Master thesis

Aid effectiveness: deeper into the aid-policy link

Student: **Arne Brouwers**
Number: **358025**
Supervisor: **Dr. E. M. Bosker**

29-11-2012
Erasmus University Rotterdam

Abstract
This paper explores the question whether foreign aid is only effective in combination with good policy. First it is assumed that aid does not affect growth directly, but it influences policy, which in turn affects growth. I investigate this channel by testing 20 policy variables on how their effectiveness is enhanced by foreign aid, and how this depends on the stage of development. Two different ways to include stage of development into a growth equation are used. Estimation is done with both OLS and 2SLS, with several samples which include or exclude outliers and use different time frames. I find that aid can affect growth through trade and openness only for relatively well developed countries. This holds also for macroeconomic policies at a slightly lower level of development. For the lowest developed countries political stability is an important variable for aid to affect growth. Schooling is important at a small interval of development. Aid can affect the effectiveness of capital formation at all levels of development, but decreases the saving rate at all levels of development.

Contents

I Introduction
- a Empirical literature
- b Theory
- c Policy

II Methodology
- a Dummy model
- b Continuous measure of stage of development
- c Specification of growth equation

III Data description
- a Original dataset
- b Additional variables

IV Basic results
- a Dummy model
- b Continuous measure of stage of development

V Endogeneity
- a Aid lagged
- b Original instruments
- c Bilateral instrument

VI Robustness checks
- a Shorter sample
- b Outliers

VII Conclusion

References

Appendix A: Data description

Appendix B: Interpretation

Appendix C: Result tables

I Introduction

Over the past 50 years substantial amounts of aid have been sent to the developing world. The question whether this did any good for the developing world is still widely discussed in literature. This paper focuses on the effectiveness of development aid. Although there is an exhaustive literature on this topic, I believe this paper can add value to this literature by digging deeper into the dynamics of growth, policy and aid.

In order to show where the existing literature is incomplete, I will first discuss the pioneering paper in this field, Burnside & Dollar (2000). This paper relates the effectiveness of aid to the macroeconomic conditions in developing countries. The claim that only for countries with 'good' macroeconomic conditions aid is effective is based on a positive interaction of aid and policy in a growth regression[1]. Burnside & Dollar (2000) argue that it is ineffective to donate aid to countries without 'good' macroeconomic conditions.

There are two reasons why more research is required on this topic. First, as will be discussed in the next section, the results of Burnside & Dollar (2000) are not robust. Many other studies find opposing results. Second, their results imply that bad macroeconomic conditions cannot be improved by foreign aid, because foreign aid is ineffective in these countries, which makes it difficult to help them. I make two statements about the existing literature, in order to see where it can be improved.

1) As I will discuss later, aid is not expected to influence economic growth directly, but only through policy. The interaction of aid and policy should therefore be interpreted as the ability of aid to enhance the 'policy effectiveness'. The findings of Burnside & Dollar (2000) therefore imply that the effect of macroeconomic policy can be improved by aid, and not that macroeconomic policy is a requirement for aid to be effective, as they suggest.
2) There are many different policies that stimulate economic growth. The effectiveness of these policies can vary over the stage of development of the country. Therefore the usefulness of aid might depend on the combination of stage of development and the particular policy.

To illustrate the line of thought consider for example openness. Openness might be a valuable policy for the average 'Burnside & Dollar' country and therefore development aid might influence the 'openness effectiveness' positively. However, for lesser developed countries, openness might be a dangerous policy strategy[2], and development aid that increases openness will do more harm than good. For these countries it might be much better to direct aid to basic institutions and property rights. It should be clear that aid combined with 'good' policy means something different for every country.

This paper attempts to find the right combination of stage of development and policy, for aid to be effective. I believe that for every country there is a policy through which aid can affect growth. The question which policies, and at what stage of development, is the main concern of this study.

[1] Aid alone is found to have a negative or neutral effect on growth, which implies that the only source of aid effectiveness comes from the interaction term aid*policy.
[2] Consider for example the infant industry argument.

To support the statements above with a solid background, I discuss empirical literature and economic theory in the next section. Subsequently, I will collect a set of interesting policy variables that might interact with aid at different levels of development.

I use two econometric models to test the questions outlined above. These are discussed in the methodology section. The data section explains the choices made while constructing the dataset and describes the variables. The results are split into two parts: basic results and endogeneity robust results. Also, a discussion on the role of outliers is included.

a. Empirical literature

It is convenient to discuss Burnside & Dollar (2000) in depth first, since many choices of this paper are based on it. Burnside & Dollar (2000) initiate the discussion on whether aid only works for countries with sound macroeconomic conditions or not. Their findings suggest that aid is only effective for countries with 'good' policies, which influenced the World Bank policy.

Burnside & Dollar (2000) estimate a growth equation using a panel dataset from 170 countries and six 4-year periods. The most important terms in the growth equation are aid and the interaction of aid and policy, where policy is an index based on openness, inflation and budget surplus[3]. They find that aid individually has no effect on growth and that aid interacted with policy is positive. This means that only countries with a positive policy index can benefit from development aid.

Although Burnside & Dollar (2000) take into account endogeneity of aid and policy as well as the role of outliers, a major discussion arose on the robustness of their results. Easterly, Levine and Roodman (2003) did the same regression with additional countries and more recent data and found no evidence for a robust relationship between policies, aid and growth. Roodman (2007) again expands the dataset and finds a weak relation between aid and policy, but a stronger relation between aid and tropics.

At the same time, many interesting studies with slight adjustments of the specification, variables and dataset were published. For example, Rajan & Subramanian (2005) find no robust relation between aid and growth for different time horizons, time periods and types of aid. An extra variable 'geography', which is suggested by Bosworth and Collins (2003), is also included. The interaction term aid*policy does not turn out to have a robust impact on growth. Also, there is little evidence for a positive link between aid individually and economic growth.

Hansen & Tarp (2001), in their turn, do find a positive effect between aid and growth which is not related to 'good' policy. They stress however that the results are sensitive to choice of control variable and a sound theoretical framework is required. Hansen and Tarp (2001) find that aid works via the investment link (capital accumulation) rather than via total factor productivity. Collier & Dollar (2002) find that aid is effective for poverty reduction, but not for policy reform. Also, in some situations, aid might reduce the chance of conflict and raise private investment.

[3] Economic growth = constant + **aid** + **aid*policy** + control variables + error term

The aid effectiveness literature is extremely large and it is virtually impossible to discuss all papers. Fortunately, Doucouliagos & Paldam (2007) perform a meta-study on a hundred aid-growth studies. Their findings suggest that good policy has a positive effect on growth, but it has no effect in the marginal effect of development aid.

The discussion seems to settle down with the conclusion that, if aid is effective at all, there is no evidence that it depends on the combination with good policies. When one considers the possibility that 'good' policy is not universal and the dynamics differ over level of development, it might be easier to find a strong relationship. The theoretical discussion below will further clarify these possibilities.

b. Theory

Next to the broad empirical discussion, there has also been important conceptual work on development aid. In fact, a drawback of Burnside & Dollar (2000) is the lack of a theoretical background. In order to create some structure in this section, it is split up into three parts. First I will discuss the role of aid in different growth models, subsequently I will discuss why aid might not work and finally I will elaborate on the causality of aid on growth.

Growth models with aid

It is rather puzzling that there is no empirical evidence for a strong relation between aid and growth, because theoretically it is straightforward. Doucouliagos & Paldam (2009) discuss this puzzle. On micro level, they argue, many aid projects seem to be very effective. It is remarkable that on the aggregate aid seems to be ineffective. Macroeconomic theory depicts that due to a balance-of-payment improvement and public spending aid should unambiguously have a positive effect. According to growth theory and empirics, capital accumulation causes growth. Aid finances investment and therefore increases growth. A possible explanation for the fact that theory and empirics are so far apart, according to the authors, is that the theory does not take transfer problems and the role of the real exchange rates into account.

More sophisticated models exist in the aid effectiveness literature. Since this paper estimates a growth model, it is interesting to go deeper into the growth theory. Dalgaard, Hansen & Tarp (2004) consider aid as a transfer of capital or income in a theoretical model. Governance and determinants of productivity determine whether aid positively or negatively affects productivity. This is in direct contradiction to Obstfeld (1999), who uses a different theoretical framework model and finds that aid only affects consumption, but not productivity[4].

Harmful aid

Both empirically and theoretically it is not clear how aid exactly works. It might be insightful to discuss why aid would not work. William Easterly, a well known critic of foreign aid, argues that aid

[4] Dalgaard, Hansen & Tarp use an overlapping-generations (OLG) model, which deals with different generations. Obstfeld (1999) uses a Ramsey-Cass-Koopmans (RCK) model, which is characterized by infinitely lived households.

often does more harm than good. The quality of aid should improve and more modest objectives should be defined (Easterly, 2006). Another popular example is Dambisa Moyo, who states that foreign aid only makes countries more dependent and vulnerable (Moyo, 2009).

There are also arguments that aid is sometimes used as a strategic instrument of Western countries to attain trade relations or political power. The conditions whereupon aid is given are not conditions that should increase growth most efficiently, but they are conditions that benefit the donor the most[5]. Dalgaard (2008) for example introduces the importance of donor policies and their attitude towards inequality in an aid model. Bearce & Tirone (2010) state that aid can facilitate economic reform, but only when the stakes of the donor are not too high.

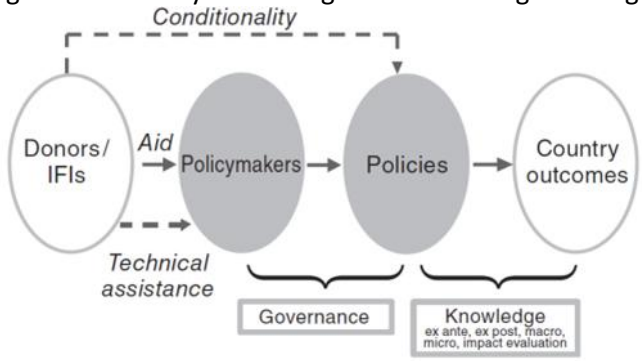
As discussed above, transfer problems and the real exchange rate might be responsible for ineffective aid. In trade theory there are arguments against aid, based on exchange rates. An example is the transfer paradox of Gale (1974), or the Dutch disease.

A standard example of transfer problems is the problem of corruption. Rajan & Subramanian (2005) argue that it is realistic to assume that half of all aid is wasted or consumed, which makes it more difficult to find a robust relation between aid and growth. Corruption can be embedded in the cultural values, due to for example gift exchange norms. Raffinot & Venet (2011) offer a different explanation of the role of cultural values in an aid effectiveness model. They look at the effect of foreign aid on the saving rate, using dynamics of two generations in an overlapping generations model. Their model depict that the saving rate is a negative function of the share of aid that goes to the old generation. The authors also state that this is likely to be the case in African countries, because cultural values are in favor of the old.

Causality

Burnside & Dollar (2000) implicitly suggest that aid has a direct effect on economic growth, and 'good' policies smoothen the process. Bourguignon & Sundberg (2007) show that aid itself is not a factor that enhances economic growth, which is illustrated in figure 1. Development aid can only enhance policies, which in turn can cause growth.

Figure 1: Causality of aid on growth according to Bourguignon & Sundberg (2007)



Source: Bourguignon & Sundberg (2007)

[5] For example, a condition can be opening up borders with the donor country. This might do more harm than good for the recipient, but be a goldmine for the donor.

This shines different light on the results of the empirical literature. The interaction term (aid*policy) should be interpreted as the ability of aid to increase 'policy effectiveness'. When this interaction term is found to be positive, it implies that all countries that have a positive level of macroeconomic policy can benefit from aid. It still holds that for countries without 'good' macroeconomic conditions aid cannot influence growth. This is not surprising, because in these countries no 'policy' exists that can be improved by aid. For these countries, aid might work through another policy than macroeconomic policy.

As 'good' policy is neither homogenous nor universal, for a particular subset of countries an alleged 'good' policy might in fact be harmful[6]. This means that the interaction term (aid * policy) might be zero or even negative for these counties. Either aid is unable to reach policy, or the particular policy is unable to cause growth. Again, for this set of countries there might be several other policies that help aid to be effective.

At this point it is important to think about what policy actually means. I think for this study a very broad definition is sufficient. Every effort of the government to improve conditions in their country with the intention to cause economic growth can be considered as being a policy. Every policy that can be improved by means of development aid is interesting for this paper.

To sum up the objective of this paper, note that I assume that aid only works through policy. The extent to which aid improve the effectiveness of a policy can be modeled by the interaction term aid*policy in a growth regression. Further, I expect that this interaction term depends on the particular policy and on the level of development of a country.

c. Development policies

In order to test how the interaction term differs for different policies a set of policy variables that can be substituted for 'policy' is required. Later on, these policies will be tested on their interaction with aid in a growth regression. It is important that a wide range of policy variables is collected, since the objective of this paper is to find a suitable strategy for countries at various levels of development.

I use two strategies to find interesting policy variables. First, since I expect that aid works through policy, I search the literature for effective policy in different stages of development, irrespective of aid. Second, I adopt the policy variables that are used in the aid effectiveness literature, which are originally used to reflect 'good' policy in general.

A study that empirically tests in which stage of development which strategy is useful, is offered by Polterovich & Popov (2004). They investigate a set of variables and look at which range of income these variables positively influences growth. First trade policy is considered, because there is no conclusive evidence about the role of trade in the development of a country. They conclude that for countries with less than 50% of United States GDP per capita and little corruption protection it is a feasible strategy, for higher developed or more corrupt countries it is not.

[6] It is not hard to imagine that some policies, such as openness, could be harmful for a particular set of countries.

The accumulation of foreign exchange reserves is an important tool in controlling the real exchange rate, which is an important determinant of trade flows and hence growth. Poltervich & Popov (2004) find it to be an effective tool for lower income countries, but not for countries with higher than 75% of United States GDP per capita. This exchange rate protectionism is effective until higher levels of GDP per capita, up to middle income countries and is less corruption prone.

The innovation and technology import variables show that low developed countries need to import technology. Own research becomes more important as a country develops. The authors state that FDI is not proved to be promoting economic growth, because it might make countries economically more vulnerable. It turns out that FDI is only good for developing countries with a very good investment climate.

Also migration is characterized by different mechanisms. Polterovich & Popov (2004) find that low income countries receive immigrants that are even less educated than the rest of the population. Outward migration gets more costly as the country develops. At a certain level of development brain gain as an effect of an inflow of immigrants can balance this out.

Finally Polterovich & Popov (2004) come up with a stage of development advice. The first stage is technology and industrialization, the second is export, the third is accelerating development and the final stage is the developed market. Also Sachs (2004) theorizes a similar development structure. He defines development in four stages: pre-commercial, commercial, industrial and knowledge. Each of these strategies has an inverted u-shape and partly overlaps with the preceding and succeeding stage.

The World Development Report (2009) gives policy suggestions for economic integration based on urbanization. In low stages of urbanization property rights and basic institution are essential. In the second stage, infrastructure should be added to the policy program. The final step, when the basic institutions and infrastructure are in place, is to address the slum problem.

According to Armendáriz & Morduch (2007) a main reason for backwardness is the poverty gap. People are too poor to be able to invest in small projects. Many development aid initiatives try to improve the financial markets in developing countries, e.g. microfinance banks. De Soto (2001) argues that well defined property rights are the key for development.

Although the largest part of the aid literature treats policy as homogeneous, many different variables are suggested. First of all, I disentangle the policy index of Burnside & Dollar (2000) into openness, inflation and budget surplus.

Bezemer & Wijsman (unknown year) suggest a different composition of the policy index, based on the developmental state literature. According to the authors these variables have proven their usefulness, irrespective of aid, in the past. They include stability of the state, credit market, the exchange rate and education. The effect of the new policy index and its interaction with aid on growth varies between continents. Most importantly, it is found that development aid should focus on the agricultural sector.

In a study on aid effectiveness in terms of poverty reduction Collier & Dollar (2002) also use different policy variables. Their policy index consists of twenty variables, including corruption, basic institution and property rights.

Kasuga & Morita (2012) suggest that in low stages of development infrastructure is a feasible strategy for aid, but in later stages governance is most effective. Rajan & Subramanian (2005) argue that when only part of the donated aid is actually spent on development initiatives, because the rest is wasted to corrupt governments, it becomes harder to find a significant relation between aid and growth.

It is clear that there is a large amount of potential policies in which aid can be effectively invested. In sake of clarity, I identify categories that capture the most important policies mentioned above. These are trade, macroeconomic, political, education, financial, social and infrastructure. Before indicators of these categories are collected, I will discuss two models that are used to test the dynamics of development aid, various policies and stage of development.

II Methodology

It is helpful to discuss the methodology of the conventional papers in this field first. Most papers estimate a growth equation that looks like this:

$$Y_g = \beta_0 + \beta_1 \text{Aid} + \beta_2 X + \beta_3 \text{Aid} * X + \varepsilon$$

The coefficient in front of the interaction term shows the effect of aid through policy (X)[7]. This interaction term is usually considered as homogeneous, while in fact the choice of the policy variable and the stage of development of a country may matter a lot. Different policy variables can replace X in the regression above. In order to differentiate between stages of development I use two different approaches.

The first model estimates the model described above for samples that only include countries of a certain level of development. This allows me to estimate how the interaction term aid*policy differs between different groups of countries.

The second model uses the idea that every interaction term aid*policy has an optimal point for a certain level of development. In order to model this, I include GDP per capita and GDP per capita squared, and interact them with policy, aid and aid*policy.

a. Dummy model

The idea of this model is very simple. Since it is expected that the effect of aid*policy differs for different levels of development, I just estimate the equation for countries with a certain level of income.

In order to subdivide the set of countries in groups of development, I adopt the OECD definitions. There are four groups, least developed countries (LDC), other low income countries (OLIC), lower middle income countries (LMIC) and upper middle income countries (UMIC). I generate dummy variables that take the value of 1 when the country belongs to the group, containing respectively, 49, 12, 49 and 43 countries[8].

For every policy variable that is tested, four different regressions are estimated. The policy effectiveness of policy X is a function of aid.

$$\frac{\partial Y_g}{\partial X} = \beta_2 + \beta_3 Aid$$

The extent to which aid can influence this policy effectiveness is given by:

$$\frac{\partial Y_g / \partial X}{\partial Aid} = \beta_3$$

[7] Aid squared * policy is also a popular interaction term, indicating diminishing returns to aid. For the purpose of this study it is not necessary to add it to the equation.

[8] Not all countries in the dataset can be allocated in one of the four categories according to the OECD definition, so this model leaves out a number of observations.

The four coefficients of β_3 for the four income groups will indicate at which income levels aid can positively influence policy effectiveness. As argued above, these coefficients are expected to differ between income groups. Note that, since four independent regressions are estimated, the difference cannot be tested formally, because they all have different samples[9]. This is not a serious problem, since the aim of this model is to see what the dynamics of the marginal effects (β_3) are like, not whether they differ significantly.

Note that a positive marginal effect does not necessarily imply that aid is effective in general. It would only suggest that aid is effective in improving the effectiveness of a certain policy for a certain type of country.

This model has some downsides. The definition of the OECD does not change over time. It is not taken into account that a country can be a least developed country in 1960 and an upper middle income country in 1990, consider for example South Korea. This might bias the results. Furthermore, the dummy model only uses four stages of development. It would be much more interesting to see how the effect of aid*policy changes over the course of development.

b. Continuous measure of stage of development (parabolic model)

This model includes a different measure of level of development: GDP per capita[10]. This allows me to see how aid influences policy effectiveness for all levels of development. In this case, I can estimate a linear relation between level of development and the interaction term (aid*policy).

There is reason to assume that the relation is not linear. As discussed before, a certain policy is most effective in a particular stage and less effective in earlier and later stages of development. Therefore it is likely to assume that aid*policy has a peak at a certain stage of development. I include another interaction term of aid*policy with GDP per capita squared, implicitly assuming that aid*policy has a parabolic relation with level of development.

$$Y_g = \beta_0 + \beta_1 Aid + \beta_2 X + \beta_3 \left(\frac{GDP}{c}\right) + \beta_4 \left(\frac{GDP}{c}\right)^2 + \beta_5 Aid * X + \beta_6 Aid * \left(\frac{GDP}{c}\right) + \beta_7 Aid * \left(\frac{GDP}{c}\right)^2 + \beta_8 X * \left(\frac{GDP}{c}\right) + \beta_9 X * \left(\frac{GDP}{c}\right)^2 + \beta_{10} Aid * X * \left(\frac{GDP}{c}\right) + \beta_{11} Aid * X * \left(\frac{GDP}{c}\right)^2 + \beta_{12} controls + \varepsilon$$

[9] Two other models were considered during this study that use all countries in every regression. The most straightforward one, a single regression with all countries and dummies for every group of countries, requires a too large amount of terms (because every dummy should be interacted with aid, policy and aid*policy). The second option included a dummy to the interaction term (aid*policy*dummy) in addition to the original equation, only for one group at the time. In this case, four different equations are estimated for a single policy, but with all countries. However, the four different regressions have different control groups, so it is difficult to compare effects. For the record, this option leads in general to higher significance, but patterns are less clear.

[10] Poltervich & Popov (2006) also use this procedure to estimate the effect of policy on growth, irrespective of aid.

Here X can be substituted by any policy. I should be aware of the fact that I implement a certain shape to the data, although the real shape can be quite different. I think, for the reasons stated above, that a parabolic shape is the most realistic one.

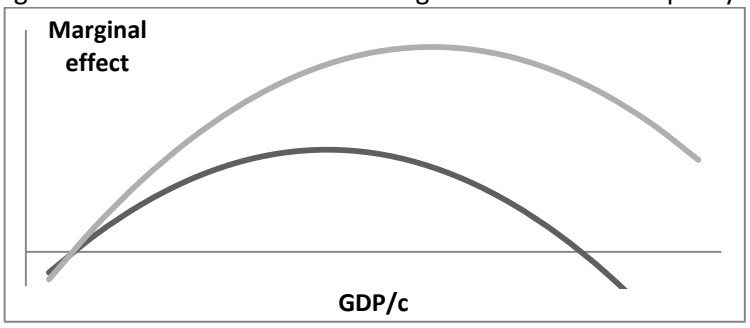
In this case the marginal effect of a policy on GDP per capita is given by:

$$\frac{\partial Y_g}{\partial X} = \beta_2 + \beta_5\, Aid + \beta_8 \left(\frac{GDP}{c}\right) + \beta_9 \left(\frac{GDP}{c}\right)^2 + \beta_{10}\, Aid * \left(\frac{GDP}{c}\right) + \beta_{11}\, Aid * \left(\frac{GDP}{c}\right)^2$$

The marginal effect depends on a constant, on aid, on GDP per capita, on GDP per capita squared, and on mutual combinations. The extent to which foreign aid influences this effect is given by the marginal effect of aid on policy effectiveness (hereafter referred to as the marginal effect):

$$\frac{\partial Y_g / \partial X}{\partial\, Aid} = \beta_5 + \beta_{10} \left(\frac{GDP}{c}\right) + \beta_{11} \left(\frac{GDP}{c}\right)^2$$

Figure 2: Relation between the marginal effect of aid on policy effectiveness and GDP per capita.



As the theory predicts, an inverted u-shape is expected, this implies that $\beta_{11} < 0$. Figure 2 draws a fictive example of such a situation. The two different lines may represent two different policies.

Whenever the function lies above the horizontal axis, the marginal effect is positive. This does not necessarily mean that aid is effective overall. It only says that, for the interval of GDP per capita where the function is positive, aid improves the policy effectiveness. The question whether aid in general is effective depends on the other aid-terms in the equation, and is not the main interest of this paper.

The objective of this study is eventually to find which policies are good in which development stages. The more the function lies to the right, the more effective it is in later stages. Since the effect of interest is a function of GDP per capita, the standard error is as well. See appendix C for a discussion how to interpret the results.

c. Specification of growth equation

Apart from the interaction terms, the same specification is used in both models. In the conventional literature the growth equations use the following control variables: logarithm of initial income, institutional quality, ethnic fractionalization, assassinations, fractionalization * assassinations, m2/GDP (lagged), and the Sub-Saharan Africa dummy. These control variables are widely accepted and there is no apparent reason why I should reconsider them.

Further, the data is organized in a panel structure. This allows me to include fixed or random effects. The convention in literature is to use period specific effects only. Barro (2012) offers a comprehensive discussion on the use of country fixed effects in panel growth models. Fixed effects are useful to correct for omitted variables. This advantage can be small when sufficient control variables are included. The logarithm of initial income per capita, for example, already controls partly for country fixed effects, because no omitted variables that are perfectly correlated with GDP per capita remain.

Moreover, there are several downsides to fixed effects. Variables that are constant over time, or have little within country variation will not be estimated precisely. Also, according to Hansen & Tarp (2001), country fixed effects can only be included when the explanatory variables are strictly exogenous. This is not the case in my model. Barro (2012) also stresses that including country fixed effects makes it difficult to find significant effects on variables that have little within country variation.

This literature uses heteroskedasticity robust standard errors, which do not correct for autocorrelation. According to Drukker (2003) autocorrelation in panel data tends to make the results less efficient. Although it seems that autocorrelation might not be a big problem[11], I should bear in mind that some regressions in this study might be biased due to autocorrelation.

I am aware of the fact that the decisions about fixed effects and standard errors made in the conventional studies are discussable. The strongest reason for following this literature is to keep my results comparable with previous studies. Keep in mind, however, that the forthcoming results depend highly on these decisions.

[11] I randomly tested ten regressions (from both models) for autocorrelation using a Wooldridge test for panel data (Drukker, 2003). In almost all cases it fails to reject the null-hypothesis of no autocorrelation. Testing all regressions in this paper would be unnecessary work, because there are other reasons to use only heteroskedasticity consistent standard errors.

III Data description

The starting point of the empirical study is the dataset of Roodman (2004), which contains all variables that are used in the original equation of Burnside & Dollar (2000), over the time span 1950-2001 for 171 countries. The same variables are used by most papers discussed in the literature section. Below, this dataset is described and subsequently supplemented with additional variables.

a. Original dataset

The convention in the literature is to organize the data in 4-year time intervals, mainly to find long run effects and to fill gaps in the data. The first three periods (1950-1961) are dropped from the dataset, because of unavailability of the additional variables. The remaining periods are numbered from 0 to 9.

Table 1 sums up the variables that are used in Burnside & Dollar (2000), Easterly, Levine and Roodman (2003) and Roodman (2007), to estimate the basic equation. Table 2 summarizes the two main variables of this study, see appendix A for the complete description.

Table 1: Original variables

Variable	**Specification**	**Original Source**
Per capita GDP growth	Annual, %	World Bank
Aid / GDP	EDA and ODA % of GDP	OECD/DAC & World bank
Inflation	Natural logarithm of 1 + inflation rate	World Bank
Budget surplus	Fraction of GDP	World Bank & IMF
Sachs Warner (openness)	1 = open, 0 = closed	Sachs and Warner index
Initial GDP	Log of initial GDP	World Bank
Ethno-linguistic fractionalization	Probability that two individuals will belong to different ethnic groups	Roeder, 2001
Assassinations	Counts number of assassinations	Banks, 2002
Monetary base	M2 % of GDP, lagged one period	World Bank
Institutional quality	International Country Risk Guide (0-10)	PRS Group's IRIS III data set (see Knack and Keefer, 1995)
Dummy Sub Saharan Africa	Dummy = 1 for countries in Sub Saharan Africa	
Dummy East Asia	Dummy = 1 for countries in East Asia	

Table 2: description main variables

Variable	Observations	Mean	Standard deviation	Minimum	Maximum
GDP / capita, growth	1240	1.48	5.31	-43.65	46.85
Aid / GDP	1164	1.45	2.75	-12.61	33.10

The attempts to update the dataset with two additional 4-year periods failed. A number of variables are not available in the exact same specification after 2001[12]. I substituted variables with slightly different specifications or variables from other sources for the missing original variables. These new variables turned out the correlate too little with the original variables, which makes it difficult to compare the expanded dataset with the original one.

In order to estimate the models discussed in a previous section, a number of new variables are needed. First, a wide range of additional policy variables are necessary for the analysis. Secondly, the measures of stage of development are obtained.

b. Additional variables

In table 3 the new policy variables are reported. The choice of the variables is based on the discussion on policy variables in a previous section of this paper. To keep the set of policy variables manageable not all variables that are mentioned in that discussion can be analyzed. However, the most interesting ones and the factors that are mentioned in various studies are included. When a factor is measured by a different variable in another study, the variables with the highest amount of observations is chosen. For two important factors no appropriate data was found[13]. The set of policies consists of twenty variables, which are shown in table 3. In order to structure the variables they are organized into categories.

Although the policy index of Burnside & Dollar (2000) is in contrast with the philosophy of this paper, it is helpful to estimate the new models with the original policy index as well. In the aid effectiveness literature the original results are usually first imitated before changes to the dataset or specification are estimated, which allows to see where the change takes place. This policy index is generated by adding up three policy variables according to their effect on economic growth[14].

[12] The aid, openness, budget surplus, assassinations and institutional quality variables are not available in the exact same specification as in the original dataset for the additional years.

[13] These are corruption and basis institutions. The data sources of the studies that suggested them are not freely available, or not available for the appropriate time frame.

[14] In the Burnside & Dollar (2000) dataset this is 1.278 + 6.845 * budget surplus - 1.398 * inflation + 2.157 * openness. Note that the coefficients here change with the sample.

Table 3: Policy variables

Category	Description	Source
Trade	Import tariffs	World Bank (WITS, UNCTAD)
	Trade (% of GDP)	World Bank
	Openness dummy	Sachs and Warner (1995)
	Foreign exchange reserves	IMF
Macroeconomic	General government final consumption (% of GDP)	World Bank
	Budget surplus/surplus (% of GDP)	World Bank
	Inflation rate	World Bank
	Policy index	Burnside & Dollar (2000)
Political	Stability	Beck, Clark, Groff, Keefer & Waksch (2001)
	Degree of authority	Marhsall & Jaggers (2010)
	Decision making	Marhsall & Jaggers (2010)
	Political competition	Marhsall & Jaggers (2010)
Education	Public spending on education (% of GDP)	World Bank
	School enrollment secondary (% gross)	World Bank
Investment	Foreign Direct Investment	World Bank
	Capital formation	World Bank
	Gross domestic savings (% of GDP)	World Bank
Other	Telephone lines (per 100 people)	World Bank
	Net inflow of migrants	World Bank
	Gini coefficient	World Bank

The first category contains trade variables. As discussed above, lower developed countries benefit from protectionism. As a country develops it pays to open up the borders. The turning point for tariffs lies at a lower stage of development than for exchange rate protectionism, these are both variables suggested by Polterovich & Popov (2004). The openness dummy is part of the original policy index of Burnside & Dollar (2000). Trade as a percentage of GDP is included, because it offers a more general and direct measure of trade.

Macroeconomic conditions are tested in the conventional literature by a policy index. This index is also included in this study. Following the results of this literature, it can be expected that the aid interacted with macroeconomic variables, is positive for the average country. However, these results are not very robust and lose significance in different specifications.

The political variables consist of four different measures of the health of the political system. Stability measures the amount of veto players that drop from the government. The degree of authority is based on three variables that measure the political executive recruitment. Decision making power depends on institutional constraints an executive faces. Political competition measures the extent to which alternative preferences can be pursued (Gurr, Jaggers & Marshall, 2010). Literature does not offer a clear indication at which stages the variables are most effective, but at least they are expected to be important in low stages of development.

For education and investment holds the same. Both are well known determinants of development, but it is not clear exactly in which stage of development these determinants are most effective.

Inflow of migrants implies inflow of skills, technology and expertise, which is expected to increase growth. Income equality is also proposed as a determinant of economic growth. However, keep in

mind that inequality is sometimes considered as an inevitable and temporary stage in development (Kuznets, 1955). I assume that aid in general increases inequality (Herzer & Nunnenkamp, 2012) and I investigate whether this increase in inequality harms or improves growth. Infrastructure is perceived as a basic factor in development, however as discussed earlier, building infrastructure is not the first stage in economic integration (WDR, 2009).

Note that this study is not interested in how these policy variables influence growth. What I want to know is whether and how development aid can enhance their effectiveness. For none of the variables it is clear in which stage of development aid may do this. At the utmost, I could suggest that aid would be able to influence the effectiveness of the policy at a level of development at which this particular policy is effective in itself, but this does not necessarily have to hold.

For some policies it might be more likely that aid can exercise a direct effect, such as infrastructure or education. Other policies might not be that easily influenced by aid, because the channel is not that direct (political health), because the decisions are political (trade) or because the factors are embedded in culture (migration). The remainder of this paper tries to find out at what stage of development aid is able to influence growth through the various policies.

Before turning to the results, a remark on the measure of level of development should be made. This paper uses GDP per capita. The choice is discussable, because GDP per capita does not measure development, but economic activity. Level of development also depends on technological, social and cultural factors. It is beyond the scope of this study to go further into this. Although not perfect, GDP per capita is a reasonable proxy for development and widely accepted in the literature.

IV Basic results

This paper produces a large amount of statistical output. All results tables are reported in appendix C. In order to acquire structure in the results, this section only reports the basic ordinary least squares (OLS) results of both models. Issues concerning endogenous regressors and the influence of outliers are discussed in the next section.

a. Dummy model

For each policy I run four regressions, one for every income group. A positive β_3 will indicate that the aid-policy link for that particular income group is positive.

$$\mathrm{Y_g} = \beta_0 + \beta_1\,\mathrm{Aid} + \beta_2\,\mathrm{X} + \beta_3\,\mathrm{Aid} * \mathrm{X} + \varepsilon$$

The results are shown in table 1 in appendix C. For sake of clarity, note that while interpreting the results I am not interested in the overall effectiveness of aid. Neither am I interested in the question whether a certain policy is desirable in itself. What I am focusing on is the dynamics of the interaction term aid*policy, where policy is assumed to influence growth and aid may or may not improve this link.

It is interesting to consider the original policy index first, because this is closest to former research. The least developed countries (LDC's) have a negative interaction term, which means that aid does not promote growth through this measure of policy. Only for the lower middle income countries (LMIC's) a positive interaction term is found, and for this set of countries aid does a good job in increasing policy effectiveness.

Now it seems clear that the aid-policy link indeed differs over stage of development. This paper attempts to find policies that have positive interactions with aid for other stages of development. It would for instance be nice to find a policy that helps aid to be effective in LDC's. The results are discussed below according to category.

Above is argued that getting involved in the world market is not a universal good strategy. The results confirm that aid does not promote trade effectiveness at all levels of development. The interaction term on tariffs is only negative for the upper middle income countries (UMIC's). Value of trade has only a positive interaction term for the LMIC's and UMIC's, so the relatively more developed countries. For exchange rate protectionism (foreign reserves) holds that aid can influence it for other low income countries (OLIC's) only.

The macroeconomic variables show similar results. The size of the government has positive and significant interaction terms for LMIC and UMIC countries, for lower developed countries the interaction term is negative and insignificant. The budget surplus variable is positive for LDC's, is subsequently negative for OLIC's and LMIC's, and becomes negative again for UMIC's. An inverted u-shape seems to be visible here, but is only significant for LMIC's.

The interaction term for inflation is negative for LMIC's. This suggests that when aid reduces inflation, it positively influences growth. For LDC's the opposite holds. The effect of aid * inflation is positive for growth. This means that the higher the interaction term, the higher (in absolute terms)

the effect of inflation on growth, which is counterintuitive. Note that inflation can also be an effect of economic growth, in which case the causality is not clear.

It is not surprising that these macroeconomic variables give the same conclusion as the policy index. For the LDC's alleged 'good' policies tend to be not or negatively influence by aid. Only at later stages aid is able to affect macroeconomic policies positively.

The political variables show little significance. Aid can enhance political stability for LDC's, which is the first policy we find that offers a channel for aid to enhance growth for the least developed countries. All other regressions of the political variables have insignificant interaction terms of aid*policy.

Human capital turns out to be not very important for aid effectiveness. Only schooling for LMIC's shows a positive interaction term. Note that in the most backward countries aid cannot induce development through education or schooling.

Aid has a negative effect on the effectiveness of savings for both LDC´s and LMIC´s. Assuming that a higher saving rate is desirable, this means that aid decreases savings. This is a possibility in the model of Raffinot and Venet (2011), as discussed before. Also interesting, capital formation is only positively influenced by aid for LMIC's, and is therefore not necessarily the main channel by which aid works, especially not for the extremely poor countries.

The Gini coefficient has a positive interaction term for the two most developed groups. As explained above, inequality is hard to interpret, because it can have both positive and negative effects on growth. I assume that aid in general increases inequality (Herzer & Nunnenkamp, 2012), which means that the interaction term can be interpreted as the effect of the additional inequality (caused by foreign aid) on growth. In this case, for LMIC's and UMIC's the increase in inequality seems to affect economic growth positively. Note that the causality is not clear, which biases the results. Growth might also be the source of the inequality.

Migration is a complicated variable as well, because several forces interact. According to Polterovich & Popov (2006) inflow of migrants into poor countries might be less educated than the rest of the population. Migration might induce human capital loss or gain, and it is not clear what the effect of foreign aid on migration is. The results do not show a clear story and are only slightly significant.

Infrastructure shows surprisingly weak results. One might expect that aid can easily be invested in building infrastructure, which in turn can benefit the local economy due to employment in the project and mobility. According to the results, at least one of these two links is not that straightforward.

The expectations drawn in the introduction seem to be met. Different policies can be fueled by aid at different stages of development. The most important question is what aid can do for the least developed countries. I found only one policy which has a positive interaction with aid for LDC's, namely political stability. At least as important, I also found policies that combine negatively with aid for LDC´s. These are savings and inflation.

This model only offers a subdivision into four categories based on income per capita; it's much more interesting to look how the result changes over the course of development.

b. Model with continuous measure of stage of development (parabolic model)

It is expected that the aid-policy link is effective at a certain range of development. More and less developed countries will benefit to a lesser extend from investing aid in that particular policy. For these countries it might be optimal to invest aid in other policies.

In this section, GDP per capita is used as a continuous indicator of level of development. Due to the fact that an optimal level at some level of GDP per capita is expected, a parabolic function is imposed by including GDP per capita squared. A negative coefficient on the interaction term with GDP per capita squared (β_{11}) will indicate that there is an inverted u-shape relation between the marginal effect of aid on policy effectiveness and level of development. However, this does not necessarily mean that there is an optimum within the relevant frame of income per capita.

$$Y_g = \beta_0 + \beta_1\, Aid \;+\; \beta_2\, X \;+\; \beta_3\, GDP + \beta_4\, GDP^2 + \beta_5\, Aid * X + \beta_6\, Aid * GDP + \beta_7\, Aid * GDP^2 + \beta_8\, X * GDP + \beta_9\, X * GDP^2 + \beta_{10}\, Aid * X * GDP \;+ \beta_{11}\, Aid * X * GDP^2 + \beta_{12}\, controls + \varepsilon$$

Recall the discussion in the methodology section. The marginal effect of aid on policy effectiveness (hereafter referred to as the marginal effect) is:

$$\frac{\partial Y_g / \partial X}{\partial\, Aid} = \beta_5 \;+\; \beta_{10}\, GDP + \beta_{11}\, GDP^2$$

The results are reported in appendix C, table 2. The inverted u-shape is found in most instances. Note again that the model imposes a parabolic shape, so care is required. Table 4 below shows graphs of the marginal effects for the most significant regressions, which gives insight in the evolution of the interaction term along development. The horizontal axis represents the marginal effect and the vertical axis represents GDP per capita. The points at which the marginal effect is maximized vary between 1200 and 2600 GDP per capita[15].

Trade and openness have their peak at relatively high levels of development, suggesting that these strategies are best pursued when a country has a certain level of development. Since this also appears in the dummy model, there is reasonable certainty that aid cannot stimulate benefits from trade for lower developed countries.

The macroeconomic variables have their peaks at somewhat lower points, but still for the very poor aid cannot help in making the macroeconomic policies more effective. This is also reflected by the dummy results.

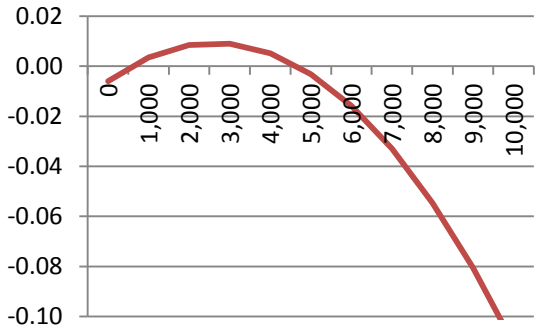
Political stability has always a positive interaction term. The other three political variables have strong results and have a clear inverted u-shape. However, for very low levels of development, these policies interact negatively with aid.

The interaction term of aid and schooling is positive in a short interval of development. At zero GDP per capita the effect is zero, but it starts rising immediately afterwards. From the level of 2000 US dollar GDP per capita onwards it is negative again.

[15] The mean of GDP per capita in constant US dollars is 2837, the median is 1764.

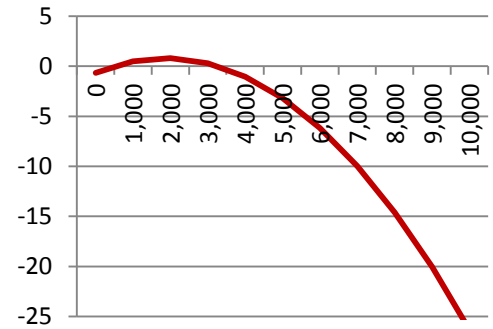
Table 4: Graphs of marginal effect as a function of GDP per capita

Trade (percentage of GDP)



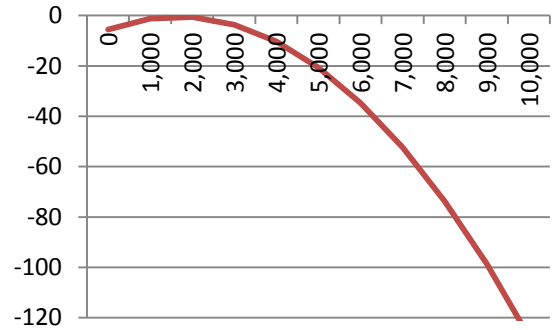
Peak: 2624

Openness



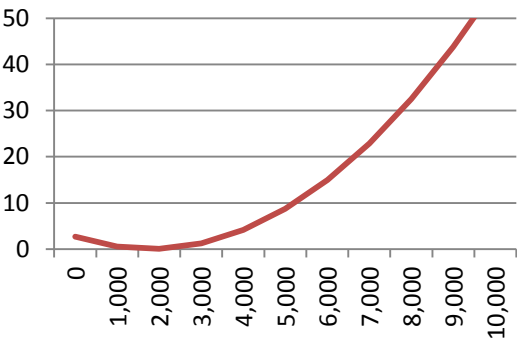
Peak: 1880

Budget surplus



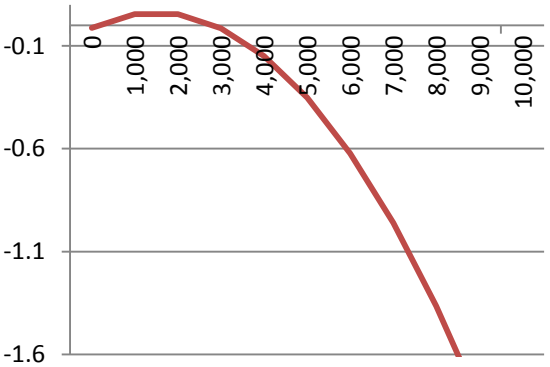
Peak: 1671

Political stability



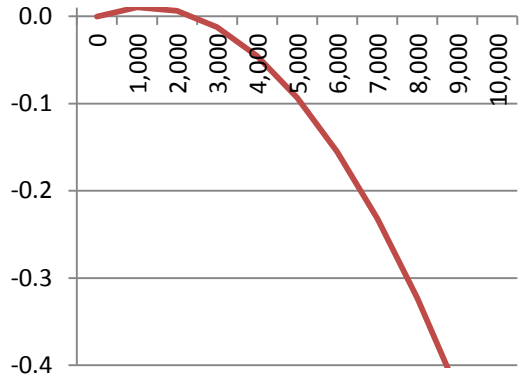
Peak: 1783

Political competition



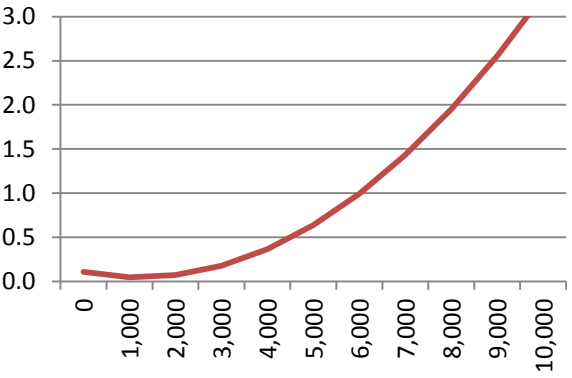
Peak: 1492

Schooling



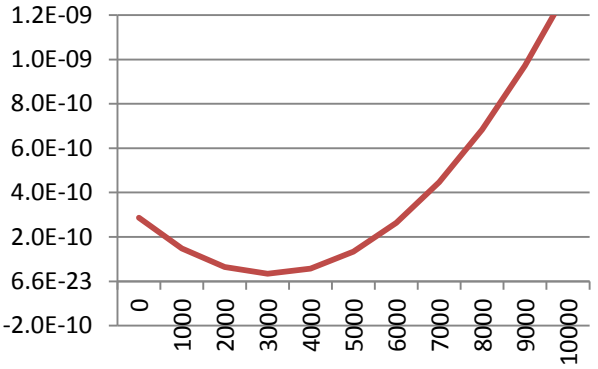
Peak: 1224

Gini coefficient



Peak: 1220

Capital formation



Peak: 3071

The horizontal axis shows GDP/capita, the vertical axis shows the marginal effect of aid on policy effectiveness.

The saving rate is constantly negatively influenced by aid. Capital formation is constantly a positive channel for aid to affect growth. The interaction term of aid with the Gini coefficient is constantly positive, which was also found before. Migration and infrastructure show no clear results.

In order to interpret the results properly, note that the marginal effect of interest is a function of GDP per capita and GDP per capita squared. This means that also the standard error depends on GDP per capita and therefore changes with GDP per capita. I calculated the t-value at different levels of GDP per capita for each policy. Appendix B discusses this in depth. In most cases the t-value is significant at zero GDP per capita and then drops immediately[16]. Subsequently, the t-value starts rising gradually, but crosses the 1.96 point far beyond the average GDP per capita level.

Unfortunately, the marginal effect is not significant at the peaks of any policy. Still, the data give interesting results. In almost all cases, the marginal effect is negative for the lower levels of development, becomes positive afterwards, and subsequently drops forever. This means that for every policy there is only a specific interval in which aid can be helpful. Note that in every interval where the marginal effect is positive, aid is able to increase this policy effectiveness.

Many of the results of both models are consistent with each other. Aid can affect the effectiveness of trade variables for relatively high levels of development. At slightly lower levels of development, macroeconomic variables can be supported by development aid. For the lowest levels of development, political stability is important. Other political variables are important at somewhat higher levels of development.

Aid can enhance growth through schooling, but only for intermediate developed countries. The effectiveness of the saving rate is always negatively influenced by aid, and the effectiveness of capital formation is very often positively influences by aid. Finally, the interaction term of aid and inequality increase growth, but, as discussed above, there are different interpretations possible for this finding.

[16] At GDP per capita = 0, β_5 directly represents the marginal effect and significance.

V Endogeneity

Although the results above are interesting, they should be interpreted with care. The aid effectiveness literature is characterized by a large discussion on the robustness of the results. Results that are consistently significant through different specifications seem to be hard to find. In this section the role of endogenous regressors is discussed.

a. Aid lagged

In the aid effectiveness literature endogeneity is a serious problem. A reversed causality bias arises when the aid decision depends on the situation in the recipient country. The donor might give more aid to countries that suffer more, or conversely give more aid to countries with better chances to improve. Note that the direction of the bias is not clear. The ordinary least squares (OLS) results could be over- or underestimated.

For the reasons stated above, the OLS estimations might neither be unbiased nor consistent. There are different ways to address this and I will follow them step by step in order to see what changes when. First I will assume that the aid decision of donors cannot be influenced by next periods GDP per capita growth, and use lagged aid instead of aid. Subsequently, I will use the instrumental variable approach of Hansen & Tarp (2001), which is in fact an expansion of the original set of instruments of Burnside & Dollar (2000). Finally, I construct a dataset included bilateral aid flows in order to construct a non-economic motivated instrument, which is in line with Rajan & Subramanian (2005).

For sake of simplicity, these experiments are performed using the parabolic model. This will keep the statistical output manageable. At the same time this is the more complex model of the two, which means that when instruments are found to be proper, they are probably also good in the dummy model. Later on, the dummy model with the best instruments is estimated.

The simplest way of addressing endogeneity is to use the lagged version of the endogenous variable. The parabolic model contains five variables that are a variation of aid, so five terms might be endogenous. The results are shown in appendix C table 3. I will briefly discuss the results.

Government share, capital formation and savings change from non-significant to significant, although capital formation and savings do not show an inverted u-shape. Stability improves significance. Migration and openness are robust. Overall, the coefficients and the significance are much lower. This is not surprising, because a less direct relation is tested. The downside of this approach is that it doesn't estimate what I am really interested in, namely the effect of aid(t) on GDP per capita(t). Moreover, lagging a variable will induce a loss of observations.

The most important finding is that significance disappears and coefficients become smaller. It is definitely important to find other strategies to address endogeneity.

b. Conventional instruments

Another more accurate way of addressing endogeneity is the use of instrumental variables. It is usually difficult to find proper instrument, so I will follow the conventional literature in their choice for instruments.

The set of instruments that are used by Burnside & Dollar (2000) are shown in the second column of table 5. The parabolic model has four additional terms that include aid. I obtain extra instruments by interacting the original instruments with GDP per capita, GDP per capita squared and policy. In order to improve the efficiency of the estimation, Hansen & Tarp (2002) include the lagged versions of the endogenous regressors as instruments[17]. These are shown in the third column of the table.

Table 5: overview of instruments

Endogenous regressors	**Original instruments**	**Additional Hansen & Tarp**
Aid	Logarithm of population	Aid(t-1)
	Arms(t-1)	
Aid*policy	Log of pop * policy	Policy *aid(t-1)
	Log of pop² * policy	
	Arms(t-1) * policy	
	Log of income * policy	
	Log of income² * policy	
General	Egypte dummy	Policy(t-1)
	Franc zone dummy	Policy² (t-1)
	Central america dummy	
Instruments obtained by extra interaction		
Gdp*aid	Arms(t-1) * gdp	Gdp*aid(t-1)
	Log of pop * gdp	
Gdp²*aid	Arms(t-1) * gdp²	Gdp²*aid(t-1)
	Log of pop * gdp²	
Gdp*aid*policy	Arms(t-1) * policy * gdp	Gdp*aid*policy(t-1)
	Log of pop * policy * gdp	
Gdp²*aid*policy	Log of pop * policy * gdp²	Gdp²*aid*policy(t-1)
	Arms(t-1) * policy * gdp²	

In aid effectiveness literature the two stage least squares (2SLS) approach leads almost consistently to lower significance. The most important exception is Burnsides & Dollar (2000), who find a significant aid*policy term after instrumenting. This was fiercely debated by Easterly et al. (2003), who didn't find this significance after expanding the dataset. The results seem rather unstable. In general, it can be expected that the 2SLS results are weaker than the OLS results.

The results are shown in table 4 of appendix C. The first thing that catches the eye is the weak significance of almost all variables. Note that proper instruments should satisfy two assumptions. They should correlate with aid, but be uncorrelated with economic growth.

I use the Kleibergen-Paap LM statistic to test the null-hypothesis of under-identification. The Cragg-Donald Wald F-statistic tests the weak identification hypothesis. This test should be interpreted using the Stock-Yogo critical values, which are not available for all instruments jointly. These critical values are only computed for one endogenous variable at the time, so there is no joint critical value for all

[17] A downside of this is that it implies a loss of observations.

endogenous variables. The individual F-test and critical value are not reported in the table[18]. In general holds that the higher the F-score is, the stronger the instruments are. However the high F-score might be produced by only one or two strong instruments.

To see whether the instruments are not correlated with dependent variable, I execute the Hansen J-test for over-identification, with the null-hypothesis that the instruments are valid. I also test whether the alleged endogenous variables are in fact exogenous. The error term of the first stage regression is used as a variable in the original equation. If its coefficient is zero the OLS estimates are consistent. This test might lose power when the instruments are not correct; however Tchatoka & Dufour (2007) argue that as long as one instrument is correct, the test is valid.

The under-identification test indicates whether the instruments explain the endogenous variables sufficiently. In most cases under-identification can be rejected. However, weak identification appears to be a problem in many of the regressions. As explained above, a formal cut-off point is not offered, but a closer look at the first stage regression for each instrument individually shows that the instruments are not perfect. Note that weak instruments might be a cure that is worse than the disease.

The Hansen J-test is rejected in almost all regressions, which again lowers the faith in the instruments.

The exogeneity test is never rejected. This means that the alleged endogenous regressors do not suffer from serious problems, and the OLS estimation can be trusted to a certain extent, as long as one instrument is correct.

The results can be considered as intermediate only. The reserve variable suddenly shows significant positive coefficients, which did not happen in any of the models before. The budget surplus variable still shows an inverted u-shape. Political authority has a u-shape, contrary to the OLS estimation.

Further, all drop significance. This is what happens a lot in literature, with 2SLS the significance is hard to find. The instruments here are not very convincing. Although they are accepted in literature, it is not very likely that they are strictly exogenous. Fortunately, there is a more sophisticated way to construct an instrument, proposed by Rajan & Subramanian (2005).

[18] This produces too much statistical output. Please request the Stata-file and do-file.

c. Bilateral instrument

Rajan & Subramanian (2005) argue that the instrument choice of the conventional papers has great shortcomings. It is very hard to motivate why population and imports of arms would be correlated with aid and would be unrelated with GDP per capita growth. Therefore they propose a different way of generating an instrument, based on non-economic motivated aid.

The main idea is to calculate the expected amount of aid received by a recipient, based on a set of non-economic explanatory variables. These variables are shown in table 6.

Table 6: Construction of the bilateral instrument

Variable	Description	Source
Share Bilateral aid	Aid donor towards recipient / total aid donor	OECD
Strategy	Donor and recipient common member dummy	Correlates of War
Camp Davis	1 for US-Egypt & US-Israel after the Camp Davis agreement	Manually
Common colony	Recipient was former colony of donor	CEPII
Colony UK	Recipient was former colony of the UK	CEPII
Colony FRA	Recipient was former colony of France	CEPII
Colony SPA	Recipient was former colony of Spain	CEPII
Colony POR	Recipient was former colony of Portugal	CEPII
Current colony	Recipient is current colony of donor	CEPII
Common language	Common language donor recipient	CEPII

$$a_{drt} = constant + \beta' X'_{dr} + \varepsilon_{drt}$$

Variable a_{drt} is the share of total aid expenditure of donor d that flows to recipient r. The estimated β' is used to calculate the fitted value of each observation, $\tilde{a}_{drt}$[19]. This is multiplied by total aid of a donor to get the amount of aid that flows from donor to recipient. Summing up these amounts for all donors gives the amount a recipient expects to receive each period, based on non-economic motivation of aid.

$$Z_{rt} = \frac{\sum_d \tilde{a}_{drt} * total\ aid_{dt}}{GDP_{rt}}$$

The result is an instrument, Z. To obtain a sufficient amount of instrument to meet identification, I need to generate interaction terms. The terms that include aid will be instrumented by the same term, with Z substituted for aid. Note that there is no over-identification test possible here, since there are as many instruments as endogenous variables.

The instrument appears to have a high correlation with actual aid. At this point it is insightful to discuss the effect of the instruments on the results of Rajan & Subramanian (2005) with the original

[19] $\tilde{a}_{drt} = .0172981 + .002594 * language + .0671848 * common\ colony + .0153588 * current\ colony + .1475707 * Camp\ Davis - .0574475 * colony\ Fra - .0672818 * colony\ UK - .0532178 * colony\ Spa + .0431916 * colony\ Por + .0095232 * Strategy$

equation[20]. Rajan & Subramanian (2005) consistently find that the instruments correct for the overestimated negative effect of aid in the OLS results. For the interaction term of aid and policy holds that with OLS the p-value of the coefficient is just above 0.1. The IV results show much lower significance.

Continuous measure of level of development (parabolic model)

Table 5 in appendix C shows the results of the parabolic model with the instruments of Rajan & Subramanian (2005). At first sight it becomes clear that less coefficients are significant compared to the OLS results, consistent with the alleged overestimation of OLS. Before discussing what implication the results have for the allocation of aid, the validity and necessity of the instruments are tested.

The same testing procedures as above are used here, except for the over identification test, which requires more instruments than endogenous variables. Since it cannot be tested whether the instruments are uncorrelated with GDP per capita growth, I will have to assume it. At any rate, the instruments are much more likely to be exogenous than the original instruments of Burnside & Dollar (2000). I will discuss the results according to the validity of the instruments.

Six regressions have valid instruments, have correctly excluded endogenous variables and have significant interaction terms. These include the four political variables, which show similar coefficients as in the OLS model. The other two, trade and openness, show slightly different results than the OLS results, but roughly the same conclusion can be drawn.

In seven regressions the instrumented variables appear to be exogenous, which means that the OLS estimates might be a better indication. These are tariff, size of the government, foreign exchange reserves, schooling, education, capital formation and migration. For most of them, the OLS estimates did not find a significant effect, so we can conclude that these variables are not important in combination with aid. Schooling, however, has significant OLS coefficients. Also, capital formation might have a positive effect for the very poor, according to the OLS estimations.

For six regressions holds that the instruments are valid, the coefficients on the interaction terms are insignificant and the OLS estimates are not consistent. This means that we cannot find an effect and the OLS results are not trustworthy. These are budget surplus, inflation, the policy index, FDI, the Gini coefficient and infrastructure. Note that two of the three original policy variables and the policy index are among these.

One regression, savings, has both under-identified instruments and endogeneity, meaning that not much can be concluded.

As expected, the 2SLS results are weaker. Again it is found that aid can only influence trade effectiveness for relatively high developed countries. Political stability is the only policy that appears to be positively related with aid for the poorest of the poor. One difference is that aid appears to be

[20] Only aid, aid*policy and the control variables are included in the regression.

not effective in combination with macroeconomic policy at all. For schooling and capital formation, I find that the OLS results are trustworthy.

Dummy model

The results of the dummy model estimated with the instrumental variables are shown in appendix C, table 6. The endogeneity test is executed when OLS results were good and 2SLS are weak, but at no instance the test fails to reject the null hypothesis of endogeneity.

The trade variables show the same conclusions as the OLS estimation of the dummy model. Only at high stages of development the interaction terms are positive. Also, the macroeconomic variables are consistent to the instrumental variables approach; more or less the same results are generated. The interaction term for political stability for LDC's is still the only significant coefficient of the policy variables. It is remarkable that the other three policy variables are, both with OLS and 2SLS, very strong in the parabolic model, but weak in the dummy model. A possible reason for this could be the difference in sample. The dummy model leaves out a number of observations.

Table 7: Summary of main findings

Category	**Significance**	**Conclusion**
Trade	High	In both the dummy and parabolic model (and both OLS en 2SLS), there is a strong indication that aid can only enhance growth through trade for relatively high developed countries. It might even be harmful for low developed countries to use aid to pursue trade or openness.
Macroeconomic	Medium	OLS estimation shows that aid cannot enhance the effectiveness of macroeconomic policy for the least developed countries, but it does for the somewhat more developed countries. Not all results survive instrumentation.
Political	Medium	The parabolic model consistently finds positive interaction terms over a large range of development. Unfortunately, the dummy model only finds the stability variable to be relevant. Political stability is a feasible aid strategy for low income countries. The other political variables are only relevant at higher levels of development.
Education	Medium	Public spending on education turned out to be a useless variable. Enrollment in school is a channel by which aid can enhance growth, except for the extreme poor, according to both models estimated with OLS. The 2SLS estimation of the parabolic model suggests that the OLS results are consistent, but this does not hold for the dummy model.
Investment	Medium	Capital formation is important for aid effectiveness for all levels of developed, although the 2SLS results are not convincing. The saving rate is always reduced by aid, but this is solely based on OLS results of the dummy model. FDI turned out to be unimportant in this study.
Social	Medium	Both inequality and migration are hard to interpret. The dynamics of aid and migration might vary a lot, but this result is not very robust. The interaction of the Gini coefficient with aid is always positive, but not very robust.
Infrastructure	Low	There is no indication that infrastructure is a feasible aid strategy. Note that the telephone lines variables is only one of many possible proxies for infrastructure.

For the human capital and investment variables, the instruments are weak, and where the instruments are correct, they are insignificant. This means that they are not robust to endogeneity. Only capital formation keeps the same conclusion.

Table 7 summarizes the findings until now. Although not all results are equally strong, there is enough information in the data to give a clear conclusion. The most important policies required to find this conclusion are tested for robustness in the next section.

VI Robustness checks

As mentioned before, the aid effectiveness literature is characterized by discussions on the robustness of results. Now the dataset is complete for both OLS and 2SLS it is easy to execute several sample restrictions. The keep the output manageable, only a subset of the policy variables is used. For the same reason as in the previous section only the parabolic model is used here.

Due to the fact that not all policy variables show sufficiently strong results, it is not necessary to consider all of them in this section. The strongest results in the 2SLS regression come from trade/GDP, openness, political stability, authority and migration[21]. For two variables the 2SLS results are weak, but their OLS results are reliable according to the exogeneity test. These are schooling and capital formation.

For the first five variables the effects of changes in the sample are tested by the 2SLS parabolic model, for the last two the OLS parabolic model is used. The subset of seven variables does not contain any macroeconomic variable, because the 2SLS show no effect and the OLS results cannot be trusted or show no effect either.

a. Shorter sample

A popular experiment in literature is to play with the time frames. One can imagine that over the course of time people learnt better how to spend development aid. Therefore one might expect that for periods after e.g. 1980 the effects are larger and more significant. Also, Bearce & Tirone (2010) state that after the Cold War aid became more effective.

Many papers discussed in the literature section (e.g. Rajan & Subramanian, 2005) find weaker results for shorter samples. I re-estimate the regressions for the subset of policy variables without the first four periods, so the sample contains six 4-year periods from 1978 until 2001.

Table 7 of appendix C indeed shows that the coefficients tend to become smaller and less significant, but this drift is not strong enough to change the conclusion. The capital formation regression even becomes more significant. The stability variable shows exactly the same results, because no complete observation from before 1978 exists.

It is clear that in general the results for the second half of the sample are weaker. Out of all OLS regressions only for three regressions better results are obtained[22]. However, for the subset of policy variables the results are still robust to this shorter sample.

[21] Political authority, decision making and political competition are highly correlated, so only one of these are considered in this section. Migration might have reliable OLS estimates, but here it is tested according to 2SLS results.

[22] See the footnotes of appendix C table 2.

b. Outliers

Easterly et al. (2003) argue that the results are for a large part driven by a few outlying observations. It is therefore important to address the issue of outliers. Burnside & Dollar (2000) pick 5 outliers from their sample[23], and find that the quadratic term entirely relies on these outliers. Hansen & Tarp (2001) exclude outliers, depending on the specific regression.

Easterly et al. (2003), Roodman (2007), and Rajan & Subramanian (2005) detect outliers on a more formal and objective way, using the Hadi (1992) procedure. This procedure allows for detecting outliers based on a combination of two or more variables.

It is clear from the literature that outliers have great influence on the results. Unfortunately there is not a pre-description on how to deal with it. Outliers can be cause by measurement error or other types of misreporting. However, some outliers are legitimate. Not all outliers should be excluded, since they might contain valuable information.

It is beyond the scope of this paper to investigate the role of outliers in depth. The literature where my analysis is based on uses two different methods. I think it's best to see the effect on the results of excluding both sets of outliers separately.

First I will simply exclude the five Burnside & Dollar (2005) outliers. These outliers are detected according to the impact of the observation on the slope of the interaction term aid*policy. These outliers only hold for the original policy index and say little about outlying observations for the other policy variables. It is necessary to detect outliers for every policy individually. I use the formal Hadi procedure to find outliers in the aid-policy dimension for every policy. Note that the number of outliers is different for every regression.

The exclusion of the Burnside & Dollar (2005) outliers has an effect on the results, but cannot offset the conclusions. It seems that the results of the subset of seven policy variables are robust to these five outliers.

The exclusion of the Hadi outliers gives a radical different result. Only two terms remain to be significant, all the others drop dramatically. In another experiment, where the outliers are detected in the aid*policy – growth dimension, the results are even worse. Extremely large amounts of outliers are detected and not any coefficient remains significant.

Since these results are troublesome, let's see what the Hadi procedure actually does. Appendix C table 9 shows the scatter plots of the interaction term aid*policy and growth with and without Hadi outliers. The Hadi procedure detects many outliers, but a great share of them does not seem to be real outliers. Although it is clear that some observations are very influential, the Hadi procedure might be too enthusiastic in deleting outliers.

[23] Gambia 1986-1989, 1990-1993; Guyana 1990-1993; and Nicaragua 1986-1989, 1990-1993

VII Conclusion

This paper went deeper into the dynamics of aid, policy and growth in order to get more insight in how foreign aid works. 'Good policy' was disentangled into a set of 20 different policy measures, and it was asked at what stage of development which policies can be enhanced by aid.

I assumed that aid doesn't influence economic growth directly. Aid might only influences different policies, which in turn influences economic growth. Aid can therefore only influence 'policy effectiveness'. Subsequently, I tested the 20 policy variables and the role of stage of development using two models.

In the aid effectiveness literature the robustness of results is often weak. In order to address endogeneity of aid, I adopted an instrumental variables approach based on non-economic motivated aid. Also, regressions were run for a shorter time frame and for samples that excluded or included outliers.

I find that a robust interaction term of aid and macroeconomic policies in a regression on economic growth is hard to find. This is a dreadful confirmation of former literature. Even if one would trust the results despite of the robustness problems, it becomes clear that aid is not helpful in combination with macroeconomic policies for the least developed countries. Fortunately, other policies show a stronger interaction with aid.

Several trade and openness variables show to be consequently significant throughout different models and different estimation methods. Development can be enhanced by aid through these policies, but only for the relatively more developed counties.

In the introduction I stated that it is counterintuitive that, according to a part of the literature, aid should not be sent to countries with the worse conditions. This paper found that even for the least developed countries foreign aid can actually be helpful. The most robust policy that interacts positively with aid for underdeveloped countries is political stability. Also, but a little weaker, schooling and capital accumulation are policies through which aid can be effective for very poor countries.

A number of policies that were expected to be important for aid effectiveness turned out to be weakly correlated with aid and growth, most notably FDI, education and infrastructure. The role of inequality and migration is not clear, because their results are not very strong and can be interpreted in different ways.

The results give important insight in how aid works. It is now clear through which channels aid can be effective for a certain type of country. Although it might be helpful to invest aid into these policies, this is not what the data says. What the data actually says is that aid 'somehow' affects the effectiveness of a certain policy. This does not necessarily mean that aid has been invested in this particular policy, hence I cannot give the advice that aid will be effective when spent on this policy.

This is in fact a great drawback of this study, and the main reason why more research is required. Future research could for example try to subdivide aid according to what it was actually spent on.

Since this is not clear now, some results might be not realistic. If in a country aid has never been spent on education, it is unlikely to find an indication of a positive interaction term aid*education, even though it might be very beneficial to invest aid in education in this country.

Although no hard policy advice can be made, it became clear that effective aid allocation depends on more factors than Burnside & Dollar (2000) suggest and it requires a specific assessment of policy and recipient country. Altogether, this paper offers a step towards a more tailored aid allocation.

References

Armendariz, B. & Morduch, J. (2007). *The Economics of Microfinance.* Massachusetts: Massachusetts Institute of Technology.

Banks, A. (2002). *Cross-National Time-Series Data Archive*, Bronx, NY: Databanks International.

Barro, R. (2012). Convergence and Modernization Revisited. *not published, Harvard University.*

Bearce, D & Tirone, D (2010). Foreign aid effectiveness and the strategic goals of donor governments *The Journal of Politics*, 72(3), 837–851.

Bezemer, D. & Wijsman, K. (unknown year). Aid Effectiveness in Africa Requires Good Policies - But What is Good? Not published, *Working Paper University of Groninge.* Retrieved from: http://www.uneca.org/trid/documents/Macro_24nov08/addis%20paper%20Bezemer.pdf

Bosworth, B & Collins, S (2003). The Empirics of Growth: An Update. *Brookings Papers on Economic Activity*, 34(2), 113-206.

Bourguignon, F. & Sundberg, M. (2007) Aid effectiveness—opening a black box. *American Economic Review: Papers and Proceedings*, 97(2), 316-321.

Burnside, C. & Dollar, D. (2000). Aid, policies and growth. *The American Economic Review*, 90(4), 847–868.

Collier, P. & Dollar, D. (2002). Aid allocation and poverty reduction. *European Economic Review,* Elsevier, 46(8), 1475-1500.

Correlates of War Project (2002). Correlates of War 2, University of Michigan

Dalgaard, C.J., Hansen, H. & Tarp, F. (2004). On the empirics of foreign aid and growth. The Economic Journal, Royal Economic Society, 114(496), F191–F216.

Dalgaard, C.J. (2008). Donor policy rules and aid effectiveness. Journal of Economic Dynamics & Control, 32(2008), 1895–1920.

De Soto, H. (2001). The Mystery of Capital. Finance & Development, IMF, 38(1).

Doucouliagos, H. & Paldam, M (2007). Aid effectiveness on growth: A meta study. European Journal of Political Economy, 24(2008), 1–24.

Doucouliagos, H. & Paldam, M (2009). The aid effectiveness literature: The sad results of 40 years of research. Journal of economic surveys, 23(3) 433-461.

Drukker, D. (2003). Testing for serial correlation in linear panel-data models. The Stata Journal 3 (2), 168–177.

Easterly, W. (2006). The White Man's Burden: Why the West's Efforts to Aid the Rest Have Done So Much Ill and So Little Good. The Penguin Press HC, New York.

Easterly, W., Levine, R. & Roodman, D. (2003). New data, new doubts: revisiting ‘‘Aid, policies, and growth (*NBER Working Paper No. 9846).* Retrieved from:

http://www.cgdev.org/content/publications/detail/2764

Gale, D. (1974). Exchange equilibrium and coalitions: An example. *Journal of Mathematical Economics,* 1(1974), 63-66.

Gurr, R., Jaggers, K. & Marshall, M. (2010). Polity IV Project: Dataset Users' Manual. Center for Systemic Peace.

Hadi, A. (1992). Identifying Multiple Outliers in Multivariate data. *Journal of the Royal Statistical Society*, B(54), 761–771.

Hansen, H. & Tarp, F. (2001). Aid and growth regressions. *Journal of Development Economics*, 64 (2) 547-570.

Herzer, D. & Nunnenkamp, P. (2012). The Effect of Foreign Aid on Income Inequality: Evidence from Panel Cointegration, *Kiel Institute for the World Economy*, Working paper no. 1762.

International Monetary Fund (IMF) (2012). International Financial Statistics database, Washington, DC (July).

Kasuga, H. & Morita, Y. (2012). Aid effectiveness, governance and public investment. *Economic Modelling, Elsevier*, 29(2), 514-521.

Knack, S. & Keefer, P. (1995). Institutions and Economic Performance: Cross-Country Tests Using Alternative Institutional Measures. *Economics and Politics*, 7(3), 207–27.

Kuznets, S. (1955). Economic Growth and Income Inequality. America Economic Review, 45(1): 1-28.

Moyo, D. (2009). Dead Aid: Why Aid Is Not Working and How There is Another Way for Africa. New York: Farrar, Straus and Giroux

OECD, DAC (Development Assistance Committee) database on Aid, 2012.

Polterovich, V. & Popov, V. (2004). Appropriate Economic Policies at Different Stages of Development. *NES Journal of the New Economic Association*. 2011(11), 107-126.

Rajan, R. & Subramanian, A. (2005). Aid and Growth: What Does the Cross-Country Evidence Really Show? (International Monetary Fund Working Paper 05/127). Retrieved from: http://www.imf.org/external/pubs/ft/wp/2005/wp05127.pdf.

Roeder, P.G. (2001). Ethnolinguistic Fractionalization (ELF) Indices, 1961 and 1985. Retrieved from: http//:weber.ucsd.edu\~proeder\elf.htm.

Roodman, D. (2007). The Anarchy of Numbers: Aid, Development, and Cross-Country Empirics. *World Bank Economic Review, Oxford University Press*, 21(2), 255-277. Data obtained from: http://www.cgdev.org/content/publications/detail/2745.

Sachs, D (2004). "Stages of Economic Development", Speech at the Chinese Academy of Arts and Sciences, Beijing, June 19

Tchatoka, F. & Dufour, J.-M. (2007). Exogeneity tests and estimation in IV regressions. *Not published.* Retrieved from: http://www.econ.upf.edu/docs/seminars/dufour.pdf

World Bank (2012). World Development Indicators 2003 database, Washington, DC.

Appendix A – data description

Table A1: variable description

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP/capita growth	1240	1.47771	5.308716	-43.65384	46.8469
Aid per capita	1164	1.454303	2.750737	-12.60611	33.09496
Log of initial GDP	1169	7.494909	.9142816	4.213761	10.97509
Assassinations	1308	.1966743	.716873	0	11.5
Fractionalization	1050	.4400952	.2925953	0	.93
M2, lagged	977	32.0188	29.63055	.0461627	534.5886
Political risk	1150	4.476896	1.90737	0	10
Sub Saharan Africa	1700	.2823529	.4502766	0	1
East Asia	1700	.0470588	.211827	0	1
Tariff	576	10.70188	11.12472	0	183.38
Trade / GDP	1508	79.59278	49.94413	0	431.0305
Openness	956	.3111925	.4497472	0	1
Foreign reserves	1497	6.55e+09	5.18e+10	45000	1.74e+12
Government share	1450	15.65374	7.086934	2.308769	58.96301
Budget surplus	855	-.0341417	.0560662	-.4503273	.4775561
Inflation	1026	.178878	.3549252	-.0633278	3.878448
Policy index	Different in each sample				
Political stability	1207	-83.28106	269.5471	-999	.75
Authority	1474	.9414292	15.34948	-85.25	8
Decision rule	1474	-.4562981	15.08963	-85.25	7
Political competition	1474	.3290366	15.45055	-85.25	10
Education	785	4.426243	3.3525	.4249725	49.51542
Schooling	1316	51.90864	31.84081	.05661	162.763
FDI	581	.7026767	2.272963	-3.352062	28.77492
Capital formation	938	1.31e+10	4.77e+10	3082211	1.01e+12
Savings	1468	15.51622	16.19549	-99.5549	80.40018
Telephone lines	1676	8.967855	13.05487	.0118124	89.92067
Migration	1457	-50724.97	371376.3	-3418302	4200000
Gini coefficient	486	41.42764	10.16053	19.4	74.33

Table A2: the development stage dummies

GDP/capita	Obs.	Mean	Std. Dev.	Min	Max
LDC	411	453.2349	609.6405	74.983	8045.924
OLIC	110	450.1928	180.2321	137.2146	991.9935
LMIC	431	1230.972	617.9679	84.61497	3623.3
UMIC	361	4028.078	2203.468	270.282	13601.76

Table A3: original instruments

Variable	Obs.	Mean	Std. Dev.	Min	Max
Arms import	967	.0596337	.1802557	-.2984421	2.461196
Egypt	1700	.0058824	.0764931	0	1
Log of population	1601	15.06098	2.00624	9.680344	20.94013
Sub Saharan Africa	1700	.2823529	.4502766	0	1
Franc zone	1708	.0761124	.2652556	0	1
Central America	1708	.0409836	.1983103	0	1

This dataset is structured in the same way as the main dataset. There are ten 4-year time periods, from 1962 until 2001. Aid flows are organized into three categories: donor, recipient and year.

Table A4: bilateral dataset instruments

Variable	Obs	Mean	Std. Dev.	Min	Max
ODA (mln$)	20290	20.81694	99.51563	-343.7825	4438.567
Total donor (mln $)	20290	2935.484	3497.239	1.75	23514.25
ODA / total donor	20290	.0085637	.0310566	-1.085146	.8064126
Common language	20290	.182898	.3865924	0	1
Common Colony	20290	.0646131	.245848	0	1
Currunt Colony	20290	.0086537	.090393	0	1
US-IS-EG, Camp Davis	20290	.0006407	.024813	0	1
Comcolfra	20290	.0163135	.1266812	0	1
Comcoluk	20290	.0290291	.1678922	0	1
Comcolspa	20290	.0050271	.0707254	0	1
Comcolpor	20290	.0021193	.0459879	0	1
Strat	20290	.0095121	.0970673	0	1
Atilde (fraction)	20290	.0193653	.0103538	.0172011	.1674628
Atilde (mln $)	20290	58.22203	93.38746	.0302717	3175.249
Inserted into main dataset					
Fitted aid	1617	677.6166	443.4563	0	4051.479
Fitted aid / GDP	1145	.6686616	1.680988	0	24.15329

The fraction ODA /total donor is the dependent variable in the regression. The fitted value of this (atilde) is also a fraction, but is converted into dollars by multiplying with total donor. This last value is summed over all donors for every combination over recipient and year, and subsequently divided by GDP to get fitted aid/GDP for each recipient in a period.

Appendix B - interpretation

As discussed in the methodology section, I am interested in the marginal effect of aid on the marginal effect of policy in economic growth. This is the ability of aid to influence the effectiveness of a policy, and is given by:

$$\frac{\partial Y_g/\partial X}{\partial\ Aid} = \beta_5 + \beta_{10}\, GDP + \beta_{11}\, GDP^2$$

As is clear from the equation, this marginal effect depends on a general effect and on the level of development. Since the marginal effect is a function of multiple coefficients, the variance is not directly obtainable from the statistical output. In order to see in which situations the marginal effect is significant, I do the following manipulations.

$$se\,(\frac{\partial Y_g/\partial X}{\partial\ Aid}) = \sqrt{Var\,(\beta_5 + \beta_{10}\, GDP + \beta_{11}\ GDP^2)}$$
$$= \sqrt{var(\beta_5) + (GDP)^2 * var(\beta_{10}) + (GDP^2)^2 * var(\beta_{11})}$$

The mean standard error, which I observe in the statistical output, is the square root of the variance, so

$$se^2 = var(\beta)$$

Inserting this into the formula above gives,

$$\sqrt{se(\beta_5)^2 + GDP^2 * se(\beta_{10})^2 + (GDP^2)^2 * se(\beta_{11})^2}$$

which is the variance of the total marginal effect. Since this term varies with GDP per capita and GDP per capita squared, it might not be significant for all values of GDP per capita, even when the mean standard errors of all coefficients are significant. Every level of GDP per capita has its own significance level. It is possible to calculate all t-values, and see when it exceeds 1.96 for every policy.

<u>The peak</u>

The main objective of this study is to find the most effective channel for aid. For all policies that are analyzed, we can draw a graph as below. To find the 'GDP per capita'-value of every peak, the derivative of the marginal effect with respect to GDP per capita is taken and set to zero. Solving gives the GDP per capita level at the point at which the marginal effect is at its maximum.

$$f = \beta_5 + \beta_{10}\, GDP + \beta_{11}\, GDP^2$$
$$f' = 0 \ \rightarrow\ \beta_{10} + 2 * \beta_{11}\, GDP = 0 \ \rightarrow\ GDP = \frac{-\beta_{10}}{(2 * \beta_{11})}$$

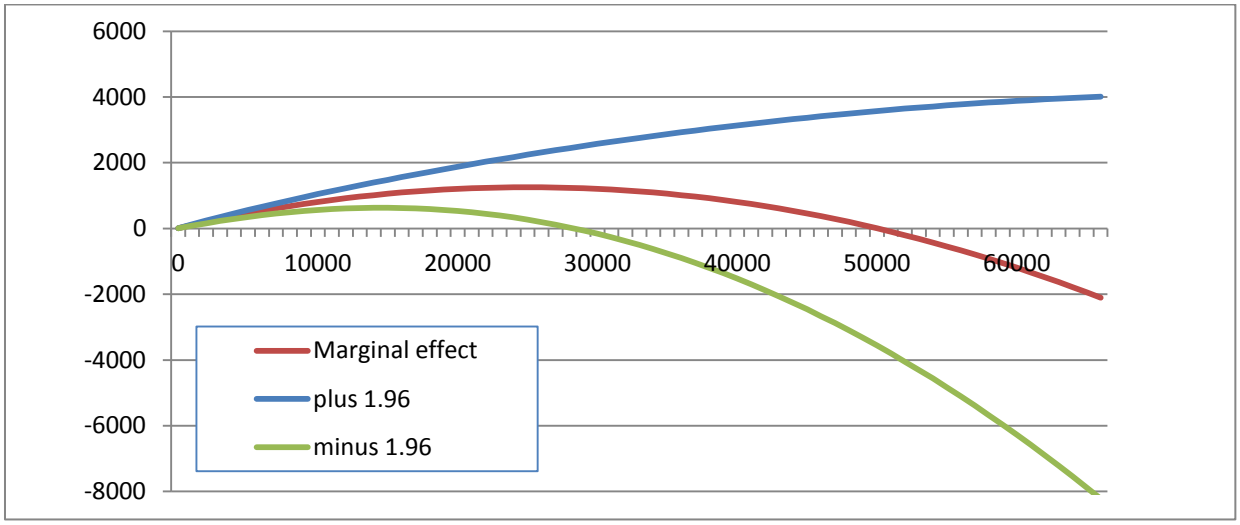
For this level of GDP, the specific combination of aid*policy is the most effective.

Example

Now consider an example. Suppose the following results are estimated for a certain policy.

	Coefficient	**Std. error**
β_5	6	0.8
β_{10}	0.1	0.01
β_{11}	-2.00E-06	7.00E-07

Using the coefficients, the functions for all realistic values of GDP per capita are plotted:



The marginal effect (of aid on policy effectiveness) has a peak at GDP per capita of 25,000. At GDP per capita = 0 the standard error is 0.08, with a t-value of 7.5, extremely significant. At low levels of development, the standard error decreases, until a certain level (+/- 1000). At higher levels of development, the standard error of the marginal effect as a whole becomes larger, so the effect itself becomes less significant. At 29,000 the t-value drops below 1.96, which means it is insignificant.

The peak is at 25,000, which means that it is within the range of significant marginal effects. For observation above 29,000 the results lose significance and should therefore not be taken seriously. Note that in this case, 29,000 is a very high level of income, so not many relevant observations are insignificant.

We can conclude that:

- aid has a decreasing positive effect on $^{\partial Y_g/\partial X}/_{\partial\ Aid}$ for countries with GDP per capita < 29.000
- aid has no effect on $^{\partial Y_g/\partial X}/_{\partial\ Aid}$ for countries with GDP per capita > 29.000

Appendix C – Results tables

Table C1: OLS results dummy model

OLS	LDC	OLIC	LMIC	UMIC
Tariff	.002 (0.03)	.164 (1.04)	.029(0.81)	-.803 (-2.41)**
Observations	24	16	65	41
Trade/GDP	-.004 (-0.78)	.002 (0.13)	.005 (2.32)**	.042 (2.74)***
Obs.	147	60	244	131
Openness	-.127 (-0.43)	.671 (0.75)	.619 (1.61)	.762 (1.03)
Obs.	140	61	249	124
Government share	-.005 (-0.22)	-.038 (-0.4)	.033 (2.24)**	.215 (2.34)**
Obs.	134	51	244	131
Exchange reserves	7.35e-10 (0.34)	4.32e-09 (1.84)*	1.51e-10 (1.3)	1.65e-10 (0.41)
Obs.	155	61	247	136
Budget surplus	3.645 (1.14)	-4.091 (-0.31)	-4.393 (-2.02)**	.634 (0.09)
Obs.	113	54	223	118
Inflation	.808 (1.68)*	.791 (0.62)	-.318 (-2.35)**	-8.305 (-1.3)
Obs.	141	61	228	130
Policy index	-.232 (-1.89)*	.472 (1.15)	.145 (1.78)*	.207 (0.74)
Obs.	97	54	208	108
Stability	2.001 (3.1)***	.095 (0.04)	-.812 (-.06)	-.633 (-0.14)
Obs.	110	41	158	86
Authority	.007 (0.78)	.005 (0.1)	-.017 (-0.57)	.094 (1.18)
Obs.	155	61	251	136
Decision rules	.006 (0.75)	.013 (0.28)	-.018 (-0.59)	.073 (0.84)
Obs.	155	61	251	136
Political competition	.006 (0.75)	.01 (0.2)	-.03 (-1.03)	.095 (1.3)
Obs.	155	61	251	136
Schooling	-.022 (-1.01)	.013 (0.4)	.025 (2.34)**	-.022 (-0.93)
Obs.	124	44	192	106
Education	-.002 (-0.05)	-.106 (-0.19)	.048 (0.46)	-.534 (-0.63)
Obs.	67	27	107	67
Saving rate	-.042 (-2.39)**	.055 (0.65)	-.017 (-2.05)**	.063 (1.57)
Obs.	146	50	244	130
Capital formation	1.67e-10 (0.41)	-3.67e-10 (-0.5)	1.82e-10 (2.79)***	1.76e-10 (1.02)
Obs.	82	34	208	107
FDI	-.456 (-0.11)	1.973 (-0.52)	.451 (0.69)	-3.469 (-0.81)
Obs.	27	19	84	61
Gini	.038 (1.18)	-.075 (-0.36)	.096 (3.1)***	.246 (2.74)***
Obs.	31	19	84	55
Migration	9.48e-07 (0.96)	3.04e-06 (1.69)*	-1.34e-06 (-1.69)*	.00001 (1.41)
Obs.	127	49	202	110
Telephone	-.502 (-0.94)	1.278 (1.44)	-.046 (10.47)	-.237 (-1.71)*
Obs.	137	53	214	118

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. The t-values (heteroskedasticity robust) are in the parenthesis.

Table C2: OLS results parabolic model

OLS	Aid*X	Aid*X*GDP	Aid*X*GPD^2
Tariff	.0191823	4.81e-06	-8.77e-09
Obs. 174	(.0437965)	(.0000702)	(2.23e-08)
Trade/GDP	-.0059262	.0000116	-2.21e-09
Obs. 641	(.004062)	(4.27e-06)***	(8.36e-10)***
Openness	-.6577575	.0015461	-4.11e-07
Obs. 611	(.3461095)*	(.0004344)***	(1.14e-07)***
Government share	-.0097407	.0000307	-9.30e-09
Obs. 620	(.029054)	(.0000305)	(7.89e-09)
Exchange reserves	6.40e-10	-2.85e-13	2.62e-17
Obs. 661	(6.50e-10)	(3.98e-13)	(5.16e-17)
Budget surplus	-5.473845	.0061165	-1.83e-06
Obs. 560	(2.694286)**	(.0034637)*	(7.74e-07)**
Inflation[24]	.054639	.0004853	-3.84e-07
Obs. 626	(.8705543)	(.0012016)	(4.71e-07)
Policy index	-.1175722	.0003798	-1.31e-07
Obs. 501	(.191306)	(.000239)	(6.49e-08)**
Stability	2.665528	-.0030035	8.42e-07
Obs. 440	(.7168397)***	(.0014419)**	(4.47e-07)*
Authority	-.0115933	.0000988	-3.05e-08
Obs. 654	(.0047397)**	(.0000258)***	(1.16e-08)***
Decision rules	-.0091929	.000102	-3.37e-08
Obs. 654	(.0037953)**	(.0000213)***	(1.05e-08)***
Political competition	-.0126424	.0001006	-3.37e-08
Obs. 654	(.0048395)***	(.000025)***	(1.07e-08)***
Schooling	-.0003488	.0000178	-7.27e-09
Obs. 505	(.0099075)	(8.30e-06)**	(2.53e-09)***
Education	.17637	-.0002057	2.63e-08
Obs. 131	(.1491865)	(.0002085)	(5.60e-08)
Saving rate[25]	-.0309979	.0000111	-6.34e-10
Obs. 630	(.0147229)**	(8.96e-06)	(1.44e-09)
Capital formation [26]	2.86e-10	-1.64e-13	2.67e-17
Obs. 475	(1.70e-10)*	(1.49e-13)	(2.49e-17)
Fdi	-.9588671	.0005695	2.07e-08
Obs. 228	(.9497)	(.0009221)	(1.48e-07)
Gini	.1067957	-.0001013	4.15e-08
Obs. 201	(.0471447)**	(.0000683)	(2.22e-08)*
Migration	-2.99e-07	2.17e-09	-1.10e-12
Obs. 538	(1.05e-06)	(1.62e-09)	(4.36e-13)**
Telephone	.1157301	-.0000653	2.32e-09
Obs. 578	(.1222162)	(.0000722)	(7.18e-09)

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. In order to calculate the standard error of the marginal effect of interest, the unrounded heteroskedasticity robust standard errors of the coefficients are in the parenthesis.

[24] With short sample, inflation has a clear inverted u-shape.

[25] With short sample, save shows much better results.

[26] With short sample, capital formation has a significant upright u-shape.

Table C3: OLS results parabolic model, aid lagged

OLS	Aid(t-1)*X	Aid(t-1)*X*GDP	Aid(t-1)*X*GPD^2
Tariff	.0090081	.0000237	-1.65e-08
	(.0378369)	(.0000437)	(1.26e-08)
Trade/GDP	.002646	1.11e-06	-5.35e-10
	(.0047338)	(4.28e-06)	(8.14e-10)
Openness	-.2767544	.0009937	-2.77e-07
	(.3341847)	(.0004492)**	(1.35e-07)**
Government share	-.0327056	.0000566	-1.65e-08
	(.0238826)	(.0000314)*	(8.38e-09)**
Exchange reserves	3.22e-10	-1.58e-13	2.00e-17
	(2.17e-10)	(1.19e-13)	(1.46e-17)
Budget surplus	4.547788	-.0025055	2.21e-08
	(4.954705)	(.0027379)	(2.82e-07)
Inflation	.6373888	-.001	4.64e-07
	(1.101237)	(.0016224)	(7.10e-07)
Policy index	.0490015	.0003132	-1.45e-07
	(.2149983)	(.0002895)	(8.84e-08)
Stability	1.266801	-.002278	7.79e-07
	(.2150458)***	(.0007634)***	(2.80e-07)***
Authority	.0122308	-2.38e-06	7.26e-09
	(.002152)***	(.0000247)	(9.20e-09)
Decision rules	-.0130014	5.51e-06	-1.55e-09
	(.0022068)***	(.0000262)	(9.69e-09)
Political competition	-.0133032	8.01e-06	-1.44e-09
	(.0023857)***	(.0000228)	(7.68e-09)
Schooling	-.0023575	7.76e-06	-4.18e-09
	(.0081357)	(8.74e-06)	(3.03e-09)
Education	-.066446	.0000172	-2.43e-08
	(.1307257)	(.0001672)	(4.27e-08)
Saving rate	-.0065617	-.000	4.37e-09
	(.0140817)	(.0000105)	(2.31e-09)*
Capital formation	3.47e-10	-2.15e-13	3.04e-17
	(1.21e-10)***	(8.69e-14)**	(1.22e-17)**
FDI	-1.374876	.000	1.80e-08
	(.9282995)	(.000826)	(1.10e-07)
Gini	.0259022	1.13e-06	1.82e-09
	(.0355379)	(.0000507)	(1.76e-08)
Migration	-6.03e-07	7.74e-10	-4.42e-13
	(2.76e-07)**	(6.01e-10)	(2.10e-13)**
Telephone	-.040	-2.00e-06	-6.15e-10
	(.0727614)	(.0000385)	(3.80e-09)

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. In order to calculate the standard error of the marginal effect of interest, the unrounded heteroskedasticity robust standard errors of the coefficients are in the parenthesis.

Table C4: 2SLS results parabolic model, original instruments

2SLS	Aid*X	Aid*X*GDP	Aid*X*GPD^2	Underid	Weakid (F)	Overid	Endog
Tariff	-.1108761	.0000341	-1.92e-08	0.2124	7.230	0.0638	0.7212
obs. 104	(.126883)	(.0001951)	(7.02e-08)				
Trade/GDP	-.0043321	.0000125	-2.08e-09	0.0650	9.564	0.0003	0.3227
obs. 586	(.0065878)	(3.41e-06)***	(1.81e-10)***				
Openness.	.5273813	.0001811	-1.14e-07	0.0000	15.152	0.0002	0.1162
obs.562	(.5933213)	(.0007059)	(1.90e-07)				
Government share	-.001515	.0000399	-9.67e-09	0.0000	11.204	0.0046	0.2382
obs.566	(.0500593)	(.000067)	(1.57e-08)				
Exchange reserves	1.99e-09	-1.18e-12	1.52e-16	0.0000	7.800	0.0055	0.1209
obs.608	(7.47e-10)***	(4.78e-13)**	(7.19e-17)**				
Budget surplus	-1.105782	.0046513	-2.31e-06	0.0000	7.144	0.0038	0.7158
obs.496	(5.922356)	(.005183)	(9.52e-07)**				
Inflation	-1.760074	.0025281	-1.02e-06	0.1742	8.145	0.0059	0.4246
obs.571	(1.531439)	(.0020146)	(7.58e-07)				
Policy index	.3536156	.0001741	-1.44e-07	0.0000	14.91	0.0003	0.3815
obs.441	(.3044825)	(.0003386)	(1.06e-07)				
Stability	.1167473	-.001364	9.04e-07	0.0000	2.311	0.0009	0.1222
obs.364	(2.342424)	(.0041408)	(1.16e-06)				
Authority	.0319733	-.0000596	2.94e-08	0.0000	12.884	0.0211	0.0422
obs.601	(.0078172)***	(.0000334)*	(1.62e-08)*				
Decision rules	.0208159	-7.62e-06	1.15e-08	0.0000	12.101	0.0233	0.1783
obs.601	(.007712)***	(.0000347)	(1.58e-08)				
Political competition	.0288901)	-.0000379	1.44e-08	0.0000	13.733	0.0151	0.0171
obs.601	.0074042)***	(.0000299)	(1.27e-08)				
Schooling	.003192	.0000161	-7.66e-09	0.0021	10.812	0.0007	0.5602
obs.415	(.0132282)	(.0000133)	(5.30e-09)				
Education	.1362359	-.0002565	9.54e-09	0.0101	3.512	#	#
obs.171	(.2052066)	(.0002667)	(7.41e-08)				
Saving rate	-.0164707	5.28e-06	-1.67e-09	0.0000	11.011	0.0165	0.2239
obs.578	(.0278328)	(.0000167)	(3.50e-09)				
Capital formation	6.44e-10	-4.41e-13	6.02e-17	0.0145	6.068	0.0012	0.4350
obs.407	(3.35e-10)*	(3.04e-13)	(5.42e-17)				
FDI	-.638293	-.0000412	2.59e-07	0.0076	3.364	#	#
obs.168	(1.202562)	(.0012171)	(2.06e-07)				
Gini	-.0000831	-.0000203	7.24e-08	0.8489	1.199	0.2439	0.2793
obs.114	(.1271514)	(.0001543)	(3.82e-08)*				
Migration	-5.58e-07	2.38e-10	-5.24e-13	0.2361	3.782	0.0105	0.3632
obs.354	(1.65e-06)	(2.93e-09)	(9.13e-13)				
Telephone	.0023603	-.0001025	1.75e-08	0.0000	3.404	0.0009	0.0256
obs.478	(.1583549)	(.0000844)	(8.10e-09)**				

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. In order to calculate the standard error of the marginal effect of interest, the unrounded heteroskedasticity robust standard errors of the coefficients are in the parenthesis. # Stata gives a warning while executing the test, which means that the test might not be reliable.

Table C5: 2SLS results parabolic model, bilateral instruments

2SLS - bil	Aid*X	Aid*X*GDP	Aid*X*GPD^2	Under id	Weak id (F)	Endogeneity test
Tariff	.084624	.0000672	-1.08e-07	0.0189	1.133	0.3491
obs. 153	(.1191552)	(.0001414)	(5.66e-08)*			
Trade/GDP	-.0021114	.0000168	-4.89e-09	0.0047	1.590	0.0122
obs. 566	(.0102452)	(9.47e-06)*	(1.59e-09)***			
Openness.	-1.205782	.0020086	-2.94e-07	0.0000	6.754	0.0159
obs. 531	(.5582396)**	(.0008247)**	(2.61e-07)			
Government share	.156365	-.0000754	-3.65e-11	0.1601	1.320	0.2018
obs. 554	(.1954021)	(.0002026)	(4.15e-08)			
Exchange reserves	1.81e-09	-6.53e-13	5.83e-17	0.0001	7.413	0.1009
obs. 571	(1.50e-09)	(8.26e-13)	(9.11e-17)			
Budget surplus	-3.146493	-.0051215	2.45e-06	0.0038	1.703	0.0669
obs. 491	(10.89933)	(.0101362)	(3.36e-06)			
Inflation	-.2094459	.0018013	-1.49e-06	0.0000	3.962	0.0114
obs. 549	(3.176114)	(.0035349)	(1.36e-06)			
Policy index	-.133409	.0001796	7.61e-08	0.0117	4.148	0.0038
obs. 443	(.2866832)	(.0003602)	(1.29e-07)			
Stability	3.375553	-.0049262	1.15e-06	0.0000	5.702	0.0569
obs. 385	(.4892475)***	(.0020616)**	(6.77e-07)*			
Authority	-.0168585	.0001532	-2.68e-08	0.0199	5.136	0.0057
obs. 567	(.0152025)	(.0000321)***	(9.84e-09)***			
Decision rules	-.012558	.0001515	-3.00e-08	0.0237	4.835	0.0040
obs. 567	(.0169361)	(.0000321)***	(9.33e-09)***			
Political competition	-.0124806	.0001507	-3.02e-08	0.0234	5.056	0.0005
obs. 567	(.0160947)	(.0000333)***	(9.90e-09)***			
Schooling	.0012498	3.80e-08	-2.59e-09	0.0003	2.126	0.2617
obs. 438	(.0426623)	(.000021)	(6.10e-09)			
Education	-3.704467	.0007529	1.32e-07	0.9369	0.006	0.3387
obs. 261	(42.08878)	(.0098497)	(1.15e-06)			
Saving rate	.0855714	-.0000484	1.03e-08	0.2633	1.441	0.0470
obs. 556	(.0991765)	(.0000532)	(9.59e-09)			
Capital formation	1.92e-09	-1.53e-12	2.93e-16	0.3056	0.358	0.1135
obs. 441	(2.03e-09)	(1.78e-12)	(3.51e-16)			
FDI	-.798818	.0002423	-1.82e-07	0.0001	1.534	#
obs. 203	(1.325173)	(.0014722)	(2.01e-07)			
Gini	.1921103	-.0001387	4.80e-08	0.0011	4.881	0.0834
obs. 185	(.0760202)**	(.0001058)	(3.78e-08)			
Migration	-5.84e-06	1.41e-08	-4.25e-12	0.0091	4.615	0.5174
obs. 467	(3.33e-06)*	(6.86e-09)**	(1.91e-12)**			
Telephone	.3579224	-.0000945	-5.09e-09	0.0001	10.994	0.0354
obs. 510	(.2198554)	(.0001095)	(1.01e-08)			

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. In order to calculate the standard error of the marginal effect of interest, the unrounded heteroskedasticity robust standard errors of the coefficients are in the parenthesis. # Stata gives a warning while executing the test, which means that the test might not be reliable.

Table C6: 2SLS results dummy model

OLS	LDC	OLIC	LMIC	UMIC
Tariff	.119 (0.93)	.26 (2.94)***	.086 (1.85)*	-1.554 (-3.1)***
Observations	23	16	61	36
Trade/GDP	.058 (-0.79)	.007 (0.29)	-.14 (-0.04)	.057 (1.94)*
Obs.	128	60	224	112
Openness	-3.244 (-1.19)	-3.036 (-0.95)	2.216 (2.55)**	1.129 (1.76)*
Obs.	114	61	224	107
Government share	.203 (1.09)	1.471 (0.59)	-.213 (-0.78)	.294 (2.11)**
Obs.	125	51	224	112
Exchange reserves	7.00e-10 (0.22)	1.46e-09 (0.35)	2.43e-10 (1.31)	5.89e-10 (1.04)
Obs.	129	61	222	117
Budget surplus	-32.953 (-.018)	-25.138 (-0.87)	-1.562 (-0.41)	.643 (0.13)
Obs.	88	54	207	108
Inflation	-9.374 (-0.23)	-1.378 (-0.34)	-.142 (-0.63)	-15.126 (-2.01)**
Obs.	115	61	214	117
Policy index	-1.891 (-0.64)	-.589 (-0.7)	.284 (2.25)**	.286 (1.38)
Obs.	72 #	54	195	98
Stability	2.82 (5.51)***	.088 (0.06)	1.362 (0.66)	-.557 (-0.11)
Obs.	95	41	145	74
Authority	.006 (0.26)	-.082 (-0.62)	.065 (1.04)	-1.763 (-0.97)
Obs.	129	61	226	117
Decision rules	.009 (0.35)	-.069 (-0.59)	.046 (0.77)	-1.191 (-1.3)
Obs.	129	61	226	117
Political competition	.004 (0.18)	-.083 (-0.55)	.048 (0.84)	-.571 (-0.63)
Obs.	129	61	226	117
Schooling	.453 (0.21)	-.061 (-0.89)	-.017 (-0.38)	-.026 (-0.62)
Obs.	105 #	44	174	92
Education	2.157 (0.26)	.354 (1.25)	-.351 (-0.65)	-.569 (-0.44)
Obs.	59 #	27#	95 #	57 #
Saving rate	-.315 (-0.76)	-.019 (-0.1)	.017 (0.86)	.052 (1.49)
Obs.	127 #	50#	224 #*	113
Capital formation	2.54e-10 (0.29)	-6.20e-09 (-1.02)	2.15e-10 (2.04)**	1.84e-09 (1.83)*
Obs.	79 #	34#	197	98 #
FDI	-8.941 (-1.71)*	3.677 (3.29)***	1.302 (0.53)	-1.404 (-0.36)
Obs.	27 #	19 #	82 #	52#
Gini	.083 (2.84)***	.129 (0.99)	.104 (3.59)***	.128 (1.34)
Obs.	31 #	19 #	80	53
Migration	1.19e-06 (0.69)	-1.89e-06 (-0.64)	-1.56e-06 (-0.85)	.000028 (2.64)***
Obs.	107 #	49	182	95
Telephone	-189.237 (-0.01)	.9 (0.74)	.15 (1.1)	-.021 (-0.05)
Obs.	117 #	53	197	104

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. The z-values (heteroskedasticity robust) are in the parenthesis. A # indicates that there are validity problems with the instruments.

Table C7: Results shorter sample

1978 - 2001	Aid*X	Aid*X*GDP	Aid*X*GPD^2
2SLS			
Trade/GDP	-.002	.00002	-4.29e-09
obs. 385	(0.007)	(7.06e-06)**	(1.34e-09) ***
Openness.	-1.19	.002	-2.65e-07
obs. 356	(-1.86)*	(0.0007)**	(2.19e-07)
Stability	Original results entirely relies on 1978 onwards		
obs. 385			
Authority	-.017	.0002	-2.75e-08
obs. 381	(0.009)*	(0.00004)***	(1.16e-08)**
Migration	-4.71e-06	1.23e-08	-3.91e-12
obs. 324	(2.76e-06)*	(6.35e-09)*	(1.84e-12)**
OLS			
Schooling	.002	.00001	-5.35e-09
obs. 438	(.01)	(8.55e-06)	(2.28e-09)**
Capital formation	4.18e-10	-2.53e-13	3.79e-17
obs. 353	(2.11e-10)**	(1.62e-13)	(2.57e-17)

*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. In order to calculate the standard error of the marginal effect of interest, the unrounded heteroskedasticity robust standard errors of the coefficients are in the parenthesis.

Table C8: Results outliers excluded

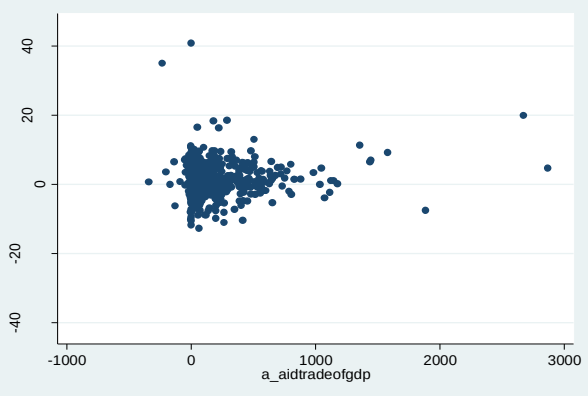
	Aid*X		Aid*X*GDP		Aid*X*GPD^2	
2SLS	BD	Hadi	BD	Hadi	BD	Hadi
Trade	.003	-.001	.00001	.00002	-5.8e-09	-5.4e-09
562/550	(0.015)	(0.03)	(.00001)	(.00002)	(2.2e-09)***	(3.7e-09)
Openness	-1.88	-.73	.002	.0007	-2.9e-07	1.3e-07
527/525	(1.22)	(1.17)	(0.0009)**	(0.001)	(2.7e-07)	(2.9e-07)
Stability	3.49	.71	-.006	-.004	1.3e-06	8.8e-07
381/380	(0.34)***	(0.03)	(0.002)***	(0.002)**	(7.4e-07)*	(6.7e-07)
Authority	-.03	.06	.0002	.0005	-3e-08 (1.1e-	-9.1e-08
563/518	(0.03)	(0.54)	(0.00)***	(.0005)	08)***	(9.6e-08)
Migration	-8.4e-06	1.3e-06	1.9e-08	2e-09	-5.4e-12	-1.1e-12
464/433	(5.1e-06)*	(2.7e-06)	(9.5e-09)**	(5e-09	(2.5e-12)**	(1.6e-12)
OLS						
Schooling	.003	-.0004	.00002	.00001	-7.1e-09	-6e-09
502 /502	(0.01)	(.01)	(8.4e-06)*	(8.6e-06)	(2.6e-09)***	(2.5e-09)**
Capital Formation	2.9e-10	2.54e-10	-1.7e-13	-1.52e-13	2.8e-17	2.50e-17
472/429	(1.7e-10)*	2.30e-10	(1.5e-13	2.16e-13	(2.5e-17)	4.00e-17

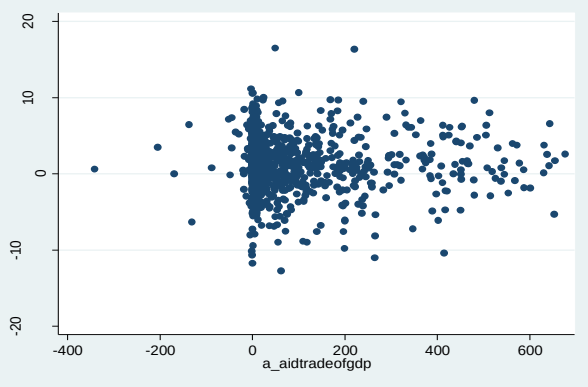
*, ** and *** stand respectively for significance at the 0.1, 0.05 and 0.01 confidence interval. In order to calculate the standard error of the marginal effect of interest, the unrounded heteroskedasticity robust standard errors of the coefficients are in the parenthesis.

Table C9: Scatter plots with and without Hadi outliers

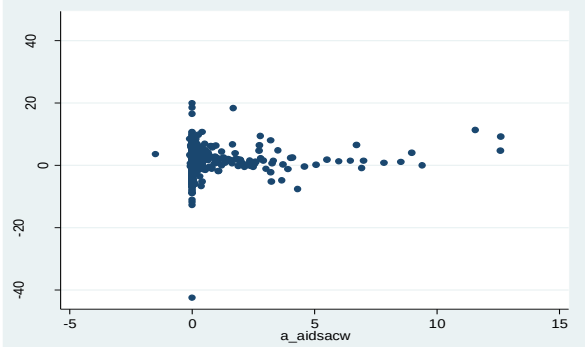
All observations | **Hadi outliers excluded**

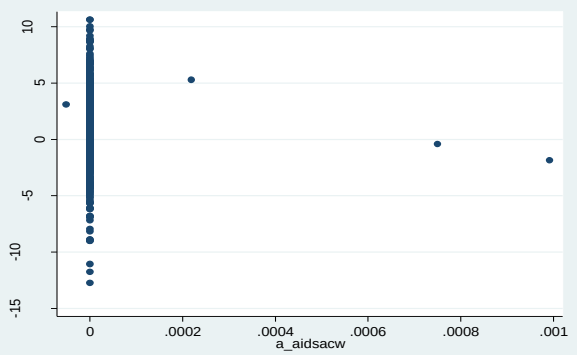
Trade / GDP



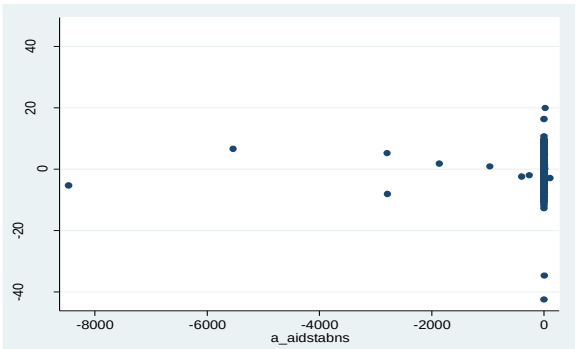


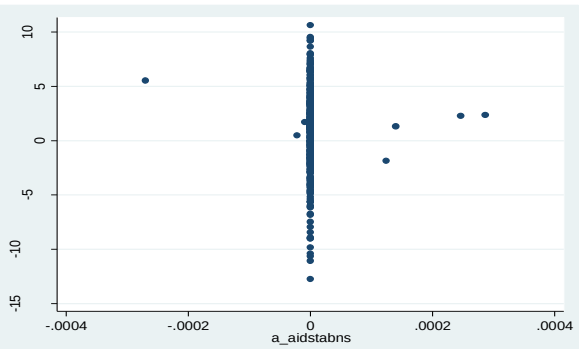
Openness



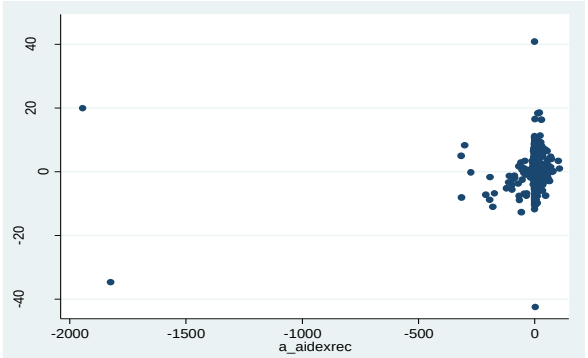


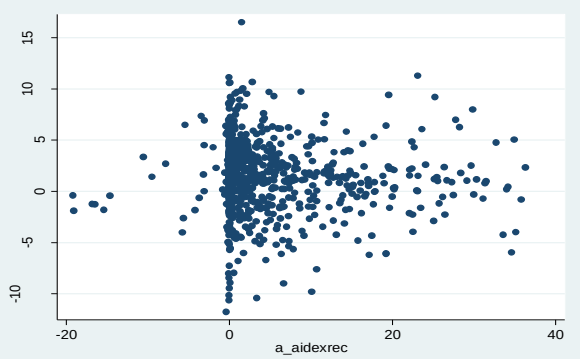
Stability





Authority





Graphs are drawn by Stata.