Aid, Infrastructure and Growth

by

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Abstract

In their seminal paper, Burnside and Dollar (2000) introduced the interactive term aid*policy into growth equations. Most studies up until then had merely added aid as a variable on its own with GDP growth as the dependent variable in order to check aid effectiveness. They were testing the hypothesis that aid, merely distributed, without other considerations, is not enough for aid effectiveness but must be considered conditional on policy. They claimed that a policy variable interacted with aid makes aid more effective. However, empirically, they needed to perform some manipulations to their dataset in order to achieve the required result. Subsequently, other authors have criticised the result based on other grounds and offered other variables as interactive terms. Collier and Hoeffler (2001) offer aid*policy*post-conflict as an important variable while Dalgaard *et al.* (2004) offer aid*fraction of land in the tropics as a good measure of aid effectiveness. This paper seeks to add to the literature on aid effectiveness by suggesting that infrastructure is as an, if not more important determinant of aid effectiveness by empirically testing the interactive term from it against the other terms offered so far. Aid*infrastructure outperformed most of the other interactive term, consistently entering with a significant positive coefficient in equations using world and low income datasets. Using the Africa dataset, aid*infrastructure does not perform as well but infrastructure itself gains significance while the policy variable losses it significance, whereas in the first two datasets, the significance of the two had been reversed. All this possibly points to the primacy of infrastructure in growth.

***To the best of my knowledge, this is my own work, all sources have been properly acknowledged, and the paper contains no plagiarism.**

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Intro

In their influential paper, Burnside and Dollar's (2000) major finding is that aid is effective only in countries that implement what they see as "good" policies. They find this by adding an interactive term- aid multiplied by “good” policy to growth-equations. The finding by Burnside and Dollar (2000) that good policies may be a key determinant of aid effectiveness has been used as the starting point for assessing potential aid effectiveness by donors. Most notably the World Bank used the findings as a basis for their widely read publication *Assessing aid: what works and what doesn’t* (1998), which is the theoretical benchmark for their aid policies. Other authors have criticised the Burnside and Dollar findings and offered other possible key determinants of aid effectiveness, adding them in a similar manner as Burnside and Dollar, as interactive terms. Roodman (2007) created a uniform dataset and tested seven specifications from what are seen as the main contributors to the debate on interactive terms. He found that most did not consistently perform well. It is proposed here that the interaction term of aid multiplied by infrastructure, may perform better and be a better determinant of potential aid effectiveness.

The starting point here is analysing the effect of infrastructure on growth in general before assessing its importance for growth orientated aid. As shown in models below, infrastructure is important not merely as an addition to production functions as a measure of physical capital with a direct impact on output but indirectly through its effect on productivity. What is tested here is its impact on growth as an interactive term when combined with aid. What is proposed here is that aid effectiveness is determined among other things by the infrastructure in place in a given country.

The channel through which infrastructure becomes a determinant of aid effectiveness may be through the concept of absorptive capacity. Bhagwati and Eckaus (1970) have already pointed out a possible obstacle to aid effectiveness through analysing the concept of absorptive capacity. Most

recent literature on absorptive capacity has however focused on the dearth of human capital or low policy as a constraint on aid effectiveness with very few studies looking at the impact of a dearth of infrastructure. Roodman (2006) for example, looks at the proliferation of aid projects and how limited human capital may lead to decreasing marginal returns when it becomes an administrative burden which reduces government efficiency by taking too much time up in government ministries. He notes that in Tanzania, this situation became so bad in 2003, the government decided to declare August a 'donor-free' month i.e. work on filing necessary reports and other donor related activities would be reduced to a minimum in order for the government to be able to concentrate on forming it's budget. Another way in which aid proliferation can affect growth is through the poaching of the few qualified people in government to work on aid projects/programs hence reducing the effectiveness of government.

With regard to diminishing returns due to infrastructure, Clemens and Radelet (2003) draw the comparison between the effectiveness of aid in the Marshall Plan versus the general apparent lack of effectiveness of aid in Africa and conclude that lack of supporting infrastructure and an existing plan by aid recipients, makes aid less effective in Africa compared to the success of the Marshall Plan. After World War II when America doled out aid to countries such as Germany and Japan with seemingly great success. They mention examples for how infrastructure may be a limiting factor. For example medical aid effectiveness can be hampered if there are not enough warehouses. The impact of infrastructure for aid effectiveness has not, however been tested empirically nor tested as extensively as the testing for the importance of institutional, policy and economic environment variables on aid effectiveness have. Testing for the importance of infrastructure is done in this paper.

Burnside and Dollar (2000) started the trend of adding interactive terms to aid effectiveness analysis, when testing whether aid effectiveness varies with the quality of the policy environment. They

introduced their policy variable and aid*policy into growth regressions testing the impact of aid in good policy environments. A similar approach shall be taken here. The significance of infrastructure shall be investigated by adding the term aid*infrastructure to growth regressions. Adding it to different specifications shall help test *(i)* the robustness of the variable by adding it to different specifications of growth equations offered by other authors to see whether it maintains its significance; and *(ii)* how it performs when compared to some of the other interactive term offered in the literature thus far.

This method of testing a variable based on its robustness in different specifications stems from what Roodman (2007) points out namely, "If Leamer's (1983) extreme bounds analysis is applied to the results of this testing, then a coefficient will be deemed robustly different from 0 only if it is significantly different from 0 in *every* test." Roodman (2007) notes that this may be extreme because it demands that a coefficient be significant in every specification but it is the basis of the idea used in this thesis that a coefficient must firstly, be significant in most of the differently specified regressions and secondly, that it must outperform other coefficients tested by other authors in order to have some significance. The regressions are further run on three different datasets: world, low income and low income African countries. This is for comparative reasons and robustness checking and is of relevance since the last two datasets represent countries that are the main target groups for developmental aid.

In terms of methodology, almost the same uniform dataset is used as in Roodman (2007) with the inclusion of an infrastructure variable and another difference being the use of aid per capita instead of aid/GDP as used by most of the authors examined by Roodman (2007). Aid/income was used by authors such as Boone (1996) in order to distinguish between countries with fungible aid or those in which aid was not fungible. According to Boone, in countries with aid/GNI ratios of over 15%, aid is not fungible and therefore they were excluded from his datasets for the purposes of their studies.

Other authors such as Durbarry *et al.* (1998) and Hadjimichael (1995) also use aid/income to ascertain the turning point after which aid becomes ineffective. Variables of aid/income measure aid dependence (World Bank 2004) and since the question is not whether aid is fungible, aid/income does not seem to be the best measure of aid to use. Further, aid/income came into use when extensive research was done into its impact on investment/GPD and savings/GDP which were comparable measures. It is argued here that in investigating the effect of aid on GDP per capita as most authors do, the comparable measure of aid per capita may be preferable. Further it shall be shown that merely changing the aid specification in an equation may at times give a different result for aid effectiveness so the measure of aid used may have to be chosen more carefully.

In running the regressions, it is found that the only variable that invalidates the new aid*infrastructure variable is Dalgaard's (2004) aid*fraction of land in tropical climate (referred to as tropics in this paper for simplicity). However, as explained above, this may be explained by the possible link between the two. Table 1 show regressions run using the aggregate variable for infrastructure and each individual measure of infrastructure as the dependent variables and fraction of land as the independent variable has a significant negative coefficient in every case. Links established by Acemoglu *et al.* (2001) shall be used to possibly explain this by replicating their regressions and including infrastructure in their regressions. It shall be shown that the reasons for the result may stem from correlation between tropical climates and infrastructure through the variable suggested by Acemoglu *et al*. for explaining the link between institutions and tropical areas. The variable they suggest to make the link is settler mortality.

First a general literature review shall be conducted on studies of aid effectiveness before discussing the authors whose equations are modified in greater detail as well as a brief discussion on Acemoglu *et al.* (2001) as their paper pertains to Dalgaard *et al.* (2004), the importance of which has already been alluded to and shall be discussed in greater detail below. A brief discussion of relevant aid

theory shall be given before a literature review on the debates on the impact of infrastructure on growth shall then be undertaken in order to put infrastructure into context in general growth literature. The data and methodology section shall follow before a discussion of the results and conclusion.

Lit Review

Studies of Aid Effectiveness thus far

Hansen and Tarp mention the different methodologies used to investigate the links between aid and growth. Firstly, studies have been done on macro and microeconomics level and as Hansen and Tarp point out, there is the belief that the findings on a macroeconomic level contradict the findings from microeconomic studies. Secondly, aid has been investigated in cross-country and single country analysis for example in *Aid in Africa* by Devarajan *et al.* (2001) which shall be discussed below. Lastly, qualitative and quantitative studies have been under taken.

Hansen and Tarp's (2000) give an oft quoted history of empirical aid effectiveness literature. They divide it into three generations. The first generation of aid empiricist used savings and investment as the dependent variables and aid as one of the regressors. The second generation merely added aid to growth regressions while the third generation introduced institutional, economic environment and policy variables to the growth regressions as well as aid when assessing aid effectiveness. At times, these variables were added as interactive terms with aid in order to show that aid effectiveness is intertwined with the quality of specific institutional, policy or environmental variables. This study takes its lead from these studies by suggesting that infrastructure is the main "economic environment" variables to be considered in determining aid effectiveness.

Hansen and Tarp mention that first generation studies by pro-development economists such as Rosenstein-Rodan (1961) proposed that aid increases savings and investment one for one without taking fungibility into account. However, empirical evidence found that this was not precisely case because aid doesn't always necessarily go to the projects it is meant to support. An example of fungibility is when, after receiving aid a government decides to spend more revenue paying salaries instead of in intended investment projects hence reducing the effectiveness of the aid. As Easterly (1997) points out, part of the rationale was also that an increase in aid in the form of subsidized loans would lead to increased savings in anticipation of countries having to pay back those loans. Loans were therefore especially targeted to countries with a lot of natural resources like Zambia, the Democratic Republic of Congo (then Zaire), Congo (Brazzaville) etc but this theory was rebuffed by the reality on the ground.

Hansen and Tarp review empirical studies of aid effectiveness. They do a survey of studies where savings, investment and growth are the dependent variables and aid or foreign inflows are the independent variables. When it comes to aid, of the 24 studies conducted on savings, 10 revealed a coefficient on aid that was not significantly different from zero while 14 had a significant negative coefficient and only one study had a positive coefficient that was significantly different from zero. Regarding investment, of the 16 studies conducted, 15 had a positive coefficient that was significantly different from zero, one had an insignificant coefficient and none of the studies showed aid to have a significantly negative relationship to investment. The studies with growth showed a similar pattern to the ones on investment with, out of 64 studies, aid obtained a significantly positive coefficient in 38 studies, an insignificant coefficient in 25 and only one significant negative coefficient. All in all, the first empirical studies of aid showed that aid seemed to have a negative relationship with domestic savings, a mildly positive relationship with growth overall and a more convincing positive relationship with investment.

In terms of case study analysis, in *Aid in Africa*, Devarajan *et al.* (2001) build on their previous and oft quoted World Bank analysis on foreign aid, *Assessing aid,* which is based on the Burnside and Dollar (2000) paper which is discussed in greater detail below. In the *Aid in Africa*, a case study of ten countries is undertaken. They actually divide the countries into four groups- successful reformers, post-socialist reformers, mixed reformers and non reformers. The first group comprises of Ghana and Uganda while the second includes Ethiopia, Mali and Tanzania. Mixed reformers include Cote d'Ivoire, Kenya and Zambia while the last group is comprised of Nigeria and the Democratic Republic of Congo (DRC). They continue to emphasise, following previous World Bank studies, the importance of policy variables in determining aid effectiveness

Devarajan *et al.* (2001) observe several differences between successful reformers and the rest which may be key to understanding why they were successful in making aid effective. Firstly they observe that Ghana and Uganda did not receive much aid until after they had formulated the policies they wanted to enact for economic growth and stability. They observe that both countries had undergone severe difficulties, with their economies in bad states when they finally sort the help of international bodies such as the IMF in order to bring growth and stability. As the authors state, in these economies, crises was key to reform. Before receiving large amounts of aid, as with Vietnam, which also considered a successful aid reformer, these countries received more of technical assistance than aid in order to determine what would be the best way forward for them. This was not the case with non performers such as Nigeria and the DRC for as Easterly (1997) points out. These countries received large amounts of aid in the form of soft loans thanks to their natural resource wealth and not based on their eagerness to reform.

Natural resource endowments also seemed to matter in how countries performed as Devarajan *et al.* (2001) note that Uganda and Ghana were not as well endowed in natural resources as the non performers and therefore, almost had no choice but to strive to perform well and make aid as

effective as possible. Another thing the authors consider is the type of leadership prevalent in the countries at the time of economic reform. They observe that countries that do well are ones in which the citizen are well informed and educated about the processes and go along and/or, as in Uganda, there was strong political leadership to steer the country to success regardless of the naysayers. They note that one of the problems in Zambia, a mixed reformer, was that as soon, for example, as urban dwellers protested against the removal of food subsidies, the president Kaunda, already facing opposition from within his own party on the reforms, eased off from the process in order to please the electorate. They also find that countries with newly elected governments also perform better which bodes well for countries with functioning democratic processes.

Further, in case study analysis, Devarajan *et al.* (2001) note that there is the issue of the ownership of reforms with aid being less effective in countries were economic reforms were imposed from abroad without consulting the aid recipients and getting their input. Allowing them to drive the reform process with some technical assistance for consultancy but not as the main source of ideas seemed the better alternative. The authors further point out that successful reformers are denied continued success on the same level as when they start to implement reforms and perform well because, when they start performing well, there seems to be a reduction in the amount of aid they are allocated. The first possible reason offered by the authors for this is that, as the conditions for aid are met, there is no longer an *improvement* in them and donors assume that once conditions are met, their work is done. Improvement being seen as more important than the maintenance of the good reforms enacted. In other words aid is too stringently attached to policy improvement processes forgetting that improved policy should also possibly be a condition for aid.

Another possible reason offered for the aid reduction is that, as they start to perform well it is assumed that successful reformers will naturally begin to attract foreign private investment and therefore they do not need as much assistance anymore. Deverajan *et al.* (2001) note that this is far

from the case and that foreign private investment is not as forthcoming as assumed after improvements and that, though performing well these countries continue to need to support in order to continue to perform well.

Roodman (2007) and the main third generation empiricists

Roodman's (2007) conducts a robustness check on the main empirical studies on aid effectiveness as he sees them. By making slight alterations to the datasets, alterations that should not have a significant impact on the results of the tested authors. He makes a uniform dataset to better compare and also check whether the results obtained by the various authors were not just due to the particular measurement of the variables that they used that were different from the other authors. He found that authors used different definitions of aid, different control variables as well as different time periods. As he points out, of the seven authors he replicated, without unifying the data, there were "three definitions of "policy," three of aid, and four choices of control variable set" so no concrete comparisons could actually be drawn. He sets out to investigate whether the differing results on aid effectiveness have to do with the differences in equation specification or due to differing datasets, as Roodman states, "underlying regularities in the data or...fragile artefacts". Roodman comes to the conclusion that aid effectiveness is not concrete based on the fragility of the "arbitrary" specifications given by the authors whose aid effectiveness variables lose their significance given a different dataset.

The methodology used in this paper to check the impact of infrastructure, primarily includes taking the Roodman (2007) analysis a step further, by taking the uniform dataset and adding aid*infrastructure specifications therefore, the propositions of the main authors shall now be discussed in greater detail as these are the basis for the regressions used in this paper. Guillaumont and Chauvet (2001) and Hansen and Tarp (2000) are excluded from the empirical investigations. The

first set of authors because their data is only available in 12-year averages which are not comparable to the 5-year averages used in this paper and the latter set of authors because, in terms of interactive terms, they add nothing new to literature pertaining to interactive terms. Unlike the other terms they discuss methodology i.e. ordinary least squares (OLS) and two-stage least squares (2SLS) versus dynamic generalized method of moments (GMM) and the main contribution of this paper is to the discussion of interactive terms and not methodology as such.

Burnside and Dollar (2000) set out to investigate the determinants of aid effectiveness. They point out that there are numerous studies which include aid in growth regressions (second generation studies according to Hansen and Tarp(200)) but aid turns up with very little significance in a large enough number of these most studies. They therefore try to determine whether empirically this is because the policy environment of aid recipients has not been taken into account. They set out to create an interactive term of aid and policy in order to determine whether, when this variable is added to growth regressions rather than aid on its own, this variable comes up significant. In other words, whether aid is effective is determined by considering whether the policy in a country is "good".

Firstly, they create the "policy" variable. They identify three variables that they think are important for differentiating between a "good" and a "bad" policy environment. The three variables are budget surplus, inflation and trade openness. Burnside and Dollar (2000) decide to create the policy variable by using the weighted sum method. They run a growth regression using ordinary least squares (OLS) including variables that measure political stability, financial depth, institutional quality, regional dummies in the regressions and the three policy identifiers. They then use the coefficients on the policy identifiers as weights in summing the variables to create the policy variable. Once they have created their policy variable, they multiply it by aid. This aid*policy variable therefore represents

whether aid is effective or not given policy considerations. Using the OLS their aid*policy variable actually has an insignificant coefficient which only become significant with the removal of outliers.

Some of the criticisms lodged against the authors regard the fragility of their results and the formation of the term for checking the effect of policy on aid. The method of multiplying has raised some questions but has been generally accepted and used by various authors in order to check the effectiveness of aid based on their own variable of importance. Regardless of the many criticisms many authors have come to the defence of Burnside and Dollar (2000) and offered different specifications in order to uphold the fragile results.

Among the defenders are Collier and Dollar (2004) who develop a "poverty-efficient" rule for allocating aid. This rule simply states that in the allocation of aid, if donors knew only two things about a country - the levels of poverty in a country and whether it had good or bad policies, donors should give money to the poorest countries, especially those with good policies. This rule is based on a marginal efficiency concept i.e. an increase in aid will be more effective in improving the growth in a poor country than in a middle-income country for example. In order to investigate this, they remove 'excess' variables from the Burnside and Dollar (2000) equation, leaving only regional dummies, the initial log GDP and variables pertaining to aid and policy i.e. aid, aid*policy, aid squared*policy and policy itself. They use their own measure of policy defined as the World Bank's Country Policy and Institutional Assessment (CPIA). They drop aid on its own as they find it is insignificant in their initial regressions and after all the changes, aid*policy and aid squared*policy become significant.

Collier and Dehn (2001) and Guillaumont and Chauvet (2001) explore the rationale that, if growth is affected by shocks, aid effectiveness may also be affected by them. Therefore an interactive term of aid and a type of shock may be significant i.e. aid is most effective in countries that have

experienced shocks of some kind. The rationale for this is that aid acts either as a cushion or it provides a means to build infrastructure in another sector of the economy not affected by the shock if the shock is negative.

Collier and Dehn (2001) use export price shocks as a measure of a shock to the economy. They propose that the cushion effect of foreign aid in this scenario may be that it reduces the absolute change in foreign currency inflows. They find aid*policy to be significant but their own interactive terms are more highly significant. They introduce their proposed shocks into the Burnside and Dollar (2000) equation, as shocks on their own i.e. negative and positive price shocks and then as interactive terms with lagged aid and again as interactive terms with aid differenced. They therefore introduce six new terms in total to the Burnside and Dollar (2000) equation. They introduce 'differenced aid' since, as they state, aid cannot be perfectly synchronised with price movements so it's better to look at a change in aid rather than aid in level terms.

Collier and Dehn (2001) find that negative shocks had a significant negative coefficient and therefore seemingly reduce growth whereas positive shocks had an insignificant coefficient. The only positive shock variable that is significant is the change in aid*positive shock variable but they did not investigate this further. The level aid*negative shock variable is insignificant but the differenced aid*negative shock, which is the main variable of concern to them, is significant at a 1% level significance with a positive coefficient. With regards to the findings regarding the differenced aid*negative shock variable, according to Collier and Dehn (2001), this means that aid reduces the unfavourable effects to export prices. They therefore propose that aid should be allocated to countries that are experiencing negative shocks rather than using policy as aid allocation determinant. They point out that aid is not being allocated to countries experiencing negative shocks and according to them, based on their results, this should change.

Guillaumont and Chauvet (2001) create an environment variable which includes shocks as well, and use this as their interactive term. Again, the assumption is that aid has a cushioning effect. As they state, "countries need some kind of insurance in order to avoid the interruption or collapse of the growth process (possibly leading to a lasting recession)." They create their environment variable in the same manner that Burnside and Dollar (2000) create their policy variable- by weighted sum. The four components of the variable stem from two types of shocks- climatic shocks and trade shocks. Reworking the Burnside and Dollar (2000) regression with the environment and aid*environment variable leaves the impact of aid*policy as ambiguous as in the original Burnside and Dollar (2000) regressions i.e. it is positive and significant in OLS regressions but insignificant when a two-stage least squares (2SLS) regression is run. The aid*environment variable is found to be significant in both regressions. The authors therefore conclude that it may be that aid is more effective in vulnerable countries i.e. countries that have experienced certain shocks to their economies.

Collier and Hoeffler (2004) explore another hypothesis, namely that aid can help to reduce the risk of civil war. They therefore aim to show that an interactive term of aid and a post-conflict environment will have a positive impact on growth. They are advocating for more aid to be sent to countries that are coming out of civil unrest in order to reduce the likelihood of these countries returning to a conflict scenario. This is dubbed the "security-efficient" rule of aid allocation. They also claim that aid can be unusually productive in post-conflict economies due to the recovery of a destroyed nation. The post-conflict period is also specific- with three four year episodes after peace processes have begun, counted one after the other and depicted as the peace onset, post-conflict1 and post-conflict2 episodes. Aid seems to be more effective in the second period i.e. the years 4-7 which represent the first years of full peace, versus the first and last periods, the first of which includes the period in which war is winding down and the second, the next fully peaceful period. They therefore create an interactive term of aid*policy which is multiplied by a dummy variable for

each episode i.e. aid*policy*peace onset, aid*policy*post-conflict1, aid*policy*post-conflict2. Aid is only significant given the variable aid*policy*postnflict1 which has a significant positive coefficient.

Dalgaard *et al.* (2004) propose that in order for aid to be effective, climate considerations need to be taken into account. They therefore interact aid and the fraction of a country's surface area that is found in a tropical climate (referred to as tropic in this paper for simplicity). They claim that if according to Collier and Dollar (2004), aid should be given to poor countries with good policy and, as they find, there is a strong negative correlation between their climate variable and good policy (based on CPIA ratings), then the "poverty-efficient" allocation rule should be questioned. Indeed, using dynamic panel general method of moments (GMM) the authors find that their interactive term outperforms the Burnside and Dollar (2000) aid*policy term i.e. there is a strong negative relationship between their aid*fraction of land in tropics variable and growth meaning that, according to them, aid is less effective in countries with a large fraction of their land in tropical areas. In Roodman's (2007) studies, this aid*tropic and Collier and Hoeffler's (2004) variable outperform the other variables when subjected to his robustness checks.

The negative relationship between policy and climate is explored from a different perspective by Acemoglu *et al.* (2001). They explore and find that bad institutions may be related to patterns of colonial European settlement. Given that the extent and pattern of European settlement affected the type of settlements and institutions Europeans established in the colonies, they propose, it would make sense that since Europeans did not settle extensively in tropical areas and they did not import and establish high degrees of western institutions that are essential in determining modern day measures of good policy to these areas.

Acemoglu *et al.* (2001) find a strong correlation between settler mortality and quality of institutions and since there was high colonial settler mortality in tropical areas due to numerous tropical

diseases, settlers did not settle extensively in these regions and therefore did not make a good effort of establishing western institutions that are associated with good policy in these areas. This, according to them, translates to modern day growth because, since they find current institutions relevant to current economic growth and find that settler institutions are persistent and can be observed in current institutions, there is therefore there is a link between settler mortality through settler institutions and modern growth. They conclude that settler mortality can be used as an instrument for current quality of institutions, based on the strong correlation they find between the two and they also find that it can be used as a variable in growth regressions, in place of current quality of institutions, in order to explain current GDP growth. This helps deal with the endogeneity associated with current institutions in growth literature. Later on in this paper, it shall be shown that infrastructure is also strongly correlated with settler mortality and therefore, institutions may not be the only important thing imported by European settlers that influence current levels of growth in former colonies. This link is not mentioned and tested by the authors.

Another way of putting it, proposed by Dalgaard *et al.* (2004) is through the role of geographical climate may play in determining the type of economies that are established in countries found largely to experience a tropical climate. They mention that a lot of these countries have economies that are heavily reliant on agriculture and therefore climate is a better predictor of economic performance in these economies than policy therefore the climate variable may be a better choice for an interaction term than policy.

The seventh paper tested by Roodman is by Hansen and Tarp (2000) and it differs from the above analyses in that it does not present a new interactive term for testing but questions the methodology used by the authors (they propose aid squared, already discussed by Collier and Dollar (2004) as their preferred term). By using a dynamic GMM estimation technique that takes into account several factors that can't be taken into account using the simple OLS models employed by

most of the other authors. They find, after using dynamic GMM, that aid squared to be significant. Aid squared is already taken into account by Collier and Dollar (2004) and since the emphasis here is on interactive terms, this paper is not replicated here.

To summarise the findings thus far, Burnside and Dollar (2000) introduce the trend of using interactive terms and offer the term aid*policy as a possible measure of aid effectiveness. However, they find their own variable turns up insignificant unless outliers are removed from the dataset or aid squared*policy is included in the regression. They chose the method of removing the outliers to come to the conclusion that aid*policy is a significant determinant of aid effectiveness. Collier and Dollar (2004) add aid squared*policy to their regression in order to confirm the Burnside and Dollar (2000) result. Collier and Dehn (2001) confirm in their own findings that aid*policy is significant but they find that differenced aid*negative shock may be more significant. Guillaumont (2001) and Chauvet do not find aid*policy robust and find their own variable, aid*environment, to be significant. Lastly, Collier and Hoeffler (2004) find their variable aid*policy*post-conflict to be significant while Dalgaard *et al.* (2004) find their own variable aid*fraction of land in tropics has a significant negative coefficient.

Roodman (2007) does something very important by running all the above equations on a single uniform dataset. Recognising that the results obtained by the various authors were obtained using different datasets hence making the results not particularly comparable, he replicates all the different specifications on a single uniform dataset. Firstly, he uses an expanded dataset to that utilised by the various authors. Secondly, uniform definitions of variables are employed e.g. for aid some authors had used effective development assistance (EDA) while others preferred overseas development assistance (ODA) (difference discussed in the data section). He also used uniform periodization i.e. he had a dataset for four year averages and another for five year averages. These were among some of the techniques for making the data uniform. The variable that performed the

best after controlling for various variables or time periods and other tests, seems to be the Dalgaard *et al.*'s (2004) tropic variable, followed by Collier and Hoeffler's (2004) aid*policy*postconflict1 and the Collier and Dehn's (2001) variable doesn't seem to perform too badly but Roodman (2007) states the all are sensitive to outliers.

To further explain the reason for exploring a new variable and continued exploration variables for aid effectiveness, a quote shall be taken from the introduction to "Aid and performance: A reassessment" by Guillaumont and Chauvet (2001). They note, "Aid has been assessed [World *Bank, 1998; Burnside and Dollar, 2000*].The question raised thirteen years ago by Cassen *et al.* [1986] has been answered. It can work depending on the policies. If they are good, aid will be efficient, if they are not, aid will be useless at best. Aid should be allocated to those countries pursuing good policies, to a larger extent, it is argued, than is already the case. Aid effectiveness and aid selectivity issues are thus simultaneously solved. Coming after 30 years of academic work and political discussions and facing a resilient agnosticism about the effects of external aid on development [*White*, *1992*], the new paradigm may appear reassuring. However it raises two basic and related problems: is good policy the only conditioning factor? Is it the single right criterion according to which aid should be allocated? If the answer to these questions is negative, aid needs to be reassessed, which is what we suggest."

Aid allocation

Given the findings above, it is interesting to observe the determinants of aid allocation. Alesina and Dollar (2000) focuses mainly on bilateral aid allocation. After conducting empirical analysis, they find that aid has been given on political grounds and not based on economic reasoning. The evidence for aid being given on political grounds, for example, includes middle income countries such as Israel and Egypt receiving several times the amount of aid than low income countries for seemingly

political reasons. Another example of this is that some countries, most notably Japan, seemed, according to the study, to distribute aid to countries that voted along similar lines with them in UN debates but this was not necessarily the case, for example, for the US.

Most of the authors mentioned above run a regression in order to check the determinants of aid allocation. With aid as the dependent variable, they include variables such as policy, population, measures of political stability, regional dummies, some country and franc zone dummies and the variable of interest to each particular author. According to Burnside and Dollar (2001)most studies, including theirs, find that, initial income and population have negative and significant coefficients i.e. small and poor countries receive more aid. They find that their policy variable does not come up significant in their aid regression when aid is measured as total aid disbursements for low income countries. Empirically however, they find that when aid is analysed based on the source, policy is more significant for World Bank and multilateral disbursements than for bilateral aid disbursements. Collier and Dehn (2001) find that their dummy for negative shocks comes out negative in growth regressions while Collier and Hoeffler (2004) find that aid actually decreases in postconflict1 i.e. immediately after a war, aid is increased into a country after a conflict period but the aid flow begins to decrease after about 3 years, during the period when it is most needed i.e. when the country has begun to settle down and beginning to rebuild itself.

Next, a brief discussion of the theory of aid shall be given.

Model of Aid in Growth

As Hansen and Tarp (2001) point out that empirical work has been touted as the main method to investigate aid effectiveness mainly because of the complexities of the interactions of growth determinants. "The growth process [therefore] cannot be fully captured in simple analytical

frameworks." However, a brief simple description, derived from Hansen and Tarp, shall be given here of the Harrod-Domar model. As Easterly (1997) points out, the model is important because it still underpins a lot of the ways in which donor organisations work particularly the IMF. The Harrod-Domar model uses a Leonitef production function and starts from the assumption that there is excess labour supply and that output is linearly related to capital which is seen as the scarce factor of production. Assuming the capital-output ratio, v, is constant, income growth is therefore determined by the change in capital stock as shown in the equation below:

(1)

where:

= income growth

= income

= capital stock

If capital stock changes are related to investment and depreciation is allowed for then:

– (2)

where:

= gross investment

= depreciation

In an open economy, investment is equal to savings and foreign inflows as depicted in the equation below:

(3)

where:

= aid

= total foreign inflow

= private foreign inflows

= other foreign inflows

Dividing everything in equation 3 by Y(t) yields the following equation:

(4)

Assuming that aid has no impact on private or foreign inflow i.e. —— ——, the effect of aid on investment reduces to —— ——. This last expression establishes the link between aid and savings which was the main focus of the first generation empiricists. In general the Harrod-Domar model establishes that investment is needed for growth and that aid can work through investment in order to promote growth. As mentioned before, this model is too simplistic to accommodate those complexities of the interaction of variables in current empirical work. The Chenery- Strout two gap analysis, introduced later after the Harrod-Domar is seen as an improvement on the latter because it incorporates import capacity constraints and the capital-output ratio does not remain fixed. Easterly (1997) notes that in practical terms, donor organisations still use the rational based on the Harrod-Domar model in order to assess aid and investment needs and determine aid allocation.

Debates on infrastructure in growth

Hall and Jones (1999) find that physical and human capital contribute to differences in output between countries with high outputs per worker and lower outputs by factors of 1.8 and 2.2 respectively while differences in productivity contribute to the gap by a factor of 8.3. Recent literature has emphasised that infrastructure does not only affect growth merely through its impact via the accumulation of stock physical capital but its effect it has on productivity. As shall be shown in models below, infrastructure enters both through its effect on total factor productivity as well as an input to production.

Estache *et al.* (2005) note that in the mid 2000s, only four papers had been published in the 15 years preceding their paper in which a quantitative analysis of the impact of infrastructure in Africa had been undertaken. Infrastructure has barely been mentioned in growth literature let alone in aid effectiveness studies. The lack of inclusion of infrastructure in recent literature is described by Estache *et al.* when they state that "Whatever the reason, the upshot was that infrastructure had disappeared from the radar screen of most empirical researchers working on the sources of Africa's growth."

When aid projects were started in earnest after the Second World War, infrastructure was recognised as a key component of aid effectiveness. However, most recent papers on aid effectiveness do not include infrastructure. In explaining why infrastructure may have been left out of empirical work on aid effectiveness, it may be helpful to quote Estache and Fay (2007) when discussing the scaling down of the mention of infrastructure in general growth literature:

> "The recent history of infrastructure policymaking perfectly illustrates the negative consequences of politicians and academics' attraction to fads. The problem with fads is an

up-phase is necessarily followed by a down phase, regardless of the importance of the issue. This happened to infrastructure. It never stopped being important, although to a different degree in different countries and at different stages of development. However, its standing in the agenda of researchers and policymakers has cycled through highs and lows in the last 20 years."

They also state that several investment survey climates have found that infrastructure is needed in order to attract investment for growth purposes. They mention several studies such as Fay and Yepes (2003) and Briceño *et al.* (2004), which link infrastructure to growth and mention that there are some who reason that many low income countries are not growing at the same rate as rapidly developing Asian countries because they are not investing as much in infrastructure development.

Theoretically, the importance of infrastructure may be seen in the modifying of growth models to explicitly take into account the different impact of infrastructure capital and non-infrastructure capital. Canning (1999) conducts a study on the impact of different infrastructure variables on growth and proposes the following model:

(5)

where:

= output

= total factor productivity

= non-infrastructure physical capital

human capital

= infrastructure

= labour

Constant returns to scale are assumed and so the exponents sum to 1. Using this model to empirically test the effect of aid, Canning finds that of the three types of infrastructure tested which were electricity generating power, telephones and transportation routes, the number of telephones seems to have the higher marginal return to productivity.

Straub (2008) discusses another version of this model in which infrastructure enters twice into the production, firstly, indirectly as a total factor productivity enhancing element and secondly, as above, as another factor of production i.e.

(6)

In this specification they account the "efficiency-enhancing externalities specifically linked to the accumulation of infrastructure capital" when it is identified as a determinant of total factor productivity in the term . takes into account the services provided by infrastructure.

Escribano *et al*. (2010) points out the several ways in which various authors have come to the inclusion that infrastructure adds to total factor productivity and hence growth. Firstly, they point out that Agénor and Moreno-Dodson (2006) state that high allocations of capital may reduce the cost of the adjustment to private capital i.e. lowering the cost that private investors have to pay as a starting point by having to invest in infrastructure as well as machinery hence, lowering the logistical cost when private investment is undertaken and reducing "the cost of unproductive private investments such as electricity generators or boreholes and wells with more productive investments in machinery and equipment." In a similar vein, they point out that Reinikka and Svensson (1999) find that improvements infrastructure in Uganda reduced the wasting of resources on private

investment in productive substitutes e.g. generators and led to an increase in more productive machinery and equipment.

Escribano *et al.*(2010) state that Galiani *et al.* (2005) find that channels through which infrastructure improvements may work are labour productivity and the enhancement of human capital. With regard to labour productivity the things to consider include the impact of improved transportation from home to work which also reduces stress and leads to improved organization of time. Also, infrastructure improves the efficiency of human capital through the facilitation of better health and education and further, through the promotion of further investments in human capital. The authors state that recent studies show that improvements in transport and infrastructure may also lead to improvements in the export performance of a country. Straub (2008) also notes that infrastructure may contribute to economies of scale due to better transportation leading to better inventory management for example. If infrastructure is necessary for growth then it must also therefore be a necessary consideration in aid aimed at increasing growth.

Calderon (2009) conducts a study on the impact of infrastructure on growth in Africa and finds, firstly that compared to Western Europe and EAP7 countries (The seven East Asian countries with "miracle" economies- Hong Kong (China), Indonesia, the Republic of Korea, Malaysia, Singapore, Taiwan, and Thailand), Africa has some of the lowest measures of infrastructure and that the gap between the regions is increasing. They conduct a 15 year studies of quantity and quality of infrastructure. After analysing the trends, they find that North Africa has the highest amount of stock in Africa, followed by Southern Africa with Central Africa lagging behind.

Calderon (2009) points out that in the period 1991-1995, Northern Africa, Southern Africa and West Africa had higher quality infrastructure than South Asia but since North Africa was the only region increasing its infrastructure assets, by 2001-2005, it was the only region with higher infrastructure

quality than South Asia. Using econometric analysis, they find that infrastructure has led to growth in several countries including Botswana, Benin, Egypt and Uganda. They conduct an econometric study of growth in Africa, including the usual determinants such policy variables (inflation and a government budget measure); structural policies (education, financial and institutional quality) which are predicted to increase growth in the average African country by 4.71 percent while infrastructure development leads to a surge in growth of 2.26 percent.

Taking the positive impact of infrastructure on growth and development as found by the authors above, other authors have pointed out that merely rolling out infrastructure projects is not a straight forward solution. Besides establishing how much infrastructure needs to be invested in for growth, some authors (Estache and Fay, 2007 and; World Bank, 1998) also raise the point that maintenance needs to be taken into account before rolling out infrastructure plans. In *Assessing Aid* (World Bank, 1998) it is mentioned that US$ 2 billion was poured into building roads in Tanzania which fell apart due to lack of maintenance.

According to Estache and Fay (2007), recent debates on infrastructure don't only ask about firstly, how it impacts growth, who should lead investment drives and the levels of investment necessary to produce the desired growth rate but, they also ask the question of where it would be best suited to establish the infrastructure. One of the problems is that, for example, building roads may have the opposite effect than intended. For example, the establishment of transport systems remove the trade barriers for local business and Estache and Fay(2007) mention that some, including Fanini (1983) point out that this may have led to the de-industrialization of the South of Italy. Given the possible problems with infrastructure, they point out that empirical evidence points out that investment in infrastructure is still necessary if non-sufficient for growth.

Another aspect that Estache and Fay (2007) mention is that the trends in infrastructure development have been towards private provision of infrastructure. Since the 1990s infrastructure was seen not so much as a good that the government had to provide. It was thought that for efficiency reasons, private provision of infrastructure would be the best route to go. As the World Bank points out, the assumption was that,

> "Global capital markets have the depth, maturity, size, and sophistication *potentially* to fund all viable investments and projects in developing countries' infrastructure. That they have failed to do so, and that the flow of private finance to infrastructure has declined so dramatically in recent years, is a reflection of several factors—chief among them the impact of recent macroeconomic shocks, ongoing transformations in the global electricity and telecommunications industries, the weakness of local capital markets in most developing countries, and unfinished reforms needed in many developing countries to place their infrastructure industries on a commercial footing."

Data and Methodology

Data

The basic dataset used in this paper was obtained from the Roodman (2007) and is the same uniform dataset he used to conduct his studies. It is measured in 5-year averages, which is also investigated and reported by Roodman (2007) besides his predominantly 4-year average analysis. The reason 5 year averages are used in this paper instead of the 4-year averages is that some of the new data is was more suited to 5-year average manipulation. It is assumed that this should not make too drastic a difference to the results. The data range is from 1954 to 2001. The countries used in the study are listed in Table 2 below. Three datasets are tested, one representing the world dataset, another for low income countries and the last for low income African countries. The countries found in the last two datasets are indicated in Table 2 as well. When defining low income countries the

convention used is that employed by the different authors- low income countries are therefore defined as countries with real GDP per capita below US$1 900 in constant 1985 dollars.

Based on Roodman's (2007) analysis, most prominent papers on foreign aid employ aid/GDP in growth regressions when testing for the impact of aid on growth. The first change made to the Roodman (2007) dataset was to shift from the use of aid/GDP and use of aid per capita instead. As given in arguments above, the World Bank (2004) recognises aid/GDP as a measure of aid dependence. Measuring the extent of aid dependence of a country becomes useful when one is discussing to what point aid should be increased. After running regressions using aid per capita, and assessing the impact on GDP growth per capita, it seems only then should one refer back to the papers rerun by Roodman (2007) in order to discuss whether increasing aid is a viable option to make aid more effective. It therefore seems more relevant to use aid/GDP only when discussing to what point aid should be increased and when assessing not merely whether it has an effect on growth per capita. Early studies on aid effectiveness were testing the effectiveness of aid through its impact on savings and investment, variables that were defined as being divided by a measure of income. It may therefore have been important to define aid by a comparable measurement but there seems no argument offered for why this may remain so, especially in light of the fact that the most widely tested dependent variable, growth, is measured per capita. Aid per capita is therefore the variable used for aid in this paper. The results section discusses the preliminary differences found between the use of aid/GDP and aid per capita.

Moving from the measure to the definition of aid, there are two commonly used possible definitions of foreign aid, namely effective developmental (EDA) assistance and overseas developmental assistance (ODA). EDA differs from ODA in two main respects. Firstly it excludes technical assistance. Secondly, there is a difference in the treatment of loans with the ODA only considering concessional (low interest) loans at full face value. These loans must have a grant element of 25%. EDA only takes

the grant element of loans into account and these loans need not be low interest loans but "near-commercial" ones as well (Chang et al., 1998). Roodman (2007) notes that Dalgaard and Hansen (2001) finds that there is a high correlation between EDA and ODA. Roodman (2007) therefore notes that substituting either variable for the other therefore should not cause too much of a difference. ODA was chosen in this paper because of the ease of availability ODA per capita data versus EDA per capita and given the almost one to one correlation of ODA/real GDP to EDA/real GDP found by Roodman (2007) - a correlation of 0.97- it is assumed that this will not make too much of a difference to the results.

The other main variables include the policy variable used by Burnside and Dollar (2000). This variable is created by including three variables to the initial aid growth equation aid i.e. regressing GDP growth on the log of initial GDP, ICRGE, M2 lagged one period, dummies for sub-Saharan Africa and East Asia and the three political instability variables- ethnic fractionalisation, assassinations and ethnic fractionalisation*assassinations. Included to this basic equation are budget surplus, inflation and openness. The policy variable is then created by the weighting sum of the constant and the three policy variables using the coefficients of the policy identifiers.

With regard to the budget surplus, foreign grants are included in the revenue section while aid-financed projects are included in expenditure so according to Burnside and Dollar (2000), there should be no relationship between this measure of budget surplus and aid. Inflation is included as a measure of monetary policy. The openness variable is a dummy variable developed by Sachs and Warner (1995) where the criteria for a closed economy include any one of the following criteria:

- Average tariffs on machinery above 40%
- Black market premium above 20%
- Pervasive government control of key variables

When Burnside and Dollar (2000) create their variable, the coefficients used yielded the following equation.

Policy = 1.28 + 6.85*Budget surplus - 1.40*Inflation + 2.16*Openness

The following equation was obtained and used in this study:

Policy = 4.182 +8.189*Budget surplus - 2.01*Inflation + 1.012*Openness

It was obtained using the world dataset. All three variables had significant coefficients. The same method, using the same growth regression without the policy or the policy construction variables, was used to create the aggregate infrastructure variable for this study. The individual components of the infrastructure variable are taken from Canning's updated dataset on infrastructure (Canning, 1998). Four infrastructure variables are used namely measures of electricity, road, rail and telephones. Electricity is measured as the total electricity generating capacity in thousand kilowatts, rail is a measure of the total rail track in kilometres whereas telephone is the number of telephones while road is a measure of total roads in kilometres.

When the regression is run with electricity, rail, roads and telephones all included, roads is the only variable with a significant coefficient. This is not taken as a reflection of the general insignificance of the infrastructure but maybe an indication of collinearity. This is a possibility since, when each infrastructure variable is added to the original growth regression on its own without the other three, all but telephones has a significant coefficient as reported in Table 3 below. Individually added all but telephones are significant at a 1% level of significance.

Based on the coefficients of infrastructure components, the weighted sum for the composition of infrastructure were formulated according to:

Infrastructure = 6.571015 + 0.0000147*Electricity - 7.31e-08* Telephones + 1.94e-06* Road + 0.0000139* Rail

The variables are in millions in some cases, probably hence the very small coefficients. In addressing the question of whether it is possible that in forming their policy variable, there may have been a misspecification, for example, by not including aid in the equation used to determine the coefficients to use, Burnside and Dollar (2000) state that, if indeed there had been a misspecification, this may have shown up as widely divergent coefficients being found on the their policy index in the various regressions in which it is run. A similar approach is taken here in discussing whether there may be misspecification in forming the infrastructure variable and as can seen in the results tables, the coefficients on the infrastructure do not differ greatly from each other.

As stated earlier, different authors add different variables to the equations. Collier and Dehn (2001) add and export price shock variable. To create it, firstly they develop their commodity price index based on Deaton and Miller (1995) which gives:

(7)

Where represents the weight of the item and is the international commodity price of the item measure in cost, insurance and freight (cif) border prices. The weighting term is found by:

(8)

Where the additional variables, Q, stands for quantity and j is a subscript for a particular time period. The weight of a particular commodity is based in the value of all commodities, n. They identify shocks by differencing a series of commodity prices to make it stationary, removing predictable elements and normalising the residuals in order to identify the shocks.

The most significant of the three interactive terms employed by Collier and Hoeffler (2004) is the involving postconflict1. Their interactive terms are based on time periods: peace onset, postconlfict1 and postconflict2. Peace onset covers the years during which civil unrest winds down and peace occurs; postconflict1 measures a period of several years after that, generally these being the years 4-7 which constitute the first period comprised fully of peaceful years; and postconflict2 measures the period after postconflict1. Lastly, Dalgaard *et al.* (2004) employ a measure found by calculating the fraction of land of a country found in the tropics which is self explanatory.

Other variables are included and are assumed to be exogenous i.e. they are not affected by the level of aid or shocks to GDP. Among them include, firstly, a measure of the efficiency of government and the security of property rights. This variable is the ICRGE and is based in the international country risk guide (ICRGE) developed by Knack and Keefer (1995). The next variable used in order to capture political instability, is ethnic fractionalization from Easterly and Levine (1997). This variable is found by Burnside and Dollar (2000) to be negatively correlated with growth. Also included is an assassinations variable, to capture civil unrest. An interactive term between ethnic fractionalization and assassinations is also included to further capture political instability. M2/GDP is included in order to capture the development of the financial system. It is lagged one period in order to combat any endogeneity. Also, regional dummies for sub-Sahara Africa and East Africa are included.

Methodology

As explained before the starting point of this investigation is the Burnside and Dollar (2000) aid equation specification given below. As mentioned before, the variable of interest for Burnside and Dollar is their aid*policy variable. They therefore add it to a growth regression with GDP per capita as the dependent variable and measures of political stability, financial depth, government efficiency and regional dummies. The other authors whose specifications are investigated here also use the Burnside and Dollar equation as the starting point of their investigations before they start adding their own variables of interest multiplied by aid to create their own interactive terms. The controls are the same in all the equations for better comparison so, although originally Collier and Dollar (2004) leave out aid and instead add only aid squared, it is added because they leave it out because they find that it is not significant in their regressions and since it is found to be significant in this paper, it is reintroduced to their specification in this paper. Aid squared is also removed from the Collier and Hoeffler (2004) controls.

In this paper the original Burnside and Dollar (2000) and the other different specifications used by the other authors shall have infrastructure and aid*infrastructure added to them. As explained before, this is to test the robustness of the infrastructure and aid*infrastructure variables by seeing how they perform when compared to a range of other terms.

The basic equation Burnside and Dollar (2000) equation used to run an ordinary least squares regression (OLS) is:

(9)

___ (10)

where:

= GDP growth per capita

= a vector of exogenous variables

=ODA per capita

= policy

This is the basic equation and other authors have added their own variables to or modified slightly in order, either to support the Burnside and Dollar (2000) aid*policy variable or, to show the greater importance of their interactive term for aid effectiveness by showing the resulting insignificance, or reduced significance, of the aid*policy variable due to their alterations. The basic equation when their variable/s of interest are added therefore becomes:

(11)

___ (12)

The stands for any alternative interaction term that is investigated by the other authors. What is investigated in this paper is the condition of the alternative variable being infrastructure, adding it to the Burnside and Dollar specification as well as the other author specifications that include their variables and interactive terms. This is done in order to see how it performs and the effect it has on all the other variables in the equation. Firstly when infrastructure and aid*infrastructure are merely added to the basic Burnside and Dollar (2000) equation (9), the following equations are obtained:

(13)

—— (14)

Where the new variable, stands for infrastructure. Modifying the equations of other authors, including the alternative variables of those authors, the equation therefore becomes:

(15)

—— (16)

The details of the alternative variables employed by each author are given in the literature review above. The details of the compositions of variables are given in the data section above. Due to fears of endogeneity of use of 2SLS is suggested by authors such as Dalgaard *et al*. (2009). The possibility of endogeneity of aid, according to Hansen and Tarp (2000) stems from conclusion that aid has a negative relationship with income i.e. poorer countries receive aid. The two equations for 2SLS method therefore become:

(17)

(18)

The regressors include ethnic fractionalization, ICRGE, assassinations, an interactive term of assassinations and ethnic fractionalization, M2/GDP lagged one period to control for endogeneity, dummies for East Asia and sub-Sahara Africa- all controlled for both in the growth and aid equations.

Also included in the aid equation are arms imports as a fraction of total imports, lagged for one period, the logarithm of population and dummy variables for Egypt, Franc zone, Central America, (logarithm initial of GDP*policy), (logarithm of population*policy), (lag of arms imports*policy), (logarithm of initial GDP squared*policy) and (logarithm of population squared*policy). The choice of these variables is based on the original Burnside and Dollar (2000) replication. The alternative terms such as postconflict1 and negative and positive shocks are also included in each equation depending on whether the associated interactive term is included.

However, when 2SLS regressions were run here, most of the interactive terms were dropped due to collinearity. This is because all interactive terms are treated as endogenous based on the Burnside and Dollar (2000) paper. After finding that treating all interactive terms as endogenous reduces their significance, Burnside and Dollar (2000) resort to using OLS. Further, Burnside and Dollar (2000) and Lensink and White (1999) test for the endogeneity of aid Durbin-Wu-Hausman (DWH) tests and find that the test statistics when aid is considered as endogenous, do not differ greatly when OLS is used. Most of the authors discussed here use OLS -Burnside and Dollar (2000), Collier and Dollar (2004), Collier and Hoeffler (2004) and Collier and Dehn (2001) while Dalgaard *et al.* (2004) use GMM. Given these considerations, OLS is the method of choice in this paper. It is used for all the specifications, whether the original authors used it or not, in order to create some uniformity in the methodology for better comparison of the interactive terms. As mentioned above, when interactive aid terms were treated as endogenous, most of them dropped out due to collinearity. Results for regressions where only aid is treated as endogenous are also reported however. Fixed time effects are also included. Fixed country effects were not possible to capture using OLS as other authors also found. It is the reason, seeing this common problem, Hansen and Tarp (2000) employ dynamic modelling in analysing aid effectiveness equations but these do not allow for long-run relationships to be studied and OLS suffices to compare interactive term.

With regard to Burnside and Dollar (2000), they conduct tests to allow them to treat their policy variable as exogenous. In this paper, infrastructure shall also be treated as exogenous. Firstly, Estache and Fay (2007) state that studies (Fernald, 1999; Canning and Pedroni, 2004) have been conducted into the possible two-way causality between economic growth and infrastructure and find that there is evidence of causality in both directions but in the long run, in the majority of cases, infrastructure induces long run growth. Further, the argument is offered that when it comes to road and rail for example, they are not easily changed and therefore in short time analysis, it is not easy for income to have an impact on increasing infrastructure in the short term. Since the question under investigation is whether infrastructure has an impact at all and not the magnitude, the assumption of exogeneity shall be employed. Further, the possible persistence of infrastructure makes it a candidate of exogeneity. As shown in Table 4 when average infrastructure over the period 1950-1960 is regressed against infrastructure in the early 1900's, the mid century infrastructure term is highly significant with a t-value of 42.60 and an adjusted R-squared of 0.96.

Of the seven authors tested by Roodman (2007), two are left out form this study are Guillaumont and Chauvet's (2001) aid*environment variable since their data is only available in 12-year averages and therefore would not be comparable to the other specifications. Hansen and Tarp (2000) prefer aid squared but within a dynamic GMM model. Since the emphasis in the paper is on comparing interactive terms and not methods and since Collier and Dollar already include the aid squared favoured by Hansen and Tarp, there was no use in replicating the Hansen and Tarp specification.

Results

To begin with, most of the controls performed as expected in the regressions using the world and low income datasets. The political instability variables, namely ethnic fractionalization, assassinations and ethnic fractionalization*assassination, were significant with negative coefficients

in most of the regressions using the low income dataset while only the assassinations variable was consistent significant in the regressions using the world dataset. The measure of government quality, ICRGE, also performed well with a positive significant coefficient in most regressions. The regional dummies were also significant in most of the regressions, the one for sub-Sahara Africa having a negative coefficient and the one for East Asia with a positive coefficient. Initial GDP and M2 lagged had sporadic significance. Most of these variables had sporadic significance in regressions using the Africa dataset. Tables with the results for the controls are not included here but are available on request.

Results for changing the measure of aid

The first sets of results to be discussed are those concerning the difference between the use of aid/GDP and aid per capita as the measure of aid in growth regressions. Most empirical studies of aid use aid/GDP as the measure of aid allocation, whether it is EDA/GDP or ODA/GDP and these are the measures of aid used by Roodman (2007) with the denominator represented either by market exchange rates or purchasing power parity. Studies on aid effectiveness may come to different conclusions about how aid should be allocated and these conclusions may be erroneous if the wrong measure of aid is used.

Firstly, merely adding aid/GDP or aid per capita to the basic growth equation without policy, infrastructure or and any alternative or interactive aid terms yields a difference. This is shown in Table 5 below. Aid/GDP has a negative and insignificant coefficient while aid per capita has a positive and significant coefficient with a p-value of 0.08. Aid/GDP may be important in determining whether increasing aid is a viable policy strategy but given the findings here it may be more important to do as Boone (1995) does and remove countries with aid/GDP ratios above a certain level before using aid/GDP in aid effectiveness analysis. Boone finds that in countries with aid/GDP beyond 15%,

fungibility is not an issue and therefore it was not necessary to include these countries in his analysis. Other authors that use aid/GDP do not make this distinction when determining what countries to include in their analysis when checking the effectiveness of aid/GDP on growth.

The main results affected by the differences in aid definition use are Dalgaard *et al.* (2004), Collier and Hoeffler (2004) and Collier and Dehn (2004). These results are reported in Tables 6 and 7 below. There does not seem to be a very clear pattern to how the differences are found. Using the world dataset, with regard to the Collier and Dehn (2001) equation, in their paper, as stated above, they introduce four main terms. In the replication regressions, using aid/GDP only one variable gains significance while, when aid per capita is used, three of their interactive terms which are lagged aid*positive shock, lagged aid*negative shock, differenced aid*negative shock, differenced aid*positive shock, turn out with significant coefficients albeit with signs different from the original authors expectations.

Originally, the Collier and Dehn (2001) find differenced aid*negative shock and lagged aid*positive shock significant both with positive signs. For the authors, this is significant because it supports their claim that aid is needed in countries experiencing negative shocks to the economy in order to buffer the effect. When the same equation is replicated with aid per capita, differenced aid*negative shock is insignificant whereas the other three variables become significant with different signs. Lagged aid*positive shock expectedly takes on a positive sign however, differenced aid*negative shock and differenced aid*positive shock are similarly significant with negative signs. In this paper, none of Collier and Dehn's variables are significant when aid/GDP is used but differenced aid*positive shock is significant with a negative coefficient when aid per capita is used. In the low income dataset equation Dalgaard *et al.*'s term is negative and significant when aid/GDP is used while it is insignificant when aid per capita is used. In the low income dataset regressions, Collier and Hoeffler's aid*policy* postconflict1 variable on the other hand is insignificant when aid/GDP but has

a significant negative coefficient when aid per capita is used- a different sign from that found by the original authors.

It is possible that given the differences between aid/GDP specifications and aid per capita equations, one may have to be careful in whether one uses aid/GDP or aid per capita. As has been stated, aid/GDP is a measure of dependence and is therefore more relevant when posing the question of whether an increase in aid is a good policy strategy and to what point.

Results from the inclusion of infrastructure and aid*infrastructure

The main and most significant finding are to do with the findings when infrastructure and aid*infrastructure are included. Firstly it shall be noted that following the convention set up by the other authors, aid*policy was also included in all the specifications and it hardly gained significance in any regressions before or after the inclusion of aid*infrastructure. Aid*infrastructure on the other hand performed well. When regressed using the world and low income datasets , aid*infrastructure has a positive and significant coefficient in every specification to which it is added except for the Dalgaard *et al*.'s (2004) specification where, however, it also causes their variable to lose its significance. Its inclusion leads to the loss of significance and invalidates most of the other interactive terms in the different specifications including invalidating Dalgaard et al.'s although it enters mildly insignificant in that equation where it achieves a p-value of 0.12 and its inclusion leads to the loss of significance of the aid*tropic variable.

Using the world dataset, the inclusion of infrastructure and aid*infrastructure therefore leads to the loss of significance of Dalgaard et al.'s term; Collier and Hoeffler's (2004) aid*policy*postconflict1 term; loss of significance of Collier and Dehn's (2001) lagged aid*negative shock and differenced aid*positive shock variable. Lagged aid*positive shock is the only interactive term that maintains its

significance. Burnside and Dollar's aid*policy and Collier and Dollar's aid squared term are insignificant before the inclusion and remain so afterwards. In the low income dataset regressions, similar results are obtained except although aid*infrastructure enters significantly in the Collier and Hoeffler specification it does not lead to the loss of significance of the aid*policy*postconflict1 term. These results can be seen in Tables 8 and 9 below.

As can be seen in Table 10 below, in the Africa datasets hardly any aid terms are turn out to be significant, including the aid*infrastructure term. However, infrastructure term becomes gains large positive significant coefficients in the Africa dataset whereas it exhibited small insignificant coefficients when the regressions were run using the world and low income datasets. Of further interest is that the policy variable also does a reverse turn, having been highly significant in world dataset equations and attaining insignificant coefficients in the Africa dataset equations. What is also of interest is that the inclusion of the infrastructure terms also leads to ICRGE losing its significance in the low income and Africa dataset equations, particularly in the former. This implies that in Africa and low income countries in general, infrastructure may be more significant for growth than policy and institutional variables.

In terms of the aid*infrastructure term, this is hardly surprising given the assumption that infrastructure helps aid accelerate growth through the productivity associated with it, since sub-Saharan African countries have considerably less infrastructure figures (see Table 11 below), infrastructure therefore cannot be a strong determinant of aid effectiveness. With such low numbers compared to the rest of the world and the average low income country in general, it may be explainable why infrastructure on its own is needed and significant in low income countries in general and may not be available in enough quantities to add to productivity and add to the significance of aid*infrastructure in low income countries in general. Further, in the Africa dataset results, the policy variable on its own, enters with insignificant coefficients in almost every equation

with the inclusion of infrastructure and aid*infrastructure whereas it had performed well and comes out highly significant in almost every equation using the world dataset.

The measure of institutional quality, ICRGE, also loses its significance in low income and Africa regressions. The aid*infrastructure variable outperforms aid*policy using the world dataset and whereas in low income and African dataset equations, none of the aid-interactive perform well but infrastructure comes out as a more significant determinant of growth than the policy variable which is insignificant all Africa dataset specifications whereas infrastructure in significant in all including the Dalgaard *et al* .(2004) specification in which fraction of land in the tropics is insignificant before and after inclusion of aid*infrastructure and infrastructure itself. All this may point to the greater importance of infrastructure as a determinant of growth than policy and institutional variable. All the trends in the data are found when 2SLS regressions are used with aid as the endogenous variable as reported in Tables 12, 13 and 14.

The insignificant nature of infrastructure in the world and low income regressions may confirm what Estache and Fay (2007) find that in places where infrastructure is already established, developing new stocks of infrastructure may not be as important as spending money maintaining it. They find this for North Africa, which they find would be better served by maintenance of existing infrastructure since it has a lot more infrastructure than other regions of Africa, increasing the quantity of infrastructure is more relevant they find.

What is of further interest is that the inclusion of infrastructure and aid*infrastructure in the world and low income dataset equations leads aid to change from being insignificant in most replications gaining a significant negative coefficient in almost every replication after the inclusion of infrastructure. This possibly points to the fact that aid on its own may have detrimental effects. This effect may work though the negative effect aid has on negative savings as has been investigated by

many authors mentioned in the literature review. Interestingly, in this paper, when aid is regressed against domestic savings it is insignificant until infrastructure is controlled for and becomes significant with a negative coefficient i.e. aid may have a negative effect on saving. This result is shown in Table 15.

Using Acemoglu to explain possible collinearity between infrastructure and fraction of land in the tropics

It is significant to note that the equations in which it did not perform well consistently across datasets, are those containing Dalgaard *et al.*'s (2004)'s specification with aid*fraction of land in the tropics (tropic) variable which also turns out with an insignificant coefficient . The phenomenon that transpires in the Dalgaard *et al.* equation may have something to do with the link between tropical areas and high colonial settler mortality in these areas and the possible link this has to the type of infrastructure that was subsequently developed in colonial regions. The link between tropical areas and colonial settler settling patterns is discussed extensively in Acemoglu *et al.*'s (2001). What is proposed here is for infrastructure to be added to several Acemoglu *et al.* (2001) equations in order to study the relationship between Dalgaard *et al.*'s (2004) tropic variable and infrastructure and why Dalgaard *et al.*'s et al.'s variable is the only one not that invalidates aid*infrastructure in the world dataset regressions, due to possible collinearity.

Firstly, in order to establish the possible link between tropics and infrastructure, Table 1. below shows the negative relationship between infrastructure and fraction of land in the tropics when the aggregate measure of infrastructure is used as the dependent variable and then when each individual component (e.g. electricity, road etc) of the infrastructure variable are also used as the dependent variables with Dalgaard *et al.'*s fraction of land in the tropics as the independent variable.

For all the dependent variables, the tropic variable achieves a significant negative coefficient. Acemoglu *et al.*'s finding may be relevant to help explain this.

Hall and Jones find that institutions are important for growth. Acemoglu *et al.* (2001) find that settler mortality may be an important determinant in the formation of institutions. By modifying Acemoglu *et al.*'s (2001) regressions and adding infrastructure, it may be shown that there may be a possible link between infrastructure and the settler mortality variable used by Acemoglu *et al.*(2001) which is linked to tropical areas which are linked to tropical diseases which caused high colonial settler mortality. It shall be shown by suggesting that in the Acemoglu *et al.*'s analyses on the formation of institutions, another step may added to their analysis and that step may involve infrastructure.

For data, Acemoglu *et al*. (2001) use Curtin's studies of largely of non-combat military deaths in colonies to approximate for settler mortality. A lot of these military personnel died from diseases such as malaria and yellow fever, gastrointestinal diseases being the third highest cause of death. The rates were measured by Curtin (1989, 1998) in deaths per 1 000 soldiers and logged by Acemoglu *et al.* (2001) in order that the extreme figures from Africa do not disproportionately impact the results. The measure of institutions they use is the risk of expropriation of private foreign investment by government. It is measured on a scale from 0 to 10 with a higher score means less risk of expropriation and therefore better institutions due to greater freedom.

Acemoglu *et al.* (2001) propose that settler mortality is important because colonial settlers settled in areas where there were low death rates and when they settled in those areas they imported and established the institutions from their countries of origin. The main influence of the colonizers which impacts growth today is the imposition of Western institutions that have persisted to this day. It is suggested here that infrastructure needs mention in this story either as an added determinant of institutions or in terms of its own persistence. In establishing themselves in these areas, they built

infrastructure for their businesses and general comfort. It is proposed here that institutions are not the only important channel through which growth was affected by settler mortality or that they may be a channel through which infrastructure worked. Infrastructure is therefore be added to the Acemoglu *et al.*(2001) equations in order to show that settler mortality did not just impact institutions but infrastructure development as well and it may be through this channel as well that settler mortality gains its significant impact on growth. Acemoglu *et al.* (2001) propose the following link between settler mortality and institutions:

(potential) settler mortality => settlements => early institutions => current institutions => current performance

It is proposed in this paper that the link runs either through the following links more according to:

(potential) settler mortality => settlements =>infrastructure =>early institutions => current institutions => current performance

An alternative route leaving out infrastructure and jumping straight to the impact of infrastructure on productivity may be:

(potential) settler mortality => settlements =>infrastructure=> current performance

Explicitly linking this to Dalgaard *et al.'*s tropic variable the alternative channels become:

Fraction of land in the tropics => (potential) settler mortality => settlements =>infrastructure =>early institutions => current institutions => current performance

Fraction of land in the tropics => (potential) settler mortality => settlements =>infrastructure=> current performance

Either way, the importance of the infrastructure and not just the institutions established by colonisers, is taken into account. Institutions come about when there is something of value to protect. On the face of it, it seems difficult to form laws for something that is yet to exist and more practical to assume that infrastructure needs to develop before or in tandem with the laws that defend it. The aggregate variable for infrastructure used in the growth regressions in the modified Burnside and Dollar (2000) equations, is added to the Acemoglu *et al.* regressions.

Several authors have taken geography into account when determining current economic input. Rodrik, Subramanian and Trebbi (2002) finding that geography, instrumented by distance from the equator, does not have as significant a coefficient as institutions (instrumented by settler mortality) in determining economic growth but there is a strong correlation between geography and institutions. Sachs (2003) assert that geography is important and has a direct impact on growth this is because tropical areas experience, for example, high rates of malaria transmission, therefore with malaria instrumenting for geography, they find that malaria transmission has a significant and direct negative impact on growth. As interesting as these result may be for growth analysis, it is not the direct impact of geography on growth that is of interest in this paper but the issue of geography being used to instrument for institutions.

Halls and Jones, for example, offer the explanation of differences institution in colonial settlements- they suggest that Europeans settled in places that were sparsely populated and had similar weather to Europe. Acemoglu *et al.* (2001) dispute this stating that the reasoning is not entirely convincing as the Western influence of the presence of the Belgians in the Congo could not on the face of it be said to have led to good institutions and in fact it did not. Acemoglu *et al.* (2001) offer the

explanation institutions developed due to patterns of colonial settlement with colonialists settling in large numbers then and importing institutions to areas where there was low settler mortality. It is from this more widely accepted perspective that the link between tropical areas and infrastructure shall be investigated from.

Acemoglu *et al.* (2001) identify settler mortality as an instrument for institutions. They therefore add it to growth equations in order to represent institutions. They use average protection against expropriation risks their measure of institution and use simple OLS regressions to check their hypothesis. With average protection against expropriation risk as the dependent variable, they regress it against settler mortality and find that their measure of settler mortality achieves a significant negative coefficient i.e. there is a significant inverse relationship between average protection against expropriation risk and the log of settler mortality. They also run a regression with log GDP per capita in 1995 as the dependent variable and average protection against expropriation risk as the independent variable and another where log of settler mortality is instrumenting for the average protection against expropriation risk. In both cases the dependent variables achieve significant coefficients with the former having a positive sign and the latter a negative sign.

Infrastructure is run as an independent variable in regressions with average protection against expropriation risk and log of GDP as dependent variables, with and without measures of institutions. With regard to the first regression, this is also to see whether infrastructure can be a determinant of institutions. Secondly, with Acemoglu *et al*.'s measure of current GDP- logarithm of GDP in 1995- as the dependent variable, it is regressed with infrastructure and settler mortality. Any endogeneity with regard to infrastructure in this case may be dealt with by the fact that the data for infrastructure used is the average from 1950-1970 representing the time period in which most colonial regimes came to an end and therefore current GDP growth cannot have had an impact on it.

This time period is used as an assessment of the accumulated stock of capital established by the colonisers.

To argue for the persistence of infrastructure, OLS regressions were run in this paper with current infrastructure as the dependent variable and a variable for average infrastructure in the years 1950-1970. Current infrastructure is represented by the average infrastructure from the first 5 years of the 1990s since there is more data in this time period than any later period. There is a strong correlation between infrastructure in the mid century and current infrastructure. As shown in Table 1, the infrastructure established at the end of the colonial period enters strongly in the regression with a coefficient of 1.36, a p-value of 0.00, a t-value of 42.60 and an adjusted R-squared value of 0.96.

Results of Acemoglu regressions

All this helps provide the link between Dalgaard *et al.*'s tropic and infrastructure by demonstrating:

Tropical areas => high settler mortality => little settlement => low infrastructure

Modifying the Acemoglu *et al.* (2001) equations yielded the expected results. When infrastructure is used as the dependent variable instead of institutions or a measure of institutions, there is a significant inverse relationship between settler mortality and the establishment of infrastructure in the 1950s and 1960s when most colonial regimes came to an end therefore there is a link between colonial settlers and the amount of infrastructure before the end of their tenure. So it could be that the effect that settler mortality has on current growth is not just through institutions but through the infrastructure established by colonialist who settled in large numbers in areas where their death rates were low (i.e. mostly non-tropical areas) and therefore proceeded to build infrastructure in the

areas they settled in order to make their lives more comfortable and improve infrastructure for their commercial purposes as well.

Another possible way to test this is to add both infrastructure and the measure of institutions- settler mortality- in an equation with GDP growth as the dependent variable. As shown in Table 4 below, both variables seem to be significant determinants of GDP growth. Infrastructure established by colonial settlers may still be associated with current growth because of the persistence of infrastructure. This is investigated by taking the average infrastructure for 1950-1960 and using it as an independent variable with current infrastructure as the dependent variable. As can be seen in Table 4 below, infrastructure established in the mid century is relevant to determining infrastructure 30 years later (infrastructure numbers from 1990-1994 was used for current infrastructure as data for this period was more readily available than any later period).

Lastly, another link between tropics, infrastructure and growth may be indirectly through the current institutions variable used by Acemoglu *et al*. (2001). As mentioned, when average protection against risk of expropriation is regressed against GDP growth, it is positive and highly significant. When infrastructure from mid-century is regressed against current average protection against risk of expropriation, it has a highly significant and positive coefficient when it is the only dependent variable as well as with the inclusion of log of settler mortality, therefore possibly establishing the link between infrastructure and institutions.

All his may explain why aid*tropics variable may be correlated with aid*infrastructure and may the only variable it does not perform well against.

Conclusion and policy recommendations

A summary of the main findings in this paper are:

- Using aid per capita rather than aid/GDP presents differences in regressions on aid effectiveness and therefore it may need to be a consideration taken into account in aid studies.
- Aid*infrastructure outperforms any other interactive term, including the Burnside and Dollar aid*policy term which is also added to all equations therefore possibly highlighting the greater importance of infrastructure in determining the impact of aid on growth.
- The inclusion of aid*infrastructure leads to aid/capita consistently entering significantly in the growth regressions but with a negative coefficient. Whereas before the inclusion of infrastructure and aid*infrastructure, aid, as a variable on its own was not significant.
- There is a preliminary link between infrastructure and the fraction of land in the tropics. This is found by modifying Acemoglu et al. (2001) regressions and adding infrastructure to them. This may explain why regressions with Dalgaard et al.'s tropic is the only variable out of five specification types (eight when counting Collier and Dehn's (2001) separately) against which aid*infrastructure does not perform well.
- In the Africa and low income datasets, the policy and variable for institutional quality, ICRGE, enter with insignificant coefficients with the inclusion of the infrastructure terms.

The conclusion being drawn here is not necessarily that there should be an increase in aid aimed at increasing infrastructure but to merely point out that infrastructure represents a capacity constraint on aid because infrastructure increases productivity and aid aimed at increasing growth needs to take account of constraints imposed by a shortage of infrastructure based on empirical findings that had not been undertaken before.

Estache *et al.* (2007) state that, "the initial source of today's infrastructure gap is probably the failure to adjust to the evolution of the demand from the agricultural, industrial and services activities in the increasingly open African economies." How this concerns aid is that many governments in Africa have historically experienced difficulties keeping their budget balanced and are influenced by short term concerns, such as salary payments, to forego public expenditure. Aid may therefore help to fill this gap however this does not mean that rolling out infrastructure projects wholesale by donors is the solution. That infrastructure is important for growth is not new and even though some papers come up with empirical results that are contradictory to the findings in this paper, which affirms the importance of infrastructure as important to growth acceleration, infrastructure is generally considered across ideological camps as necessary for growth. This paper merely provides empirically results for its importance with regard to aid effecctiveness. The question therefore is not necessarily about if it is necessary but how this can be implemented as a policy question.

As mentioned earlier, in *Assessing Aid* (World Bank, 1998), billions of dollars were spent on road projects in Tanzania but some of the roads deteriorated faster than they could be built due to lack of maintenance. It must therefore be pointed out that stating that infrastructure is a necessary variable in growth analysis is not the same as suggesting that infrastructure projects be rolled out in big infrastructure building drives in developing countries. The development of infrastructure is not an easy thing. In the 1960's, great infrastructure drives were established in but failed to lead to overall growth.

One may argue that most of the projects were not completed and therefore the effect on growth could not be established. One may also argue that the method of infrastructure establishment is key- big drives by government and aid agencies without the involvement of the people only lead to white elephants that are not maintained by the very people they were meant to help. As Estache and Fay (2007) point out:

> "Politically motivated projects are likely to exhibit low (or lower) rates of return as their objectives are to bring in the votes rather than to maximize growth. This is certainly not limited to developing countries as evidenced by the controversies around "Alaska's bridges to no-where" in the United States.10 Similarly, a recent careful attempt to model how investment decisions are made in France concluded that "roads and railways are not built to reduce traffic jams; they are built essentially to get politicians elected" (Cadot et al 2006 p1151)."

Further, as mentioned by Estache *et al.* (2007) another consideration is the change in the type of infrastructure needed. They state that in some parts of Africa, the emphasis moved from the importance of establishing networks in sparse areas and to establishing lower quality but better maintained roads in dense areas. However, the decrease in establishing roads in outlying areas was not matched by an equal increase in roads in more densely populated areas.

One also needs to be sensitive to regional differences in infrastructural needs. Estache and Fay (2007) find that in Southern Africa (besides Mauritius and South Africa), the largest payoff to growth would be in the development of roads whereas they do not seem to have as big a payoff in North Africa probably due to the already established infrastructure there while West, East and Central Africa could gain greater payoffs in all sectors with Central Africa with the most to gain whereas North Africa could gain payoffs from the improvement of roads in the area- in general countries with large amounts of infrastructure would benefit from improvements infrastructure whereas those with low figures would benefit from development of new infrastructure. This may be compared to other findings such as Canning who finds that, of the infrastructure variables he tests, telephones exhibit the higher marginal productivity whereas Calderon's finds (2009) that across the region, most

countries would benefit from improvements in road and electricity and less so with improvements in telecommunications.

It is suggested, given these considerations that, although policy was considered less significant in determining aid effectiveness in general and growth in Africa, the same methods offered by Devarajan *et al*. (2001) in implementing successful reforms in developing countries should be used in infrastructure projects. Firstly, reform needs to be performed where there is a strong desire for reform with steps and plans laid out. Technocrats in charge of reforms should have the strong support from government. Further, as with other successful projects, something could be taken from successful reformers such as Ghana and Uganda. Firstly, governments should decide for themselves, after a thorough assessment of their needs, what reforms or projects would best suit their needs before money is pumped in. This investigation can be done in consultation with donor countries or other countries that have been successful in implementing projects. Devarajan *et al.* (2001) point out the Ugandan officials consulted with their Ghanaian counterparts in order to form their policy strategies. There should also be a consultative process on the ground with the people in order to avoid the problems in Zambia under Kaunda when people rejected reforms. This consideration and strong leadership are needed to avoid the proliferation completed and half completed white elephant projects on the continent. As with policy, simply imposing reform in the realm of infrastructure development may not lead to the reform necessary- imposing policy reforms wholesale on governments has at times been ineffective and simply imposing infrastructure projects may have the same effect.

Secondly, and possibly more importantly a point to consider is that, failed projects such as the one stated of roads in Tanzania may have failed because roads were being built to nowhere. Building infrastructure without the establishment of the industry to utilise it or clamour for its maintenance may lead to the same failures as before. Africa may not just need infrastructural drives but industrial

drives. Again, as mentioned in the last point, merely imposing industrial projects may not be the answer. What may be more appropriate are social business type models- factories built by communities with their interests at the heart of it and the profits accruing to them further encouraging efficiency and success of projects which is has been hard to achieve with government running big projects.

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Appendix

Table 1: The link between fraction of land in the tropics and infrastructure
Dependent variables: aggregate infrastructure, telephones, electricity, road and rail.

	infrastructure	telephones	electricity	road	rail
fraction of land in the tropics	**-0.4** **0.04**	**-53089** **0**	**-21498.18** **0.01**	**-11968** **0.01**	**-11630.71** **0.02**
Observations	664	1138	1351	925	1121
R-squared	0.04	0.05	0.06	0.05	0.06

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity

Table 2: Countries used in aid effectiveness studies

Aruba	Ecuador*	Lao PDR*	Puerto Rico	Samoa*
Afghanistan	Egypt, Arab Rep.*	Lebanon	Korea, Dem. Rep.	Yemen, Rep.*
Angola**	Eritrea	Liberia**	Portugal	Yugoslavia, Fed. Rep.
Anguilla	Western Sahara	Libya	Paraguay*	South Africa
Albania	Spain	St. Lucia	French Polynesia	Congo, Dem. Rep.**
Netherlands Antilles	Estonia	Liechtenstein	Qatar	Zambia **
United Arab Emirates	Ethiopia**	Sri Lanka*	Reunion	Zimbabwe**
Argentina	Finland	Lesotho**	Romania*	
Armenia	Fiji	Lithuania	Russian Federation	
American Samoa	France	Luxembourg	Rwanda**	
Antigua and Barbuda	Faeroe Islands	Latvia	Saudi Arabia	
Australia	Micronesia, Fed. Sts.	Macao, China	Sudan**	
Austria	Gabon	Morocco*	Senegal **	
Azerbaijan	United Kingdom	Monaco	Singapore	
Burundi **	Georgia	Moldova	Saint Helena, Ascension and Tristan da Cunha	
Belgium	Ghana**	Madagascar **	Svalbard and Jan Mayen	
Benin**	Gilbraltar	Maldives	Solomon Islands*	
Burkina Faso**	Guinea**	Mexico	Sierra Leone**	
Bangladesh*	Guadeloupe	Marshall Islands	El Salvador	
Bulgaria	Gambia, The**	Macedonia, FYR	San Marino	
Bahrain	Guinea-Bissau**	Mali**	Somalia **	
Bahamas, The	Equatorial Guinea	Malta	Saint Pierre and Miquelon	

Bosnia and Herzegovina
Belarus
Belize
Bermuda
Bolivia*
Brazil
Barbados
Brunei
Bhutan*
Botswana**
Central African Republic**
Canada
Switzerland
Chile
China*
Cote d'Ivoire**
Cameroon**
Congo, Rep.**
Cook Islands
Colombia
Comoros**
Cape Verde**
Costa Rica
Former
Greece
Grenada
Greenland
Guatemala*
French Guinea
Guam
Guyana*
Gilbratar
Hong Kong, China
Honduras*
Croatia
Haiti*
Hungary
Indonesia*
Isle of Man
India*
British Indian Ocean Territory
Ireland
Iran, Islamic Rep.
Iraq
Iceland
Israel
Italy
Jamaica
Myanmar*
Mongolia
Northern Mariana Islands
Mozambique**
Mauritania**
Montserrat
Martinique
Mauritius
Malawi**
Malaysia
Mayotte*
Namibia
New Caledonia
Niger**
Norfolk Island
Nigeria**
Nicaragua*
Niue
Netherlands
Norway
Nepal*
Nauru
Neutral Zone
New
Sao Tome and Principe*
Suriname
Slovak Republic
Slovenia
Sweden
Swaziland
Seychelles
Syrian Arab Republic
Turks and Caicos Islands
Chad**
Togo**
Thailand*
Tajikistan
Tokelau
Turkmenistan
East Timor
Tonga
Trinidad and Tobago
Tunisia*
Turkey
Tuvalu
Taiwan, Province of China
Tanzania**
Uganda

Czec		Zealand	**
			Ukraine
Cuba	Jordan	Oman	*
Christm			
as			Urugua
Islands	Japan	Pakistan*	y
Cayman	Johnston		United
Islands	Island	Panama	States
		Pacific	
		Islands,	
		Trust	
	Kazakhsta	Territory of	Uzbekis
Cyprus	n	the	tan
Czech			St. Vincent and
Republic	Kenya**	Pitcairn	the Grenadines
German	Kyrgyz	Panama	Venezu
y	Republic	Canal Zone	ela, RB
Djibouti			Virgin Islands
**	Cambodia	Peru	(British)
Dominic			Vietna
a	Kiribati	Philippines*	m
Denmar	St. Kitts		Vanuat
k	and Nevis	Palau	u
Dominic			
an			
Republic	Korea,	Papua New	West Bank and
*	Rep.*	Guinea*	Gaza
Algeria*	Kuwait	Poland	Wallis and Futuna

* indicates a country included in the lowincome dataset
** indicates a country included in both the low income and low income Africa dataset

Table 3: Regressions with infrastructure variables added individually

Dependent variable: GDP growth/capita

logarithm of gdp	**-0.97**	-0.80	-0.90	**-1.09**
	0.02	0.13	0.20	**0.00**
ethnic fractionalisation	-1.20	-1.39	-1.02	-1.13
	0.23	0.12	0.20	0.18
assassinations	-0.28	-0.34	-0.30	-0.32
	0.39	0.30	0.19	0.19
ethnic fractionalisation*assassinations	0.23	0.03	0.19	0.31
	0.72	0.97	0.72	0.56
ssa	-1.04	**-1.71**	**-1.22**	**-1.49**
	0.19	**0.02**	**0.09**	**0.03**
easia	**2.47**	**3.08**	**2.44**	**2.60**
	0.00	**0.00**	**0.00**	**0.00**
icrge	**0.30**	**0.39**	**0.38**	**0.44**
	0.04	**0.02**	**0.01**	**0.00**
m21	**0.06**	0.01	**0.03**	**0.03**
	0.00	0.68	**0.00**	**0.00**
roads	**1.49E-06**			
	0.01			
rails		**0.000035**		
		0.00		
electricity			**9.20E-06**	
			0.01	
telephones				9.82E-09
				0.31
Constant	5.95	6.45	**8.25**	**8.40**
	0.09	0.14	**0.00**	**0.00**
Observations	454.00	455.00	550.00	529.00
R-squared	0.29	0.27	0.28	0.29

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

World dataset used

Table 4: Modified Acemoglu regressions

Dependent variables: current infrastracture, democracy in 1900, average protection against risk of expropriation, log GDP (PPP) 1995 and "current" infrastructure

	infrastructure	infrastructure	democ00a	avexpr	avexpr
logem4	**-0.27**		**-1.18**		**-0.42**
	0.06		**0.00**		**0.02**
avexp					
infrastructure (average 1950 and 1960)				**0.30**	**0.35**
				0.01	**0.00**
democr00		0.19		**0.15**	
		0.21		**0.09**	
Constant	**8.16**	**6.58**	**6.94**	**0.44**	**6.38**
	0.00	**0.00**	**0.00**	**0.00**	**0.00**
Observations	45.00	44.00	73.00	40.00	41.00
R-squared	0.12	0.22	0.26	0.26	0.34

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
democ00a- democracy in 1900
avexp- average protection against risk of expropriation
infr90-94- average aggregate infrastucture in period 1990-1994
logpgp95- log GDP (PPP) 1995

Table 4: Modified Acemoglu regressions

Dependent variables: current infrastracture, democracy in 1900, average protection against risk of expropriation, log GDP (PPP) 1995 and "current" infrastructure

	avexpr	logpgp95	logpgp95	logpgp95	infr90-94
logem4	**-0.58**		**-0.49**		
	0.00		**0.00**		
avexp				**0.48**	
				0.00	
infrastructure (average 1950 and 1960)		**0.35**	**0.30**	0.07	**1.36**
		0.00	**0.01**	0.15	**0.00**
democr00					
Constant	**9.20**	**6.00**	**9.48**	**4.42**	**-2.40**
	0.00	**0.00**	**0.00**	**0.00**	**0.00**
Observations	74.00	62.00	44.00	58.00	59.00
R-squared	0.24	0.09	0.59	0.55	0.96

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
democ00a- democracy in 1900
avexp- average protection against risk of expropriation
infr90-94- average aggregate infrastucture in period 1990-1994
logpgp95- log GDP (PPP) 1995

Table 5: Comparing aid/GDP and aid/capita using Burnside and Dollar (2000)controls

Dependent variables: GDP growth/capita

	Using aid/GDP	aidcap/capita
aid	-0.10	**0.01**
	0.47	**0.08**
logarithim of gdp	-0.90	**-0.79**
	0.05	**0.03**
ethnic fractionalisation	-1.16	-0.99
	0.17	0.24
assassinations	-0.34	-0.32
	0.14	0.18
ethnic fractionalisation*assassinations	0.34	0.36
	0.49	0.48
ssa	-1.05	**-1.14**
	0.13	**0.10**
easia	**2.59**	**2.89**
	0.00	**0.00**
icrge	**0.39**	**0.37**
	0.01	**0.01**
m21	**0.03**	**0.03**
	0.00	**0.00**
Constant	**5.80**	4.68
	0.08	0.11
Observations	551.00	538.00
R-squared	0.28	0.28

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

World dataset used

Table 6: Comparing results of regressions using aid/GDP and aid/capita alternatively (world dataset)
Dependent variable: GDP growth per capita

	Burnside and Dollar using aid/GDP	Burnside and Dollar using aid/capita	Collier and Dehn using aid/GDP	Collier and Dehn using aid/capita	Collier and Dollar using aid/GDP	Collier and Dollar using aid/capita	Collier and Hoeffler using aid/GDP
aid	-0.23	0.00	-0.28	0.01	-0.34	0.00	-0.19
	0.39	0.93	0.33	0.81	0.43	0.86	0.48
aid2					0.05	0.00	
					0.15	0.26	
policy	**0.84**	**0.93**	**0.75**	**0.95**	**1.04**	**0.99**	**0.88**
	0.00	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
aidpolicy	0.09	0.00	**0.13**	0.00	0.04	0.00	0.05
	0.15	0.78	**0.06**	0.95	0.54	0.92	0.46
aid2policy							
infrastructure							
aidinfrastructure							
posshock			-0.11	1.32			
			0.93	0.29			
negshock			**-2.44**	**-2.23**			
			0.09	**0.04**			
Daidposshock			-26.31	**-28.61**			
			0.25	**0.07**			
Laidposshock			**1.28**	**0.08**			
			0.09	**0.07**			
Daidnegshock			1.03	0.25			
			0.35	0.84			
Laidnegshock			-0.70	**-0.03**			
			0.12	**0.06**			
postconflict1							0.28
							0.72
aidpolpostconflict							**0.12**
							0.05
pinstab1							
tropic							
aidtropic							
Constant	1.49	-0.74	1.74	-0.02	-0.04	-0.55	1.78
	0.63	0.79	0.58	0.99	0.99	0.80	0.56
Observations	369.00	362.00	296.00	361.00	406.00	391.00	369.00
R-squared	0.40	0.40	0.42	0.44	0.39	0.38	0.41

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 6: Comparing results of regressions using aid/GDP and aid/capita alternatively (world dataset)
Dependent variable: GDP growth per capita

	Collier and Hoeffler using aid/capita	Dalgaard using aid/GDP	Dalgaard using aid/capita
aid	0.00	**0.58**	0.03
	0.90	**0.03**	0.22
aid2			
policy	**0.92**	**0.97**	**1.07**
	0.00	**0.00**	**0.00**
aidpolicy	0.00	0.00	0.00
	0.80	0.95	0.55
aid2policy			
infrastructure			
aidinfrastructure			
posshock			
negshock			
Daidposshock			
Laidposshock			
Daidnegshock			
Laidnegshock			
postconflict1	0.50		
	0.51		
aidpolpostconflict	**0.00**		
	0.06		
pinstab1			
tropic		**-1.02**	**-1.38**
		0.01	**0.01**
aidtropic		**-0.70**	**-0.01**
		0.00	**0.05**
Constant	-1.16	2.54	
	0.69	0.42	
Observations	362.00	364.00	357.00
R-squared	0.41	0.43	0.43

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 7: Comparing results of regressions using aid/GDP and aid/capita alternatively (low income dataset)

Dependent variable: GDP growth per capita

	Burnside and Dollar using aid/GDP	Burnside and Dollar using aid/capita	Collier and Dehn using aid/GDP	Collier and Dehn using aid/capita	Collier and Dollar using aid/GDP	Collier and Dollar using aid/capita
aid	-0.08	0.00	-0.18	0.03	0.13	0.03
	0.79	0.86	0.61	0.24	0.76	0.20
aid2					0.00	-0.25
					0.93	0.41
policy	**1.18**	**1.01**	**0.98**	**1.07**	**1.18**	**0.99**
	0.00	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**
aidpolicy	0.01	0.00	0.06	0.00	-0.03	0.00
	0.88	0.99	0.51	0.45	0.65	0.69
infrastructure						
aid/capita*infrastructure						
posshock			1.26	**3.27**		
			0.33	**0.07**		
negshock			-0.06	-0.37		
			0.98	0.87		
Daidposshock			10.00	**-35.41**		
			0.72	**0.04**		
Laidposshock			0.55	-0.04		
			0.53	0.61		
Daidnegshock			0.30	0.90		
			0.89	0.24		
Laidnegshock			**-0.90**	-0.06		
			0.05	0.12		
postconflict1						
aidpolpostconflict						
pinstab1						
tropic						
aidtropic						
Constant	0.69	-1.46	3.91	-1.20	-0.23	-1.60
	0.85	0.60	0.37	0.69	0.94	0.54
Observations	240.00	239.00	192.00	239.00	262.00	258.00
R-squared	0.44	0.44	0.47	0.47	0.40	0.41

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

missing values indicate values dropped due collinearity

Table 7: Comparing results of regressions using aid/GDP and aid/capita alternatively (low income dataset)

Dependent variable: GDP growth per capita

	Collier and Hoeffler using aid/GDP	Collier and Hoeffler using aid/capita	Dalgaard using aid/GDP	Dalgaardusing aid/capita
aid	-0.08	0.00	1.31	0.06
	0.78	1.00	0.11	0.14
aid2				
policy	**1.15**	**0.96**	**1.22**	**1.07**
	0.00	**0.00**	**0.00**	**0.00**
aidpolicy	0.02	0.00	-0.03	0.00
	0.83	0.79	0.67	0.32
infrastructure				
aid/capita*infrastructure				
posshock				
negshock				
Daidposshock				
Laidposshock				
Daidnegshock				
Laidnegshock				
postconflict1	**1.73**	**2.06**		
	0.01	**0.00**		
aidpolpostconflict	-0.04	**-0.004**		
	0.48	**0.05**		
pinstab1				
tropic			**-1.25**	**-1.65**
			0.06	**0.01**
aidtropic			**-1.25**	-0.04
			0.10	0.28
Constant	0.44	-0.91	2.42	1.35
	0.90	0.73	0.51	0.65
Observations	240.00	239.00	239.00	238.00
R-squared	0.45	0.46	0.47	0.47

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 8: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using OLS (world)
Dependent variable: GDP growth/capita

	Burnside and Dollar using aid/capita	Burnside and Dollar using aid per and aid/capita*infrastructure	Collier and Dehn using aid/capita	Collier and Dehn aid/capita and aid/capita*infrastructure	Collier and Dollar using aid/capita	Collier and Dollar aid/capita and aid/capita*infrast
icrge	**0.32**	**0.36**	**0.34**	**0.34**	**0.33**	
	0.01	**0.02**	**0.01**	**0.03**	**0.00**	
aid	0.00	**-1.68**	0.01	**-1.75**	0.00	
	0.93	**0.03**	0.81	**0.04**	0.86	
aid2					0.00	
					0.26	
policy	**0.93**	**0.76**	**0.95**	**0.67**	**0.99**	
	0.00	**0.00**	**0.00**	**0.00**	**0.00**	
aidpolicy	0.00	0.00	0.00	**0.01**	0.00	
	0.78	0.23	0.95	**0.02**	0.92	
aid2policy						
infrastructure		0.53		0.60		
		0.11		0.11		
aidinfrastructure		**0.26**		**0.26**		
		0.03		**0.04**		
posshock			1.32	0.83		
			0.29	0.45		
negshock			**-2.23**	**-2.38**		
			0.04	**0.05**		
Daidposshock			**-28.61**	**38.99**		
			0.07	**0.03**		
Laidposshock			**0.08**	**0.09**		
			0.07	**0.01**		
Daidnegshock			0.25	-0.05		
			0.84	0.98		
Laidnegshock			**-0.03**	**-0.03**		
			0.06	**0.10**		
postconflict1						
aidpolpostconflict						
tropic						
aidtropic						
Constant	-0.74	-1.28	-0.02	-1.82	-0.55	
	0.79	0.74	0.99	0.66	0.80	
Observations	362.00	268.00	361.00	267.00	391.00	
R-squared	0.40	0.45	0.44	0.48	0.38	

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 8: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using OLS (world)

Dependent variable: GDP growth/capita

	Collier and Hoeffler using aid/capita	Collier and Hoeffler using aid/capita and aid/capita*infrastructure	Dalgaard using aid/capita	Dalgaard using aid/capita and aid/capita*infrastructure
icrge	**0.32**	**0.39**	**0.36**	**0.41**
	0.01	**0.01**	**0.01**	**0.01**
aid	0.00	**-1.80**	0.03	-1.29
	0.90	**0.03**	0.22	0.12
aid2				
policy	**0.92**	**0.74**	**1.07**	**0.84**
	0.00	**0.00**	**0.00**	**0.00**
aidpolicy	0.00	0.00	0.00	0.00
	0.80	0.22	0.55	0.77
aid2policy				
infrastructure		0.36		0.49
		0.40		0.12
aidinfrastructure		**0.27**		0.20
		0.03		0.12
posshock				
negshock				
Daidposshock				
Laidposshock				
Daidnegshock				
Laidnegshock				
postconflict1	0.50	1.69		
	0.51	0.35		
aidpolpostconflict	**0.00**	-0.02		
	0.06	0.37		
tropic			**-1.38**	**-1.45**
			0.01	**0.00**
aidtropic			**-0.01**	-0.01
			0.05	0.51
Constant	-1.16	0.04		0.99
	0.69	0.99		0.80
Observations	362.00	268.00	357.00	263.00
R-squared	0.41	0.46	0.43	0.49

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

missing values indicate values dropped due collinearity

Table 9: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using OLS (low income)

Dependent variable: GDP growth/capita

	Burnside and Dollar using aid/capita	Burnside and Dollar using aid/capita*infrastructure	Collier and Dehn using aid/capita	Collier and Dehn using aid/capita*infrastructure	Collier and Dollar using aid/capita	Collier and Dollar using aid/capita*infrastructure
icrge	**0.35**	0.21	**0.35**	0.26	**0.39**	0.30
	0.03	0.27	**0.06**	0.21	**0.01**	0.11
aid	0.00	**-2.38**	0.03	**-2.62**	0.03	**-2.44**
	0.86	**0.05**	0.24	**0.06**	0.20	**0.03**
aid2					-0.25	0.00
					0.41	0.40
policy	**1.01**	**1.13**	**1.07**	**0.86**	**0.99**	**1.07**
	0.00	**0.00**	**0.00**	**0.02**	**0.00**	**0.00**
aidpolicy	0.00	0.00	0.00	**0.01**	0.00	0.00
	0.99	0.80	0.45	**0.08**	0.69	0.87
infrastructure		0.27		-0.06		0.32
		0.59		0.92		0.54
aid/capita*infrastructure		**0.36**		**0.39**		**0.37**
		0.05		**0.06**		**0.03**
posshock			**3.27**	2.54		
			0.07	0.25		
negshock			-0.37	1.19		
			0.87	0.66		
Daidposshock			**-35.41**	**66.14**		
			0.04	**0.01**		
Laidposshock			-0.04	-0.07		
			0.61	0.51		
Daidnegshock			0.90	-0.16		
			0.24	0.94		
Laidnegshock			-0.06	**-0.09**		
			0.12	**0.04**		
postconflict1						
aidpolpostconflict						
tropic						
aidtropic						
Constant	-1.46	2.46	-1.20	4.84	-1.60	0.24
	0.60	0.66	0.69	0.50	0.54	0.97
Observations	239.00	182.00	239.00	182.00	258.00	194.00
R-squared	0.44	0.48	0.47	0.51	0.41	0.43

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

missing values indicate values dropped due collinearity

Table 9: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using OLS (low income)

Dependent variable: GDP growth/capita

	Collier and Hoeffler using aid/capita	Collier and Hoeffler using aid/capita*infrastructure	Dalgaardusing aid/capita	Dalgaard using aid/capita*infrastructure
icrge	0.37	0.28	**0.35**	0.19
	0.20	0.15	**0.02**	0.31
aid	0.00	**-2.66**	0.06	-1.33
	1.00	**0.02**	0.14	0.33
aid2				
policy	**0.96**	**1.08**	**1.07**	**1.19**
	0.00	**0.00**	**0.00**	**0.00**
aidpolicy	0.00	0.00	0.00	0.00
	0.79	0.70	0.32	0.60
infrastructure		-0.12		0.60
		0.84		0.27
aid/capita*infrastructure		**0.40**		0.21
		0.02		0.30
posshock				
negshock				
Daidposshock				
Laidposshock				
Daidnegshock				
Laidnegshock				
postconflict1	**2.06**	**3.53**		
	0.00	**0.00**		
aidpolpostconflict	**-0.004**	**-0.03**		
	0.05	**0.00**		
tropic			**-1.65**	**-1.29**
			0.01	**0.07**
aidtropic			-0.04	-0.04
			0.28	0.31
Constant	-0.91	5.17	1.35	-0.06
	0.73	0.42	0.65	0.99
Observations	239.00	182.00	238.00	181.00
R-squared	0.46	0.50	0.47	0.50

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

missing values indicate values dropped due collinearity

Table 10: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using OLS (Africa)
Dependent variable: GDP growth/capita

	Burnside and Dollar using aid/capita	Burnside and Dollar using aid/capita*infrastructure	Collier and Dehn using aid/capita	Collier and Dehn using aid/capita*infrastructure	Collier and Dollar using aid/capita
icrge	**0.46**	0.53	0.43	0.49	0.32
	0.09	0.21	0.25	0.29	0.20
aid	0.02	1.06	**0.03**	2.13	0.02
	0.12	0.64	**0.01**	0.34	0.75
aid2					0.00
					0.73
policy	**0.72**	0.94	0.62	0.85	**0.93**
	0.00	0.28	0.11	0.40	**0.00**
aidpolicy	0.01	0.01	**0.01**	0.01	0.00
	0.19	0.39	**0.05**	0.38	0.95
aid2policy					
infrastructure		**24.25**		**25.76**	
		0.00		**0.01**	
aid/capita*infrastructure		-0.16		-0.32	
		0.64		0.34	
posshock			4.71	1.56	
			0.11	0.82	
negshock			5.13	4.76	
			0.43	0.46	
Daidposshock			**-60.67**		
			0.00		
Laidposshock			-0.15	-0.30	
			0.57	0.58	
Daidnegshock			-1.43	-2.54	
			0.68	0.39	
Laidnegshock			**-0.14**	**-0.16**	
			0.07	**0.05**	
postconflict1					
aidpolpostconflict					
tropic					
aidtropic					
Constant	-0.70	**-159.18**	0.82	**-161.97**	**5.97**
	0.86	**0.00**	0.83	**0.01**	**0.09**
Observations	100.00	75.00	100.00	75.00	105.00
R-squared	0.45	0.48	0.51	0.52	0.41

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 10: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using OLS (Africa)
Dependent variable: GDP growth/capita

	Collier and Dollar aid/capita*infrastructure	Collier and Hoeffler using aid/capita	Collier and Hoeffler using aid/capita*infrastructure	Dalgaard et al. using aid/capita	Dalgaard et al. using aid/capita*infrastructure
icrge	0.48	**0.53**	0.53	**0.45**	0.45
	0.19	**0.09**	0.24	**0.10**	0.30
aid	1.85	**0.03**	0.60	**0.33**	0.76
	0.28	**0.02**	0.81	**0.03**	0.75
aid2	0.00				
	0.43				
policy	0.72	**0.61**	0.93	**1.00**	1.48
	0.44	**0.02**	0.30	**0.00**	0.15
aidpolicy	0.01	0.01	0.01	**-0.01**	-0.01
	0.32	0.19	0.41	**0.10**	0.60
aid2policy					
infrastructure	**30.06**		**19.48**		**18.61**
	0.00		**0.01**		**0.00**
aid/capita*infrastructure	-0.27		-0.09		-0.06
	0.28		0.81		0.85
posshock					
negshock					
Daidposshock					
Laidposshock					
Daidnegshock					
Laidnegshock					
postconflict1		**2.96**	**3.13**		
		0.00	**0.01**		
aidpolpostconflict		0.01	-1.13		
		0.91	0.68		
tropic				7.86	7.47
				0.57	0.68
aidtropic				**-0.32**	-0.28
				0.04	0.17
Constant	**-188.29**	0.36	**-127.90**	-6.62	**-128.89**
	0.01	0.92	**0.02**	0.64	**0.00**
Observations	79.00	100.00	75.00	100.00	75.00
R-squared	0.44	0.47	0.49	0.49	0.53

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 11: Mean values

	World	Low income	Africa
road	92285.01	37908.28	3407.278
rail	8589.059	4031.207	961.18
electricity	15502.74	4639.692	446.33
telephones	3347810	714120.5	35323.53
inflation	0.17	0.16	0.17
budget surplus	-0.03	-0.03	-0.04
openness	0.48	0.28	0.19
infrastructure	6.75	6.74	6.6
pol	3.91	3.82	3.74

Table 12: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (world)
Dependent variable: GDP growth/capita

	Burnside and Dollar using aid/capita 2sls	Burnside and Dollar using aid/capita and aid*infrastructure 2sls	Collier and Dehn using aid/capita 2sls	Collier and Dehn using aid/capita*infrastructure 2sls	Collier and Dollar using aid/capita 2sls	Collier and Dollar aid/capita*infrastructure 2sls
icrge	**0.33**	**0.39**	**0.34**	**0.36**	**0.38**	**0.45**
	0.00	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**
aid	0.00	**-1.73**	0.01	**-1.86**	0.00	
	0.78	**0.05**	0.66	**0.05**	0.25	
aid2					0.00	0.00
					0.11	0.38
policy	**0.94**	**0.76**	**0.96**	**0.66**	**0.99**	**0.76**
	0.00	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**
aidpolicy	0.00	0.00	0.00	0.01	0.00	0.00
	0.85	0.27	0.98	0.12	0.11	0.34
aid2policy						
infrastructure		0.42		0.47		0.13
		0.43		0.40		0.80
aidinfrastructure		**0.26**		**0.28**		**0.28**
		0.05		**0.05**		**0.04**
posshock			1.26	0.85		
			0.22	0.49		
negshock			-2.22	-2.29		
			0.20	0.22		
Daidposshock			-29.63	38.63		
			0.14	0.31		
Laidposshock			**0.08**	**0.09**		
			0.07	**0.09**		
Daidnegshock			0.32	-0.01		
			0.79	0.99		
Laidnegshock			-0.02	-0.02		
			0.42	0.48		
postconflict1						
aidpolpostconflict						
pinstab1						
tropic						
aidtropic						
Constant	-0.68	-0.84	0.07	-1.14	-0.16	out
	0.77	0.87	0.97	0.82	0.94	
Observations	361.00	267.00	360.00	266.00	361.00	267.00
R-squared	0.40	0.46	0.44	0.48	0.40	0.45

Values in bold significant

p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 12: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (world)

Dependent variable: GDP growth/capita

	Collier and Hoeffler using aid/capita 2sls	Collier and Hoeffler using aid/capita*infrastructure 2sls	Dalgaard et al. using aid/capita 2sls	Dalgaard et al. using aid/capita*infrastructure 2sls
icrge	**0.34**	**0.42**	**0.37**	**0.44**
	0.00	**0.00**	**0.00**	**0.00**
aid	0.00	**-1.84**	0.03	-1.42
	0.98	**0.04**	0.19	0.13
aid2				
policy	**0.93**	**0.75**	**1.07**	**0.82**
	0.00	**0.00**	**0.00**	**0.00**
aidpolicy	0.00	0.01	0.00	0.00
	0.86	0.26	0.49	0.61
aid2policy				
infrastructure		0.27		0.33
		0.63		0.52
aidinfrastructure		**0.28**		0.22
		0.04		0.13
posshock				
negshock				
Daidposshock				
Laidposshock				
Daidnegshock				
Laidnegshock				
postconflict1	0.50	1.74		
	0.53	0.15		
aidpolpostconflict	**0.00**	-0.02		
	0.07	0.32		
pinstab1				
tropic			**-1.39**	-1.47
			0.01	0.20
aidtropic			-0.01	0.00
			0.19	0.79
Constant	-1.12	0.42	1.50	1.75
	0.61	0.94	0.52	0.72
Observations	361.00	267.00	356.00	262.00
R-squared	0.41	0.47	0.43	0.50

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

missing values indicate values dropped due collinearity

Table 13: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (low income)
Dependent variable: GDP growth/capita

	Burnside and Dollar using aid/capita 2sls	Burnside and Dollar using aid/capita*infrastructure 2sls	Collier and Dehn using aid/capita 2sls	Collier and Dehn using aid/capita*infrastructure 2sls	Collier and Dollar using aid/capita 2sls
icrge	**0.36**	0.23	**0.36**	0.25	**0.45**
	0.01	0.18	**0.01**	0.16	**0.00**
aid	**0.00**	out	**0.02**	**-2.48**	**-0.01**
	0.95		**0.50**	**0.03**	**0.76**
aid2					0.00
					0.53
policy	**1.13**	**1.13**	**1.18**	**0.88**	**1.11**
	0.00	**0.00**	**0.00**	**0.05**	**0.00**
aidpolicy	0.00	0.00	**0.00**	**0.01**	0.00
	0.84	0.83	**0.74**	**0.28**	1.00
infrastructure		0.32		0.15	
		0.61		0.81	
aid/capita*infrastructure		**0.35**		**0.37**	
		0.04		**0.03**	
posshock			**3.16**	2.21	
			0.05	0.41	
negshock			-0.55	0.43	
			0.85	0.89	
Daidposshock			-35.84	**56.02**	
			0.10	**0.25**	
Laidposshock			-0.04	-0.05	
			0.73	0.76	
Daidnegshock			0.98	0.07	
			0.57	0.97	
Laidnegshock			**-0.03**	**-0.06**	
			0.61	**0.38**	
postconflict1					
aidpolpostconflict					
pinstab1					
tropic					
aidtropic					
Constant	1.67	1.88	0.36	2.28	-1.07
	0.59	0.78	0.91	0.75	0.73
Observations	238.00	181.00	238.00	181.00	238.00
R-squared	0.45	0.49	0.48	0.51	0.42

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 13: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (low income)
Dependent variable: GDP growth/capita

	Collier and Dollar aid/capita*infrastructure 2sls	Collier and Hoeffler using aid/capita 2sls	Collier and Hoeffler using aid/capita*infrastructure 2sls
icrge	**0.02**	**0.38**	**0.30**
	0.04	**0.00**	**0.08**
aid	**out**	0.00	**-2.57**
		0.95	**0.02**
aid2	0.00		
	0.34		
policy	**1.12**	**1.08**	**1.07**
	0.01	**0.00**	**0.01**
aidpolicy	0.00	0.00	0.00
	0.94	0.63	0.72
infrastructure	0.17		-0.09
	0.79		0.89
aid/capita*infrastructure	**0.38**		**0.39**
	0.03		**0.02**
posshock			
negshock			
Daidposshock			
Laidposshock			
Daidnegshock			
Laidnegshock			
postconflict1		**2.13**	**3.57**
		0.02	**0.01**
aidpolpostconflict		**-0.01**	**-0.03**
		0.19	**0.07**
pinstab1			
tropic			
aidtropic			
Constant		0.72	4.61
		0.82	0.52
Observations	181.00	238.00	181.00
R-squared	0.45	0.47	0.51

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity
missing values indicate values dropped due collinearity

Table 13: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (low income)
Dependent variable: GDP growth/capita

	Dalgaard et al. using aid/capita 2sls	Dalgaard et al. using aid/capita*infrastructure 2sls
icrge	**0.36**	0.21
	0.01	0.23
aid		
aid2		
policy	**1.19**	**1.16**
	0.00	**0.00**
aidpolicy	0.00	0.00
	0.73	0.72
infrastructure		0.62
		0.36
aid/capita*infrastructure		0.21
		0.30
posshock		
negshock		
Daidposshock		
Laidposshock		
Daidnegshock		
Laidnegshock		
postconflict1		
aidpolpostconflict		
pinstab1		
tropic	**-1.73**	-1.33
	0.05	0.23
aidtropic	-0.03	-0.03
	0.39	0.39
Constant	2.77	-0.22
	0.40	0.98
Observations	237.00	180.00
R-squared	0.48	0.50

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity

Table 14: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (Africa)

Dependent variable: GDP growth/capita

	Burnside and Dollar using aid/capita 2sls	Burnside and Dollar using aid/capita*infrastructure 2sls	Collier and Dehn using aid/capita 2sls	Collier and Dehn using aid/capita*infrastructure 2sls	Collier and Dollar using aid/capita 2sls
icrge	**0.45**	**0.53**	**0.42**	0.49	0.35
	0.06	**0.08**	**0.09**	0.12	0.12
aid	-0.01	1.06	out	2.13	-0.03
	0.81	0.65		0.40	0.59
aid2					0.00
					0.48
policy	**0.94**	0.94	**0.82**	0.85	**1.26**
	0.03	0.20	**0.07**	0.27	**0.01**
aidpolicy	-0.01	0.01	0.01	0.01	0.00
	0.81	0.40	0.13	0.33	0.67
aid2policy					
infrastructure		**24.25**		**25.76**	
		0.03		**0.03**	
aid/capita*infrastructure		-0.16		-0.32	
		0.66		0.40	
posshock			**4.68**	1.55	
			0.07	0.87	
negshock			4.95	4.76	
			0.38	0.40	
Daidposshock			**-60.19**	out	
			0.04		
Laidposshock			-0.15	-0.30	
			0.50	0.67	
Daidnegshock			-1.36	-2.54	
			0.61	0.36	
Laidnegshock			-0.14	-0.16	
			0.16	0.10	
postconflict1					
aidpolpostconflict					
tropic					
aidtropic					
Constant	-1.45	-153.36	**0.74**	**-161.99**	**-0.22**
	0.77	0.04	**0.88**	**0.04**	**1.00**
Observations	100.00	75.00	100.00	75.00	100.00
R-squared	0.45	0.48	0.51	0.52	0.42

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

missing values indicate values dropped due collinearity

Table 14: Coefficients on relevant terms before and after inclusion of aid/capita*infrastructure using 2SLS (Africa)
Dependent variable: GDP growth/capita

	Collier and Dollar aid/capita*infrastructure 2sls	Collier and Hoeffler using aid/capita 2sls	Collier and Hoeffler using aid/capita*infrastructure 2sls	Dalgaard et al. using aid/capita 2sls	Dalgaard et al. u aid/capita*infras 2sls
icrge	**0.50**	**0.48**	**0.53**	**0.45**	
	0.09	**0.05**	**0.08**	**0.06**	
aid	1.71	0.00		0.35	
	0.52	0.91		0.16	
aid2	0.00				
	0.54				
policy	0.85	**0.84**	0.93	**1.30**	
	0.30	**0.05**	0.22	**0.01**	
aidpolicy	0.01	0.01	0.01	-0.01	
	0.47	0.25	0.40	0.36	
aid2policy					
infrastructure	**32.37**		**19.48**		
	0.03		**0.12**		
aid/capita*infrastructure	-0.25		-0.08		
	0.53		0.81		
posshock					
negshock					
Daidposshock					
Laidposshock					
Daidnegshock					
Laidnegshock					
postconflict1		2.55	**3.13**		
		0.22	**0.31**		
aidpolpostconflict		0.12	-1.13		
		0.62	0.65		
tropic				6.70	
				0.71	
aidtropic				-0.30	
				0.19	
Constant	**-206.77**	**-0.25**	**-122.23**	-7.80	
	0.03	**0.96**	**0.13**	0.66	
Observations	75.00	100.00	75.00	100.00	
R-squared	0.45	0.48	0.49	0.49	

Values in bold significant
p-values in small font beneath coefficients
standard errors and therefore p-values robust to heteroskedasticity

Table 15: Savings and investment regressions

Dependendent variavables: gross domestic savings and gross capital formation

	gross domestic savings	gross domestic savings	gross capital formation	gross capital formation
c	**15.74**	3.08	**20.61**	0.01
	0.00	0.78	**0.00**	1.00
aid/capita	-0.02	**-0.05**	**0.02**	**0.03**
	0.16	**0.00**	**0.04**	**0.00**
infrastructure		2.22		**2.90**
		0.20		**0.00**
R-squared	0.03	0.05	0.05	0.05
Observations	987.00	521.00	884.00	480.00

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

World data used

Table 16: Countries used in modified Acemouglu regressions

Afghanistan	Guinea-Bissau	Panama
Angola	Greece	Peru
United Arab Emirates	Guatemala	Philippines
Argentina	Guyana	Papua New Guinea
Armenia	Hong Kong, China	Poland
Australia	Honduras	Korea, Dem. Rep.
Austria	Croatia	Portugal
Azerbaijan	Haiti	Paraguay
Burundi	Hungary	Qatar
Belgium	Indonesia	Romania
Benin	India	Russian Federation
Burkina Faso	Ireland	Rwanda
Bangladesh	Iran, Islamic Rep.	Saudi Arabia
Bulgaria	Iraq	Sudan
Bahrain	Iceland	Senegal
Bahamas, The	Israel	Singapore
Bosnia and Herzegovina	Italy	Sierra Leone
Belarus	Jamaica	El Salvador
Belize	Jordan	Somalia
Bolivia	Japan	Sao Tome and Principe
Brazil	Kazakhstan	Suriname
Barbados	Kenya	Slovak Republic
Bhutan	Kyrgyz Republic	Slovenia
Botswana	Korea, Rep.	Sweden
Central African Republic	Kuwait	Swaziland
Canada	Lao PDR	Syrian Arab Republic
Switzerland	Liberia	Chad
Chile	Libya	Togo
China	Sri Lanka	Thailand
Cote d'Ivoire	Lesotho	Tajikistan
Cameroon	Lithuania	Turkmenistan
Congo, Rep.	Luxembourg	Trinidad and Tobago
Colombia	Latvia	Tunisia
Comoros	Morocco	Turkey
Cape Verde	Moldova	Taiwan, Province of China
Costa Rica	Madagascar	Tanzania
Czech Republic	Mexico	Uganda
Germany	Macedonia, FYR	Ukraine
Djibouti	Mali	Uruguay
Denmark	Malta	United States
Dominican Republic	Myanmar	Uzbekistan
Algeria	Mongolia	Venezuela, RB
Ecuador	Mozambique	Vietnam
Egypt, Arab Rep.	Mauritania	Yemen, Rep.
Eritrea	Mauritius	Yugoslavia, Fed. Rep.
Spain	Malawi	South Africa
Estonia	Malaysia	Congo, Dem. Rep.
Ethiopia	Namibia	Zambia
Finland	Niger	Zimbabwe
Fiji	Nigeria	
France	Nicaragua	
Gabon	Netherlands	
United Kingdom	Norway	
Georgia	Nepal	
Ghana	New Zealand	
Guinea	Oman	

Gambia, The Pakistan

Table 17: Regressions for formation of policy and infrartucture variable

Dependent variable: GDP growth/capita

	policy	infrastructure
logarithim of gdp	-0.47	-0.83
	0.15	0.23
ethnic fractionalisation	-0.98	-1.42
	0.27	0.19
assassinations	**-0.47**	-0.38
	0.02	0.30
ethnic fractionalisation*assassinations	0.44	0.24
	0.32	0.73
ssa	**-1.45**	**-1.74**
	0.01	**0.03**
easia	**2.04**	**3.18**
	0.01	**0.00**
icrge	**0.28**	**0.43**
	0.02	**0.02**
m21	0.00	0.01
	0.88	0.73
telephones		-7.31E-08
		0.53
electricity		0.0000147
		0.65
road		**0.00000194**
		0.07
rail		0.0000139
		0.74
inflation	**-2.01**	
	0.00	
budget surplus	8.19	
	0.10	
sawc	**1.01**	
	0.03	
Constant	**4.18**	6.57
	0.09	0.23
Observations	373.00	368.00
R-squared	0.39	0.26

Values in bold significant

p-values in small font beneath coefficients

standard errors and therefore p-values robust to heteroskedasticity

World dataset used

sacw- Sachs-Warner openness variable

Table 18: Data sources (Roodman, 2007; Burnside and Dollar, 2000)

Variable	Code	Data source	Notes
GDP growth per capita	gdpg	World Bank 2003	
Initial GDP per capita	lgdp	Summers and Heston 1991, updated using gdpg	Natural logarithm of GDP per capita for first year of period; constant 1985
Ethno-linguistic frationalization, 1960	ethnf	Roeder 2001	Probability that two randomly chosen individuals differ ethnically
Assassinations/capita	assas	Banks 2001	Assassinations/capita
Political instability, lagged	pinstab	Banks 2001	Simple of assas and revolutions/year
Institutional quality	icrge	Polity Risk Services (PRS) Group's IRIS III dataset (check Knack and Keefer, 1995)	Revised. Computed as the average of the three components still reported after 1997, dropping 2.
M2/GDP, lagged one period	m21	World Bank 2003	
Sub-Saharan Africa	ssa	World Bank 2003	Codes nations in the Sahara as sub-Saharan.
East Asia	easia		Dummy for China, Indonesia, South Korea, Malaysia, Philippines and Thailand

Central America	centam	World Bank 2003	
Franc zone	frz	Burnside and Dollar 2000	Codes African nations in the CFA franc zone
Egypt Budget surplus BB World Bank 2003; IMF	egypt	World Bank 2003; IMF 2003	World Bank primary source. Additional values extrapolated from IMF, using series 80 and 99b (local-currency budget surplus and GDP)
Inflation	infl	World Bank 2003; IMF 2003	log (1 + inflation). World Bank primary source. Wholesale price inflation from IMF used to fill gaps
Sachs-Warner, updated	sacw	Sachs and Warner 1995; Easterly, Levine, and Roodman 2004; Wacziarg and Welch 2002	Extended to 1998. Slightly revised pre-1993.
Positive and negative shock	posshock and negshock	Dehn 2000	Shocks are % price index changes. “Shock” threshold country-specific. Reconstructed based on underlying index data for 1957–97

Effective Development Assistance/real GDP	aid	Chang, Fernandez-Arias, and Serven 1998; OECD-DAC 2002; IMF 2003; World Bank 2003; Summer and Heston 1991	Available values for 1975–95 from Chang, Fernandez-Arias, and Serven. Missing values extrapolated based on regression of EDA on Net ODA. Converted to 1985 dollars with World Import Unit Value index from IMF, series 75. GDP computed like LGDP above
Net Overseas Development Assistance/per capita	aid per capita	World Bank 2010	
Dummy for end of civil conflict in previous period	postconflict1	Collier and Hoeffler 2004	
Fraction of land in tropics	tropicar	Gallup and Sachs 1999	
Arms imports/total imports lagged	arms1	U.S Department of State, various years	
Electricity	eleav	Canning 1998	Electricity generating capacity, thousand kilowatts
Roads	roadav	Canning 1998	Total roads, kilometres
Rail	railav	Canning 1998	Rail track length, kilometres
Telephones	telav	Canning 1998	Total telephones

Log of settler mortatily	logem4	Curtin 1989, 1998; Gutirrez 1986	Construction explained in Acemoglu 2001
Democracy	democr00	Polity III described in Gurr 1997	An eleven category scale, from 0 to 10, with a higher score indicating more democracy. Points are awarded on three dimensions: Competitiveness of Political Participation (from 1 to 3); Competitiveness of Executive Recruitment (from 1 to 2, with a bonus of 1 point if there is an election); and Constraints on Chief Executive (from 1 to 4). Set equal to 1 if country was not independent at that date.
Average protection against expropriation risk 1985-1995	avexp	Polity Risk Services (PRS) (1999)	Risk of expropriation of private foreign investment by government, from 0 to 10, where a higher score means less risk. We calculated the mean value for the scores in all years from 1985 to 1995. In our base sample this ranges from 3.5 to 10.
Log GDP per capita -PPP- in 1995	logpgp95	World Bank 1999	Logarithm of GDP per capita, on Purchasing Power Parity Basis