidemiologic data. *Annals of Epidemiology,* 7(6), pp. 251-257.

Appendix

Table 7 Countries, year and number of firms

Country and year the survey was conducted	Number of firms
Afghanistan 2014	410
Angola 2010	360
Bangladesh 2013	1442
Bhutan 2015	253
Burundi 2014	157
Cambodia 2013	472
Democratic Republic of the Congo 2013	529
Djibouti 2013	266
Ethiopia 2015	847
Lao, People's Democratic Republic 2012	270
Madagascar 2013	532
Malawi 2014	523
Mali 2010	360
Mauritania 2014	150
Myanmar 2014	632
Nepal 2013	482
Senegal 2014	601
Sudan 2014	662
Uganda 2013	762
Yemen 2013	353
Zambia 2013	720

Table 8 Sectors

WBES sectors (sectors used in this paper)	Aid recipient as defined by OECD CRS
Textiles	Textiles, leather and substitutes
Leather	Textiles, leather and substitutes
Garments	Textiles, leather and substitutes
Food	Agriculture, total
Metal and machinery	Basic metals + non-ferrous metals + engineering
Wood	Forest industries
Retail and wholesale	Business and other services, total
Other services	Business and other services, total
Hotels and restaurants	Tourism, total
Construction and transport	Construction, total + transport equipment
Chemicals and pharmaceuticals	Chemicals +pharmaceutical production

Table 9 Benchmark results, Coefficients

VARIABLES	(1) $CAPITALINVESTMENT_{i,k,j}$ Logit	(2) $CAPITALINVESTMENT_{i,k,j}$ Logit Fixed Effects
$ODA_{k,j}$	0.0864	0.0102
	(0.0582)	(0.0626)
$FOREIGN_{i,k,j}$	0.184	0.116
	(0.144)	(0.158)
$SALES_{i,k,j}$	0.102***	0.0972***
	(0.0205)	(0.0296)
$LOAN_{i,k,j}$	0.778***	0.843***
	(0.109)	(0.0734)
$BANKACCOUNT_{i,k,j}$	0.141	0.327***
	(0.119)	(0.107)
$FIRMSIZE_{i,k,j}$	0.204***	0.236**
	(0.0739)	(0.102)
$TRUST\_IN\_LEGALSYSTEM_{i,k,j}$	0.0248*	0.0211
	(0.0745)	(0.0793)
$TAX\_OBST_{i,k,j}$	0.0753*	0.0795
	(0.0425)	(0.0372)
$TRANSPORT\_OBST_{i,k,j}$	0.402	0.361
	(0.103)	(0.121)
$TRADE\_OBST_{i,k,j}$	0.0323	0.0447
	(0.0352)	(0.0424)
$ELECTRICITY\_OBST_{i,k,j}$	-0.00403***	-0.00242**
	(0.00138)	(0.00102)
$CORRUPTION_{i,k,j}$	-0.307***	-0.269**
	(0.109)	(0.108)
$INSTABILITY_{i,k,j}$	-0.205*	-0.194***
	(0.123)	(0.0707)
Constant	-2.725***	-2.815***
	(0.482)	(0.504)
Pseudo R2	0.064	0.089
Observations	3,306	3,306

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 10 Correlation table

	CAPITA~T	ODA	FOREIGN	SALES	LOAN	BANKAC~T	FIRMSIZE	TRUST_~M	TAX_OBST	TRANSP~T	TRADE_~T	ELECTR~T	CORRUP~N	INSTAB~Y
CAPITALINV~T	1.0000													
ODA	0.0487	1.0000												
FOREIGN	0.0850	0.0577	1.0000											
SALES	0.1839	0.0864	0.2851	1.0000										
LOAN	0.1847	0.0160	-0.0219	0.1059	1.0000									
BANKACCOUNT	0.0832	-0.0052	0.0607	0.0997	0.2047	1.0000								
FIRMSIZE	0.1139	0.0510	0.1299	0.2673	0.1879	0.2059	1.0000							
TRUST_IN_L~M	0.0003	0.0197	-0.0063	-0.0424	-0.0376	0.0480	-0.0307	1.0000						
TAX_OBST	0.0458	0.0381	0.0336	-0.0483	0.0010	0.1068	-0.0278	0.0114	1.0000					
TRANSPORT_~T	0.0758	0.0021	0.0004	0.0339	0.0162	0.0340	0.0186	-0.0351	0.2317	1.0000				
TRADE_OBST	0.0571	0.0075	0.0547	0.0461	0.0252	0.1280	0.0735	-0.0029	0.4077	0.3065	1.0000			
ELECTRICIT~T	-0.0698	-0.0975	-0.1218	-0.1099	0.1247	-0.0012	0.1004	-0.1605	-0.1139	0.0190	-0.0775	1.0000		
CORRUPTION	-0.0534	-0.0361	-0.0098	-0.0206	-0.0313	0.0624	0.0141	-0.1236	0.3037	0.1923	0.3037	0.0390	1.0000	
INSTABILITY	-0.0540	-0.0300	-0.1088	-0.0862	0.0461	0.0331	0.0225	-0.1447	0.1456	0.1758	0.1143	0.2062	0.3209	1.0000

Table 11 Goodness-of-fit test (Hosmer-Lemeshow)

Logistic model for CAPITALINVESTMENT, goodness-of-fit test

(Table collapsed on quantiles of estimated probabilities)

Group	Prob	Obs_1	Exp_1	Obs_0	Exp_0	Total
1	0.1515	29	26.0	192	195.0	221
2	0.1916	44	38.0	176	182.0	220
3	0.2254	57	46.0	164	175.0	221
4	0.2551	48	53.1	172	166.9	220
5	0.2844	53	59.2	167	160.8	220
6	0.3109	58	65.9	163	155.1	221
7	0.3362	66	71.2	154	148.8	220
8	0.3692	70	78.0	151	143.0	221
9	0.4027	83	84.9	137	135.1	220
10	0.4328	94	92.1	126	127.9	220
11	0.4710	95	99.6	126	121.4	221
12	0.5176	116	108.6	104	111.4	220
13	0.5767	136	120.9	85	100.1	221
14	0.6487	135	134.1	85	85.9	220
15	0.8674	151	157.3	69	62.7	220

```
  number of observations =      3306
        number of groups =        15
Hosmer-Lemeshow chi2(13) =        16.16
              Prob > chi2 =        0.2408
```

When running the goodness of fit test we are asked to assign the number of groups. As a general rule the number of groups should be the number of variables plus one, in this case 14+1=15.

Indirect effects of aid

All four regressions were run with fixed effects for country, sector and year as well as country clustered standard errors. The need for heteroscedasticity adjusted standard errors was confirmed by running the Breusch-Pagan test for heteroscedasticity on the two OLS regressions, this test is however not possible to perform on logit regressions but just as before we assume heteroscedasticity is also present in these regressions hence adjust for it. Regression 8 and 9 were performed with OLS and regression 10 and 11 are logit regressions.

(8) $CORRUPTION_{i,k,j} = \beta_1 + \beta_2\ ODA_{k,j} + \beta_3\ TAX\_OBST_{i,k,j} + \beta_4\ TRANSPORT\_OBST_{i,k,j} + \beta_5\ INSTABILITY_{i,k,j} + \beta_6\ TRUST\_IN\_LEGALSYSTEM_{i,k,j} + \beta_7\ ELECTRICITY\_OBST_{i,k,j} + \mu_j + \tau + \kappa_k + \varepsilon_{i,k,j}$

(9) $ELECTRICITY\_OBST_{i,k,j} = \beta_1 + \beta_2\ ODA_{k,j} + \beta_3\ TAX\_OBST_{i,k,j} + \beta_4 TRANSPORT\_OBST + \beta_5\ TRUST\_IN\_LEGALSYSTEM_{i,k,j} + \beta_6\ INSTABILITY_{i,k,j} + \beta_7 CORRUPTION_{i,k,j} + \mu_j + \tau + \kappa_k + \varepsilon_{i,k,j}$

(10) $CAPITALINVESTMENT_{i,k,j} = \beta_1 + \beta_2\ ELECTRICITY\_OBST_{i,k,j} + \beta_3\ SALES_{i,k,j} + \beta_4 FOREIGN_{i,k,j} + \beta_5\ LOAN_{i,k,j} + \beta_6\ BANKACCOUNT_{i,k,j} + \beta_7\ FIRMSIZE_{i,k,j} + \mu_j + \tau + \kappa_k + \varepsilon_{i,k,j}$

(11) $CAPITALINVESTMENT_{i,k,j} = \beta_1 + \beta_2\ CORRUPTION_{i,k,j} + \beta_3\ SALES_{i,k,j} + \beta_4 FOREIGN_{i,k,j} + \beta_5\ LOAN_{i,k,j} + \beta_6\ BANKACCOUNT_{i,k,j} + \beta_7\ FIRMSIZE_{i,k,j} + \mu_j + \tau + \kappa_k + \varepsilon_{i,k,j}$

The results from regression 8, 9, 10 and 11 are presented in Table 12.

Table 12 Aid effects on infrastructure and institutions, Coefficients

VARIABLES	(8) $CORRUPTION_{i,k,j}$ OLS (FE)	(9) $ELECTRICITY\_OBST_{i,k,j}$ OLS (FE)	(10) $CAPITALINVESTMENT_{i,k,j}$ Logit (FE)	(11) $CAPITALINVESTMENT_{i,k,j}$ Logit (FE)
$ODA_{k,j}$	-0.133	-94.91		
	(0.0131)	(0.974)		
$SALES_{i,k,j}$			0.0960***	0.111***
			(0.0236)	(0.0172)
$FOREIGN_{i,k,j}$			0.0128	-0.0360
			(0.106)	(0.0961)
$LOAN_{i,k,j}$			0.689***	0.651***
			(0.0565)	(0.0545)
$BANKACCOUNT_{i,k,j}$			0.390***	0.436***
			(0.0895)	(0.0765)
$FIRMSIZE_{i,k,j}$			0.203***	0.217***
			(0.0610)	(0.0569)
$ELECTRICITY\_OBST_{i,k,j}$	3.17e-05		-0.00426***	
	(0.000263)		(0.00130)	
$TAX\_OBST_{i,k,j}$	0.0731***	-0.103		
	(0.0137)	(0.312)		
$TRANSPORT\_OBST_{i,k,j}$	0.0821***	0.835		
	(0.0264)	(0.749)		
$INSTABILITY_{i,k,j}$	0.254***	0.498		

	(0.0472)	(1.714)		
TRUST_IN_LEGALSYSTEM$_{i,k,j}$	-0.0281**	-0.920		
	(0.0108)	(0.532)		
CORRUPTION$_{i,k,j}$		0.0929		-0.101*
		(0.788)		(0.0734)
Constant	0.218**	6.982	-1.904***	-2.559***
	(0.0889)	(5.473)	(0.442)	(0.312)
Observations	4,473	4,473	5,996	7,975
R-squared/Pseudo R2	0.268	0.561	0.070	0.074

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results from (8) tell us that there is no significant effect of aid on corruption. This means that we find no support for the aid pessimist approach. If taxes, transport and instability obstacles are perceived high corruption will be high as well. Similarly, if the trust in the legal system is high corruption is lower. The results for these variables suffer from simultaneity hence their result don't mean anything but the main thing to take away from regression 3 is that aid appears not to have any relation with institutions. Regression (9) shows no significant result of aid on relaxing infrastructure constraint in form of electric infrastructure. None of the other variables shows a significant result either and the reason for the high R-squared value is the country fixed effects.

Result (10) shows many significant variables with coefficients supported by theory and indicates that poor electric infrastructure does indeed act as a significant obstruction to investments. Result (11) tells us that corruption is a weakly significant obstruction to investment.