Essays on Foreign Development Aid

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Abstract

The first part of this thesis demonstrates how economic inequality in the aid recipient country is detrimental to aid effectiveness.

We model a recipient country that is characterised by a relatively rich local elite and poor rest of the population that compete over economic resources. Foreign aid is shown to be more effective when there is lower economic inequality, because of the lower contesting ability of the elite in this scenario.

This hypothesis is supported by evidence using data from 59 recipient countries over 1971-2005. A one standard deviation increase in the aid-to-GDP ratio is estimated to boost aid recipient growth by 1.25 percent in the most equal recipients, but reduce growth by 2.42 percent in the least equal recipients.

The second part of the thesis analyses two types of aid using a neoclassical growth framework, integrating the economies of aid donor and recipient. The focus is on the comparison between aid invested in social projects, such as building schools, hospitals, and aid invested in economic projects, such as building roads and bridges. Both types of aid are assumed to raise the productivity of the households in the recipient country, but social aid is also allowed to have a 'direct effect' on the utility of these households. The projects can also differ in terms of their productivity and aid wastage levels.

Because of this 'direct effect' social aid has an advantage over economic aid. All else equal, it is welfare-maximising to invest more in the social sector. However, when the social-aid wastage exceeds a certain level, the advantage of the social aid rapidly decreases in the level of social aid wastage, up to a point of becoming negligible. This questions whether the recent surge in social aid can be justified in countries with social sectors characterised by high aid wastage.

List of Contents

List of Tables

List of Figures

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Declaration

I declare that this thesis is a presentation of original work and I am the sole author. This work has not previously been presented for an award at this, or any other, University. All sources are acknowledged as References.

1 Introduction

Despite the growing extent of foreign development aid over the recent decades, it has become clear that assistance to the developing world need not work in the same way as the Marshall Plan in rebuilding the post-World-War-II Europe. Critics question whether foreign aid has been effective in promoting the growth and development of aid recipient countries. Doucouliagos and Paldam (2009) conduct a meta-study of research literature on aid effectiveness going back 40 years, and conclude that aid has not been effective. Other literature even suggests that foreign aid can have a negative impact, e.g. encourage rent-seeking (Svensson, 2000) and promote conflict (Nunn and Qian, 2014).

One explanation for the diversity of these findings is that aid works under specific conditions. Following this, the consensus is that research should focus on establishing these specific conditions (Temple, 2010). Therefore, Chapter 2 and Chapter 3 contribute to the literature investigating the specific characteristics in recipient countries beneficial for aid effectiveness.

Another explanation is that research has mostly analysed aid on a very aggregate level, ignoring that in reality aid and its effects can be heterogeneous. Consequently, Chapter 4 contributes to the strand of literature trying to distinguish between the different types of aid.

The model presented in Chapter 2 is based on the feature that many aid recipient countries lack democratic institutions. Therefore, they are often characterised by relatively rich ruling elites having a disproportionate amount of political and economic power, and poor rest of the population (the masses), who cannot easily replace the rulers. The model represents the misalignment of interests between the elite and masses as a contest, where the rich elite and poor masses compete over economic resources that include foreign aid. The model concludes that the resource inequality between the two groups of the society negatively influences the ability of aid to improve the welfare of the masses. Consequently, all else equal, aid is shown to be more effective in more equal countries.

If the growth rate is assumed to be indicative of the welfare of the households in recipient country, then investigating the relationship between aid and growth conditional on the level of economic inequality is a convenient test of the above finding. Consequently, Chapter 3 revisits aid effectiveness regressions with the growth rate as the dependent variable. The chapter investigates a dataset of 59 recipient countries over the years 1971-2005, trying to answer the question of whether aid has been more effective in economically equal countries.

The empirical research presented in Chapter 3 takes into account the criticism directed at the use of aggregate aid measures, i.e. that they fail to capture the heterogeneous effects of different types of aid. We build a measure of aid similar to the measure used by Clemens et al. (2012), taking into account only that aid which is expected to have a short term impact. We further disaggregate the measure of Clemens et al. (2012) by taking into account only that aid which is given by donors that are members of the Development Assistance Committee (DAC). This means that this aid measure excludes aid given by developing country donors. Developing country donors such as China, India and Russia may have different incentives for giving aid than the DAC donors. This could also have implications in terms of the effectiveness of such aid.

In adition to testing the hypothesis proposed in Chapter 2, Chapter 3 contributes to the existing literature investigating aid effectiveness conditional on other variables, for example, Burnside and Dollar (2000) and Angeles (2007). Chapter 3 tests for the robustness of the findings after taking into account the conditional effects already discovered by the literature, notably, the conditional effect on the policy environment in the recipient country (Burnside and Dollar, 2000) and the power of the local elite, as represented by the percentage of European colonial settlers (Angeles, 2007).

Chapter 4 starts by investigating aid flows across the different sectors of aid recipient economies. Over the past decades, there has been an increase in the aid invested in social sectors (e.g. education, health, governance) relative to the aid invested in economic sectors (e.g. building roads). Both types of aid raise the productivity, but social sector aid has the added benefit of being able to also directly raise the utility of the households. For example, building a hospital contributes to the productivity of the local economy, i.e. it creates new jobs and improves the health of the local workforce. However, it also directly improves the welfare of the households by improving their health care.

Chapter 4 analyses investment in social and economic projects from a welfare point of view, taking into account the possibility of aid wastage in these sectors. The model framework is based on a growth model integrating the economies of the foreign aid donor and recipient, assuming that the donor maximises the weighted global welfare of both countries. Chapter 4 demonstrates that in some cases investing in social projects has little welfare benefit over investing in economic projects.

The rest of the text of this thesis presents the three research chapters, followed by a general conclusion, summarizing the contributions of the chapters, discussing their limitations and suggesting possible future extensions. More detailed derivations and regression results are presented in the Appendices.

2 The Political Economy of Aid Effectiveness

2.1 Introduction

For a long time it has been questioned whether foreign aid always fulfils its objective to help the poor in the developing world (Chong et al., 2009; Doucouliagos and Paldam, 2009; Easterly, 2003; Rajan and Subramanian, 2008). Some empirical work even suggests that aid is associated with negative outcomes in the recipient countries (Brautigam and Knack, 2004; Doucouliagos and Paldam, 2009; Nunn and Qian, 2014; Svensson, 2000). The consensus is that instead of asking whether aid has been effective, the focus of research should be on investigating the specific conditions favourable to aid effectiveness (Temple, 2010). Following this, we develop a model that demonstrates how economic inequality can be detrimental to aid effectiveness.

A large proportion of foreign aid recipient countries suffer from low levels of freedom, civil liberties and political rights (see Figure 2.1). This implies that they are often autocratic states characterised by ruling elites holding most of the political power, with citizens unable to easily replace the rulers. Angeles and Neanidis (2009) find empirical evidence supporting that the power of the local elite in the recipient country significantly undermines aid effectiveness. We show that this occurs because of higher economic inequality in these recipient countries.

We model the relationship between the recipient country's elite and the rest of population as a contest, in which both groups invest funds to compete with each other over economic resources. When the elite has relatively more resources, they have an advantage in this contest. It follows that foreign aid is more effective when the recipient country is economically more equal.

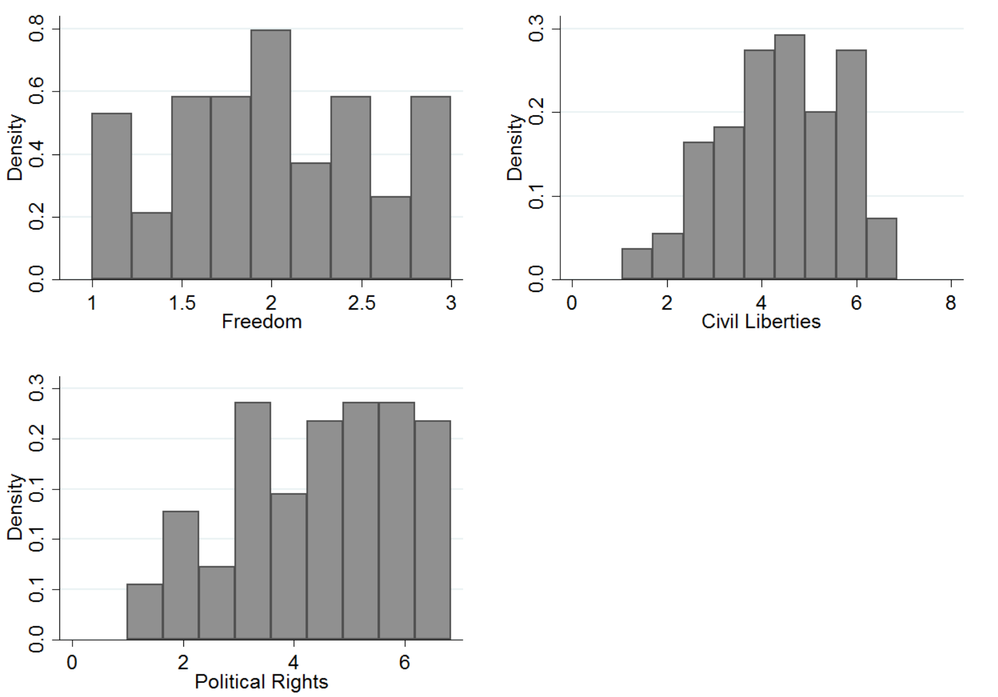
Our model assumes that not all of the aid reaches the masses, but instead a part of it is extracted by a rent-seeking elite, which is consistent with aid being disbursed via governmental institutions, that are often corrupt and lack transparency. It is shown that if the share of aid that the elite can extract is particularly high, then aid transfers are detrimental to the masses and instead benefit the elite. Therefore, the optimal aid allocation in this scenario is zero. However, if the share that the elite can extract is sufficiently constrained, it is optimal for the donor to provide a strictly positive amount of aid and this amount increases the more equal the income distribution.

The theoretical analysis adds to the literature examining the interaction between opposing groups of society (e.g. Acemoglu and Robinson (2001); Ansell and Samuels (2010); Besley and Persson (2011); Svensson (2000)). The "prize" of the contest central to the framework is endogenous which is similar to the contests analysed by Hirshleifer (1988, 1991) and Skaperdas (1992). However, the framework used in this paper differs from the former by incorporating the problem of the donor, as well as modelling features of the contest to closely represent the competition between societal groups in a typical aid recipient country.

The model generates novel hypotheses about aid effectiveness and inequality, which are supported by empirical evidence presented in Chapter 3.

Section 2.2 reviews the relevant literature. Section 2.3 introduces the model and states the main results. Section 2.4 concludes. The Appendices to Chapter 2 contain more detailed mathematical derivations.

Figure 2.1: Freedom, Political Rights and Civil Liberties Among the Aid Recipient Countries



Note: the score densities are reported for the sample of 127 foreign aid recipient countries that are included the OECD Development Assistance Committee database. Scores are averaged over 5 year periods. Freedom score is interpreted as follows: 1 – free, 2 – partially free, 3 – not free; Civil Liberties and Political Rights scores range from 1 to 7, with 1 representing the highest level of rights/liberties and 7 – the lowest level of rights/liberties.
Source: Freedom House

2.2 Literature Review

So far research on foreign aid has yielded a diverse set of contradictory conclusions about whether aid has been beneficial to the aid recipient countries. The findings range from some authors finding that aid is positively correlated with growth (Papanek, 1972, 1973), others arguing that there is no relationship between aid and growth (Boone, 1996; Rajan and Subramanian, 2008), and some showing that aid can have a negative impact in recipient economy, e.g. encourage rent-seeking (Svensson, 2000) and promote conflict (Nunn and Qian, 2014). Doucouliagos and Paldam (2009) conduct a meta-study of research literature on aid effectiveness going back 40 years, and conclude that aid has not been effective.

An important strand of this literature argues that aid can be effective under specific conditions. For example, Collier and Dollar (2001, 2002, 2004) propose various performance based criteria that can be used to determine the optimal aid allocation. Similarly, Burnside and Dollar (2000) and Collier and Dollar (2001) argue that aid should be mainly directed towards poor countries pursuing good policies. The idea is that in such countries the productive use of aid is the most likely.

However, relying on performance criteria as a principle ignores any explicit causal mechanisms and micro foundations. In addition, the usefulness of the recommendation has been questioned by the empirical research on aid effectiveness. Although Burnside and Dollar (2000) find that aid boosts growth in the presence of good policies, later work (Easterly, 2003; Rajan and Subramanian, 2008) fails to find such an effect, even in the presence of good policies and institutions.

More recent empirical studies investigate the effect of aid on other outcomes in the recipient country, such as institutions, poverty and inequality. However, there is a lack of positive findings. For example, Knack (2004) finds no evidence that aid promotes democracy; Brautigam and Knack (2004) find a robust statistical relationship between high levels of aid and worsening of governance; Chong et al. (2009) find no robust evidence that foreign aid helps to tackle poverty and inequality.

A further strand of the literature proposes structural models analysing the effects of development aid, incorporating the features of growth theory (e.g., Arellano et al. (2009)), but these rarely analyse and endogenize the donor's decision. An exception is the work by Carter et al. (2015)

who develop a model of dynamic aid allocation, where the donor chooses the optimal path of transfers by incorporating the welfare of the recipient country in its objective function. The possibility that a part of aid may be wasted potentially (but not explicitly) as a result of political economy mechanisms is reflected by an absorption capacity function, that assumes that aid wastage is decreasing in the income of recipient country. This implies that all else equal countries with higher aid intensity (aid-GDP ratio) will have a lower effectiveness of utilizing aid, allowing for the feature that as country grows and develops, less aid is wasted.

However, simply assuming an exogenous function to represent aid absorption does not explicitly analyse the political economy mechanisms that may underpin the ultimate effectiveness of aid, for example, the misalignment of interests between the local elite and the majority of citizens in a recipient economy. Indeed, Angeles and Neanidis (2009) find evidence that the local elite can play a significant role within this context. They reveal a negative link between the effectiveness of foreign aid and the percentage of European colonial settlers, which they argue is a historical determinant of the elite's power. These authors argue that the significance of local elite should not be underestimated, as aid flows are converted into goods and services via local government and firms, which are often controlled by the elite. These findings motivate future work to focus on the political economy features in the recipient economy, especially, the differences in power between the local elite and the rest of the citizens.

In conclusion, despite the vast and sometimes contradicting empirical literature on the effects of foreign aid, the theoretical arguments proposed to positively explain aid allocation are relatively scarce, especially within the context of analysing the incentives of donors and modelling the political economy mechanisms in the recipient economy. This calls for more theoretical work that would address these issues and at the same time motivate empirically testable hypotheses, that can help to reveal more about the effectiveness of aid.

2.3 The Model

There is a foreign aid donor and a recipient country inhabited by a ruling elite and masses. The agents in the recipient country live for two time periods. Before the first time period, the donor allocates funds to the recipient country in order to maximise the second period net expected welfare of the masses.

In the first time period both the masses and the elite allocate their funds between their first period consumption and investments to increase their expected second period welfare, which depend on a contest between both parties.

In the beginning of the second time period, the contest takes place. The contest outcome is the amount of output "won" by each party, which equals the total output times the power of the corresponding party. Afterwards, by the end of the second period, both parties consume their shares of output.

The game is solved using backwards induction, initially solving the problem of the elite and masses, and subsequently – the donor's problem which anticipates the equilibrium choices of the elite and masses.

2.3.1 Defining the Problem

In the beginning of the first period the elite and masses have the following levels of funds: $R_E + sX$ and $R_M + (1 - s)X$, where R_E and R_M[1] represent the initial funds of the elite and masses, respectively, excluding the money given by the donor, and X represents the money given by the donor – the aid. It is assumed that the elite are able to extract an exogenous share s of the aid, where $s \in [0, 1]$.[2] This reflects the fact that even though aid is intended to help the poor it often reaches the masses via governmental institutions and agencies that are controlled by the ruling elite.

The Decision of the Masses

The masses have logarithmic preferences. They choose the level of their first period consumption C_M, the level of investment in production F and the level of investment in contest G_M to maximise their inter-temporal utility, which consists of the utility from the first period consumption and the utility from the output secured as a result of the contest in the second period:

$$max_{C_M, G_M, F}\, ln(C_M) + ln\left(p(G_M, G_E) \cdot AF\right) \tag{1}$$

subject to:

$$G_M + F + C_M \leq X \cdot (1 - s) + R_M \tag{2}$$

[1]The subscript denotes the corresponding owner of the funds, where "E" stands for the elite and "M" stands for the masses.

[2]In the specific case when $s = 0$ all of the aid reaches the masses.

$$p(G_M, G_E) = \left(1 + e^{k(G_E - bG_M)}\right)^{-1} \tag{3}$$

$$G_M \geq 0,\ F \geq 0,\ C_M \geq 0 \tag{4}$$

(2) is a budget constraint ensuring that the consumption and the amounts invested in the contest and production do not exceed the total funds; (4) specifies that the level of consumption and investments cannot be negative; AF represents a linear production technology, where A is a productivity parameter.

(3) represents the logistic contest technology[3] where $p(G_M, G_E)$ denotes the power or the share of output accruing to the masses given that they invest G_M in the contest and the elite invest G_E.[4] The power of the elite can be expressed as $p(G_E, G_M) = 1 - p(G_M, G_E)$. Parameter b is the relative contesting effectiveness of the masses; k is a parameter representing a "mass-effect". Notice that the function $p(G_M, G_E)$ is strictly convex in G_M, as long as $b\,G_M < G_E$ and strictly concave when $b\,G_M > G_E$.[5] This implies that the contest outcome is most sensitive to additional investment when the win-probability is close to one half. See Figure 2.2 for a graphical representation of the logistic contest function.[6]

The Decision of the Elite

The elite take the output as given, and maximise their inter-temporal utility[7], which consists of the utility from the first period consumption and the utility from the amount of output they can expropriate as a result of the contest in the second period. In other words, they choose the level of consumption C_E and the level of investment in the contest G_E to solve the following problem:

$$max_{G_E, C_E}\ ln(C_E) + ln((1 - p(G_M, G_E)) \cdot AF) \tag{5}$$

[3]See Hirshleifer (1988, 1991); Skaperdas (1992). Skaperdas (1992) does not assume a particular functional form but defines the contest function by a set of properties that hold true for the logistic function. A requirement for this is that the function $p(G_i, G_j)$ is differentiable, increasing in G_i (decreasing in G_j) and the probabilities sum up to one.

[4]Hirshleifer (1988, 1991) and Skaperdas (1992) mostly discuss military conflicts, where fighting technology is arms. However, here investment in the contest technology represents any efforts to increase the post-contest output of each party, e.g. investments in repression, propaganda by an autocratic elite; investments in organizing demonstrations, spreading democratic ideas, raising awareness of the atrocities of the regime by the opposition groups.

[5]The same property holds true for the power of the elite, i.e. $p(G_E, G_M)$ is convex in G_E, as long as $G_E < b\,G_M$ and concave when $G_E > b\,G_M$.

[6]Hirschleifer (1988; 1991) highlights that the logistic function is a good representation of imperfect contest conditions characterised by lack of information and uncertainty, as there is still some chance of winning with a zero investment in the contest technology.

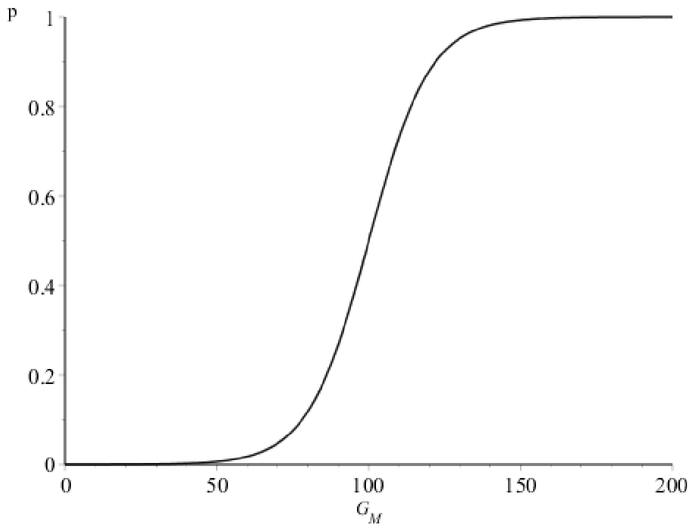
[7]The elite also have logarithmic preferences.

subject to:

$$G_E + C_E \leq X \cdot s + R_E \tag{6}$$

$$G_E \geq 0, C_E \geq 0 \quad \text{and} \quad p(G_M, G_E) \quad \text{given by} \quad (3) \tag{7}$$

Figure 2.2: Logistic Contest Function



Note: drawn for $G_E = 100$; $k = 0.1$; $b = 1$.

The Decision of the Donor

The donor chooses the optimal amount of foreign aid X^* to maximise the net expected second period welfare of the masses:

$$max_X \{p(G_M^*, G_E^*) \cdot A\,(R_M + (1-s)\,X - G_M^* - C_M^*) - q\,(X)\} \tag{8}$$

subject to:

$$p(G_M^*, G_E^*) = \left(1 + e^{k\,(G_E^* - b\,G_M^*)}\right)^{-1} \tag{9}$$

$$G_E^* = G(X) \tag{10}$$

$$G_M^* = g(X) \tag{11}$$

$$C_M^* = c(X) \tag{12}$$

$$X \geq 0 \tag{13}$$

where $G_E^* = G(X)$, $G_M^* = g(X)$ and $C_M^* = c(X)$ are the equilibrium choices of the elite and masses as functions of aid. The donor anticipates these choices and incorporates them in her problem.

The term $q(X)$ represents an opportunity cost function that is assumed to be strictly increasing and convex in the aid transfers (Assumption 1) and to not depend on the initial funds in the recipient country (Assumption 2).

Assumption 1.

$$\frac{q(.)}{dX} > 0 \quad \text{and} \quad \frac{q(.)}{dX^2} > 0 \tag{14}$$

Assumption 2.

$$\frac{q(.)}{dR_M} = 0 \quad \text{and} \quad \frac{q(.)}{dR_E} = 0 \tag{15}$$

The opportunity cost function reflects the feature that a donor faces alternatives to giving foreign aid, for example, investing in domestic projects or any other investments with the potential of a positive pay-off. Assumption 2 imposes that the opportunity cost is independent from the initial funds in the recipient country, which is consistent with these opportunities not being related to the economy of the recipient country.

2.3.2 Solving the Problem

In this section we characterise the optimal choices of the masses, the elite and the donor and discuss the conditions for the existence of an equilibrium.

The Optimal Decisions of the Masses and the Elite

Given G_E, the optimal choice of the masses is characterised by the values of C_M, G_M and F that satisfy the first order conditions for the problem in (1)-(4), which can be summarised by the following equation (see more details in Section A.1 of the Appendix):

$$C_M = F = \frac{1}{2}(R_M + (1-s)X - G_M) = p(G_M, G_E)/\left(\frac{\partial p\,(G_M, G_E)}{\partial G_M}\right) \tag{16}$$

(16) implies that the optimal amount of investment $\bar{G}_M$ occurs at the point where the increase in the expected welfare from investing marginally more in the contest equals the decrease in

the expected welfare from investing marginally less in the production (or consuming marginally less). Any investment in the contest exceeding this level is not optimal, as the marginal welfare loss from less production (or consumption) exceeds the benefit from a higher investment in the contest. Similarly, any investment in the contest below this level is not optimal, as the marginal benefit from more production (or consumption) is offset by the marginal loss from the decrease in the power.

The following assumption ensures that the contest technology is sufficiently effective, so that it is worthwhile for the masses to invest a strictly positive amount in the contest (see Section A.1 of the Appendix).

Assumption 3.

$$k\,b\,R_M > 4 \tag{17}$$

Using (16) it is possible to establish the properties of the best response curve of the masses. These are summarised below.

The Best Response Curve of the Masses:

(M1) *Given* R_M*,* X*,* s*,* A*,* b*,* k*,* G_E *and Assumption 3, there is a unique maximiser* $\bar{G}_M$ *to the problem* (1)-(4) *which satisfies* (16)*, is strictly positive, i.e.* $\bar{G}_M > 0$ *and can be represented by the function* $\bar{G}_M = r(G_E)$ *which is the best response curve of the masses for a given level of elite's investment in the contest (see Section A.1 of the Appendix);*

(M2) *It holds that* $\frac{dr(.)}{dG_E} > 0$ *and* $\frac{dr(.)}{dG_E^2} < 0$*, i.e. the best response curve of the masses is strictly increasing and concave in the level of elite's investment in the contest (see Section A.2 of the Appendix).*

The first order condition for the elite's problem in (5)-(7) can be shown to be:

$$-\left(\frac{\partial\, p(G_M, G_E)}{\partial G_E}\right)/(1 - p(G_M, G_E)) - \frac{1}{C_E} = 0 \tag{18}$$

The elite's objective function is strictly concave in the choice variable so that value of G_E that satisfies (18) is a maximiser (see Section A.3 of the Appendix).

The following assumption ensures that the contest technology is sufficiently effective, so that the elite's investment in the contest is strictly positive.

Assumption 4.

$$k\, R_E > 2 \tag{19}$$

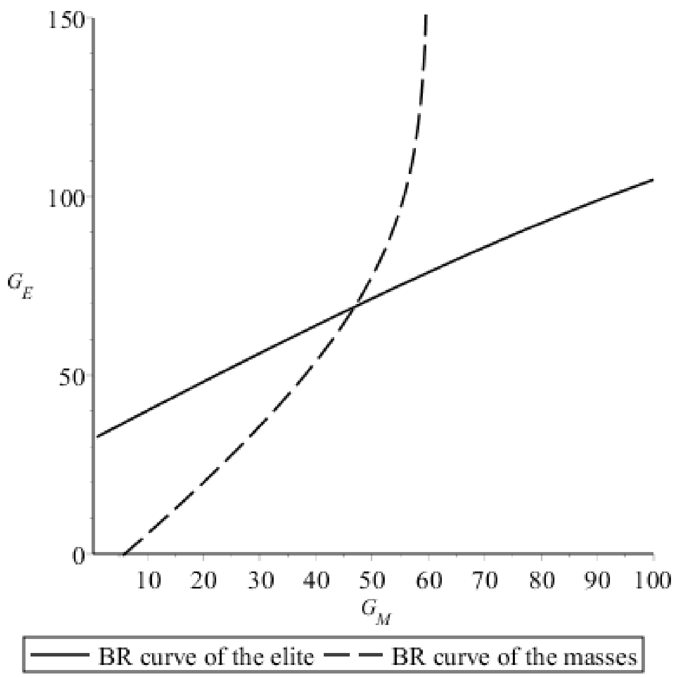
Similar to the case of the masses, equation (18) allows to deduce the properties of the best response curve of the elite. These are summarised below.

The Best Response Curve of the Elite:

(E1) *Given* R_E, R_M, X, s, A, b, k, G_M *and Assumption 4, there is a unique maximiser* $\bar{G}_E$ *to the problem* (5)-(7) *which satisfies the condition in* (18), *is strictly positive, i.e.* $\bar{G}_E > 0$, *and can be represented by a function* $\bar{G}_E = R(G_M)$ *which is the best response curve of the elite given the decision of the masses* G_M *(see Section A.3 of the Appendix);*

(E2) *It holds that* $\frac{dR(.)}{dG_M} > 0$ *and* $\frac{dR(.)}{dG_M^2} < 0$, *i.e. the best response curve of the elite is increasing and concave in the decision of the masses (see Section A.2 of the Appendix).*

Figure 2.3: Best Response Curves and Equilibrium



Note: drawn for $R_E = 150$; $R_M = 100$; $k = 0.05$; $b = 1$, $X = 0$, $A = 4$.

The following proposition states conclusions about the equilibrium choices of the elite and masses.

Assumption 3, Assumption 4 and the characteristics of the best response curves imply that the curves do indeed cross and that they cross only once (see Section A.5 of the Appendix). Figure 2.3 graphically represents the two best response curves and their crossing point, assuming specific parameter values.

Proposition 1 (Equilibrium Levels of Investment in the Contest, Production and First Period Consumption)**.** *Given the problems characterized by* (1)-(4) *and* (5)-(7)*, Assumption 3 and Assumption 4, the conditions* (16) *and* (18)*:*

(a) there exists a unique equilibrium characterized by the optimal levels of investment in the contest by both parties (G_M^*, G_E^*) *that are mutually best responses, i.e.* $G_M^* = r(G_E^*)$ *and* $G_E^* = R(G_M^*)$ *(see Section A.5 of the Appendix);*

(b) given G_M^*, G_E^* *the equilibrium investment in production is characterised by* $F^* = \frac{(R_M+(1-s)X-G_M^*)}{2}$*; the equilibrium first period consumption by the masses – by* $C_M^* = \frac{(R_M+(1-s)X-G_M^*)}{2}$*; the elite's equilibrium first period consumption – by* $C_E^* = R_E + sX - G_E^*$*.*

The Optimal Decision of the Donor

Given the equilibrium solutions (G_M^*, G_E^*) and that certain properties of the donor's objective function hold, it is possible to characterise the optimal level of aid X^*. The first order condition for the problem in (8)-(13) can be shown to be (see Section A.6.1 of the Appendix):

$$\frac{p^2 A\,(b - s(b+1))}{b\,((p+1)^2 + p^2 + p)} = \frac{d\,q(X)}{d\,X} \tag{20}$$

where $p \equiv p(g(X), G(X))$.

The level of transfers X^* that maximises the donor's objective function occurs at the point where the increase in the welfare of the masses from marginally increasing foreign transfers equals the increase in the opportunity cost of the donor. The condition in (20) can also be expressed as $\frac{d\,I_M}{d\,X} = \frac{d\,q(X)}{d\,X}$, where $I_M \equiv p(g(X), G(X))\,A\frac{1}{2}(R_M + (1-s)X - g(X))$. Here we have expressed the second period welfare of the masses I_M as a function of aid.

For the value of aid that solves (20) to be a maximizer, the second order condition must also be satisfied. It can be expressed as $\frac{d\,(I_M - q(X))}{d\,X^2} < 0$. The following assumption ensures that the objective function of the donor is concave in X and the second order condition holds (see Section A.6.2 of the Appendix).

Assumption 5.

$$\frac{(b - s(b+1))^2\,(2-p)\,(p-1)^2\,kAp^3}{((p-1)^2 + p^2 + p)^3\,b} < \frac{d\,q(X)}{d\,X^2} \tag{21}$$

Assumption 5 requires the second order derivative of the opportunity cost function to be sufficiently high, i.e. the cost function to be sufficiently convex in X in comparison to the expected welfare of the masses, such that the donor's objective function is strictly concave in X.

Proposition 2 (The Optimal Level of Aid)**.** *Given the problem characterised by* (8)-(13) *and Assumption 5, the optimal level of aid provided by the donor satisfies* (20) *and can be characterized by a function* $X^* = x(R_E, R_M, A, s, b)$.

Note that $X = x(.)$ cannot be expressed explicitly. However, it is possible to derive some useful results using implicit differentiation of the first order conditions. These are presented in the next sections.

2.3.3 Comparative Statics

The Effect of Foreign Funds in the Recipient Country

This section investigates how the transfers by the donor affect the welfare of the elite and masses.

As a share s of the foreign transfers is extracted by the elite, the aggregate effect of aid will be the weighted effects of the funds accruing to the masses and the funds accruing to the elite.[8] The parameter s can determine whether aid helps the masses or is instead counter-productive negatively affecting the welfare of the masses and increasing the consumption of elite. It can be shown that there is a certain threshold of s, denote it by $\hat{s}$, which if exceeded implies that

[8] For example, it is possible to express the marginal effect of aid on the investment in the contest by the masses as a weighted sum of the effects of the funds of the elite and the funds of the masses, i.e. $\frac{dG_M^*}{dX} = s \cdot \frac{dG_M^*}{dR_E} + (1-s) \cdot \frac{dG_M^*}{dR_M}$ and $\frac{dG_E^*}{dX} = s \cdot \frac{dG_E^*}{dR_E} + (1-s) \cdot \frac{dG_E^*}{dR_M}$. Also we show in Section A.8 of the Appendix that $\frac{dG_M^*}{dX} > 0$ and $\frac{dG_E^*}{dX} > 0$, i.e. investment in the contest by both parties is marginally increasing in aid transfers, irrespective of the parameter s.

aid has a negative effect on the welfare of the masses. This threshold can be shown to be:

$$\hat{s} = b/(1+b) \tag{22}$$

This implication is also summarised in Proposition 3.

Proposition 3 (The Effect of Aid on the Welfare of the Masses and Elite)**.** *Given that* G_M^*, G_E^* *are the equilibrium solutions to* (1)-(4) *and* (5)-(7)*:*

(a) the first period consumption by the masses C_M^**, the power of the masses* $p(G_M^*, G_E^*)$ *and the second period (post-contest) welfare of the masses* $I_M^* \equiv p(G_M^*, G_E^*)\, AF^*$ *are marginally increasing in the amount of aid transfers* X *given that the elite's ability to extract aid* s *is below the threshold* $\hat{s}$ *given by* (22)*, and (weakly) decreasing otherwise, i.e. if* $s < \hat{s}$ *then* $\frac{dC_M^*}{dX} > 0$*,* $\frac{dp^*(.)}{dX} > 0$ *and* $\frac{dI_M^*}{dX} > 0$*; if* $s > \hat{s}$ *then* $\frac{dC_M^*}{dX} < 0$*,* $\frac{dp^*(.)}{dX} < 0$ *and* $\frac{dI_M^*}{dX} < 0$*; if* $s = \hat{s}$ *then* $\frac{dC_M^*}{dX} = 0$*,* $\frac{dp^*(.)}{dX} = 0$ *and* $\frac{dI_M^*}{dX} = 0$*, where:*

$$\frac{dp^*(.)}{dX} = \frac{k\,(1-p)^2\,(b - s\,(b+1))\,p^2}{2\,p^2 - p + 1}; \quad \frac{dI_M^*}{dX} = \frac{p^2 A\,(b - s\,(b+1))}{b\,(2\,p^2 - p + 1)}; \quad \frac{dC_M^*}{dX} = \frac{(b - s\,(b+1))\,p^2}{b\,(2\,p^2 - p + 1)} \tag{23}$$

(b) the amount of output that the elite can extract as result of the contest (elite's second period welfare) $I_E^* \equiv (1 - p(G_M^*, G_E^*)) \cdot AF^*$ *is not affected by aid transfers, i.e.* $\frac{dI_E^*}{dX} = 0$*; however the elite's power* $(1 - p(G_M^*, G_E^*))$ *and first period consumption* C_E^* *are marginally increasing in the amount of aid transfers if the elite's ability to extract aid* s *is above the threshold* $\hat{s}$ *given by* (22)*, and (weakly) decreasing otherwise, i.e. if* $s > \hat{s}$ *then* $\frac{d(1-p^*(.))}{dX} > 0$ *and* $\frac{dC_E^*}{dX} > 0$*; if* $s < \hat{s}$ *then* $\frac{d(1-p^*(.))}{dX} < 0$ *and* $\frac{dC_E^*}{dX} < 0$*; if* $s = \hat{s}$ *then* $\frac{d(1-p^*(.))}{dX} = 0$ *and* $\frac{dC_E^*}{dX} = 0$*, where* $\frac{d(1-p^*(.))}{dX} = -\frac{dp^*(.)}{dX}$ *and:*

$$\frac{dC_E^*}{dX} = -\frac{(1-p)^2\,(b - s\,(b+1))}{2\,p^2 - p + 1} \tag{24}$$

To summarise the above, we find that output and investment in production can be positively influenced by the foreign transfers given that the elite's ability to extract aid is sufficiently constrained.[9] Similarly, aid transfers have a positive effect on the power and welfare of the masses in both periods, given that the elite cannot extract too much of the aid. This highlights

[9]Because $\frac{dI_E^*}{dX} = 0$, it can be shown that $\frac{dAF^*}{dX} = \frac{dI_M^*}{dX}$. Because these effects are identical, a formal statement about the effect of aid on the output can be found in Section A.9 of the Appendix.

the role of factors such as institutional quality, transparency and corruption in aid effectiveness, as these variables are expected to influence how much of the aid ends up in the pockets of the elite.

Notice that even though aid influences the power of the elite, it has no effect on the level of output that the elite get as a result of the contest. Instead it can raise or contract the elite's expected welfare by affecting their consumption. This is because the increase in the power of the elite from the extra money is offset by a decrease in production by the masses, as the masses invest more in the contest when facing a more powerful elite.

The expression for $\frac{dI_M^*}{dX}$ (see (23)) directly affects the optimal amount of aid X^*, as it constitutes the left hand side of the donor's first order condition in (20). If the elite are able to extract too much of the aid, then the donor's optimal choice will be to provide a zero amount of aid, i.e. if $s \geq \hat{s}$ then $\frac{dI_M^*}{dX} \leq 0$ and $X^* = 0$. In this scenario aid is ineffective, as it can actually decrease the second period welfare of the masses. If, however, the elite's ability to extract aid is sufficiently constrained such that $s < \hat{s}$, aid improves the second period welfare of the masses and it is optimal for the donor to provide a strictly positive amount, i.e. $\frac{dI_M^*}{dX} > 0$ and $X^* > 0$. In this case the extent of aid effectiveness also depends on the exogenous variables in the model, including the initial level of funds of the masses and the elite, R_M and R_E. This is discussed in the next section.

The Effectiveness of Foreign Aid and Initial Resources of the Masses and Elite

This section investigates the link between aid effectiveness, and the relative levels of the initial resources of the elite and masses.

If it is optimal for the donor to provide more aid under certain conditions, aid should be more effective in maximising the net expected welfare of the masses under these conditions. In other words if $\frac{dX^*}{dz} > 0$, where z is an exogenous variable, then z should be positively associated with aid effectiveness.

See Figure 2.4 for a plot of the expected welfare of the masses I_M as a function of aid X. The image on the left hand side (labelled by (A)) presents this relationship for varying levels of the initial resources of the masses R_M. As the initial resources of the masses are increased from 15 to 100, the curve becomes steeper. Similarly, the image on the right hand side (labelled by (B)), depicts this relationship for varying levels of the initial resources of the elite. As R_E is increased from 200 to 250 the curve becomes less steep.

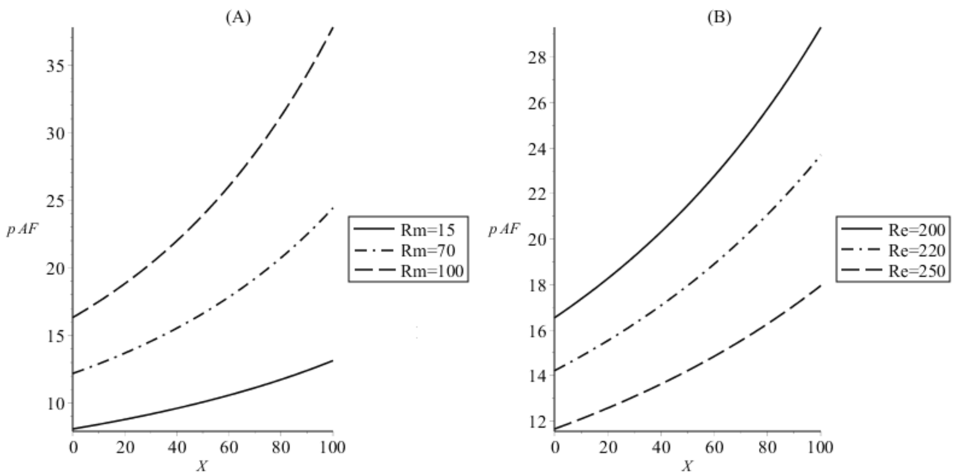
This implies that money is more beneficial in increasing the welfare of the masses when R_M is higher and R_E is lower. It also makes us expect the optimal aid transfers X^* to be increasing in R_M and decreasing in R_E. As it turns out, this is exactly the case. Proposition 4 formally summarises these findings.

Proposition 4 (Aid Effectiveness and the Existing Levels of Funds of the Masses and Elite)**.** *Given that Assumption 1 and Assumption 5 hold and X^* is the solution to* (8)-(13)*:*

(a) when the share of aid that the elite extracts equals or exceeds the threshold $\hat{s}$ given by (22)*, i.e. $s \geq \hat{s}$, it is not optimal for the donor to provide aid, i.e. $X^* = 0$, therefore aid is not effective and the initial funds of the masses and elite have no impact on aid effectiveness, i.e. $\frac{dX^*}{dR_M} = 0$ and $\frac{dX^*}{dR_E} = 0$.*

(b) when the share of aid that the elite extracts is below the threshold $\hat{s}$ given by (22)*, i.e. $s < \hat{s}$, it is optimal for the donor to provide a positive amount of aid, i.e. $X^* > 0$, and the aid X^* is more effective when the masses have relatively more initial funds and the elite have relatively less initial funds, i.e. $\frac{dX^*}{dR_M} > 0$ and $\frac{dX^*}{dR_E} < 0$, where $\frac{dX^*}{dR_M} = -b \cdot \frac{dX^*}{dR_E}$ (see Section A.11 of the Appendix).*

Figure 2.4: Aid Effectiveness and Existing Funds of the Masses and Elite



Note: It is assumed that $s = 0.2$, $A = 4$, $b = 1$, $k = 0.05$. Graph (A) depicts varying levels of R_M when $R_E = 200$; Graph (B) depicts varying levels of R_E when $R_M = 100$.

Because of Assumption 5 and the donor's opportunity costs $q(X)$ being independent of R_M and R_E, the direction of the effects $\frac{dX^*}{dR_M}$ and $\frac{dX^*}{dR_E}$ can be obtained using the feature that

$sign(\frac{dX^*}{dR_M}) = sign(\frac{dI_M}{dXdR_M})$ and $sign(\frac{dX^*}{dR_E}) = sign(\frac{dI_M}{dXdR_E})$. This is based on the same principle as in Figure 2.4, where by varying the funds of the masses and elite we change the slope of expected welfare as a function of aid. It is possible to show that the expressions for $\frac{dI_M}{dXdR_E}$ and $\frac{dI_M}{dXdR_M}$ satisfy:

$$\frac{dI_M}{dX\,dR_M} = \frac{((s-1)\,b+s)\,(p-2)\,(-1+p)^2\,kAp^3}{(2\,p^2-p+1)^3}; \quad \frac{dI_M}{dX\,dR_E} = -b\,\frac{dI_M}{dX\,dR_M} \tag{25}$$

Assuming the likely scenario when $R_E > R_M$, which implies that the initial resources of the elite exceed those of the masses, it is convenient to restate the implications on aid effectiveness in terms of inequality, which in this model can be represented by the absolute difference between the initial resources of both parties, $R_E - R_M$. This follows from the notion that the more rich the elite is relative to the masses, the higher is the inequality between the elite and masses. Therefore, a corollary follows from Proposition 4.

Corollary 1 (Aid Effectiveness and Inequality)**.** *Given Assumption 1 and Assumption 5 hold,* $s < \hat{s}$ *where* $\hat{s}$ *is given by* (22) *and* X^* *solves* (8)-(13)*, aid is more effective when the difference bewteen the initial funds of the relatively rich elite and poor masses is lower, i.e.* $\frac{dX^*}{d(R_E-R_M)} < 0$. *Assuming that* $R_E > R_M$*, this implies that aid is more effective when the initial levels of funds available to the masses and the elite are more equal.*

Corollary 1 provides with an empirically testable hypothesis. We test it in Chapter 3.

2.4 Conclusion

This work analyses foreign aid effectiveness when the recipient country is characterized by a contest between the relatively rich and rent-seeking elite, and the relatively poor and economically active rest of the population (the masses). A foreign aid donor decides on the amount of aid to be given to the recipient country in order to maximize the expected welfare of the masses.

However, a share of the aid transfers accrues to the elite instead of the masses. This occurs because of two reasons. Firstly, before the transfers reach the masses, the elite is assumed to extract an exogenous share of the aid. Secondly, after the transfers have reached the masses, the elite can extract aid via the contest.

We find that when the elite is able to extract an excessive share of the aid transfers before they reach the masses, aid is ineffective in raising the welfare of the poor, but will be counter-productive and raise the welfare of the elite instead. In this scenario a welfare optimising donor should not allocate any aid at all.

When this share is sufficiently low, aid is effective in raising the welfare of the masses, and the donor should allocate a strictly positive amount of aid. The exact amount will depend on the relative contesting ability of the masses.

We show that the optimal amount of aid transfers is decreasing in the level of inequality between the resources of the elite and masses. This occurs because the relative contesting ability of the elite is weaker, when the level of economic inequality is lower. Consequently, a donor that optimises the welfare of the majority of population in aid recipient country should, all else equal, give more aid to a relatively more equal country.

3 Aid Effectiveness and Inequality: Empirical Evidence

3.1 Introduction

Empirical literature on growth effectiveness has so far failed to provide consistent evidence that foreign aid has boosted growth of the recipient economies. The focus has shifted from studies trying to establish whether aid has been effective, to studies trying to pinpoint the specific conditions in the recipient countries favourable to aid effectiveness.

This chapter builds on the hypothesis proposed in Chapter 2, and investigates whether there is evidence for a conditional effect of equality on aid effectiveness. We define aid effectiveness in terms of the ability of aid to raise growth of the recipient country's economy. We define equality in terms of the country's household income equality.

We analyse a sample of 59 aid recipient countries during the period 1971-2005, running regressions with a rich set of controls, accounting for country unobserved heterogeneity. We report estimates obtained using the ordinary least squares (OLS) estimator on data both in levels and differences to remove any unobserved heterogeneity, as well as using the fixed effects estimator. We also report estimates using Anderson-Hsiao estimator to address the dynamic panel bias, and general method of moments (GMM) dynamic estimators.

We follow Clemens et al. (2012) and build a measure of foreign aid that takes into account only that aid which is expected to have an impact short term. This means that our aid measure is disentangled from the humanitarian aid and other types of aid that are expected to only have effects after a substantial amount of time. Using the above disaggregated aid measure allows to account for the possibility that the effects of different types of aid could potentially offset each other. In addition, we keep only that proportion of aid which is expected to have a positive effect on growth within the relevant time period, i.e. five years, as the data we use is based on five-year periods.

In addition, we dissagregate the aid measure by Clemens et al. (2012) further, by taking into account only that proportion of aid which is given by DAC donors, which means that we exclude the aid given by developing country donors. This is useful, as the developing country donors may have different motivation for giving aid than DAC donors, which could also influence the effects of the aid in the recipient economy. By retaining only the aid given by DAC donors, we are able to keep that part of the aid which we expect to affect the growth rate of the recipient.

Our results imply that, all else equal, a one standard deviation increase in the aid-GDP ratio is estimated to boost recipient growth by 1.25 percentage points in an equal aid recipient with a Gini coefficient around 32, but decrease recipient growth in an unequal aid recipient with a Gini coefficient around 55 by 2.42 percentage points.

Previous literature that has investigated conditions associated with aid effectiveness, has found that aid is effective in aid recipient countries pursuing good policies (Burnside and Dollar, 2000) and not having powerful local elites as represented by the proportion of European settlers in the colonial times (Angeles and Neanidis, 2009). Both good policy environment and powerful elites are correlated with equality. Therefore, we test for the robustness of our results by investigating whether our effect is an implication of more equal countries having better policy environments and lower power of the local elites. Our findings remain robust.

The rest of the chapter is structured as follows. Section 3.2 reviews the relevant literature. Section 3.3 discusses the specification of the estimation equations. Section 3.5 discusses the estimation strategies commonly used in literature and the issues that may arise when implementing them. Section 3.6 describes the data and variables used in the estimation. Section 3.7 presents the baseline estimation results. Section 3.8 presents the estimation results after carrying out the robustness checks and extensions. Section 3.9 concludes.

3.2 Literature Review

So far the empirical literature on aid effectiveness has been inconclusive. Current research can be divided into two strands: (i) investigation of the unconditional effect of aid; (ii) investigation of the conditional effect of aid, where aid effectiveness is conditioned on some variable. Below is an overview of some of the findings.

The early study by Papanek (1973) investigates the unconditional link between aid and growth using a dataset of 51 country over the years 1950-1965, and finds that aid has been positively correlated with growth in Asia, but not the Americas. Later work by Boone (1996) finds that aid has not been associated with increased investment, a precursor for growth. Boone (1996) analyses a sample of 96 countries during the period 1971-1990.

The study by Burnside and Dollar (2000) investigates the effect of aid conditional on an index representing the policy environment in the recipient country. The authors find that aid raises the growth rate, but only in those countries that pursue good policies.

The study by Burnside and Dollar (2000) triggered attempts to replicate their strategy, after implementing various modifications. Notably, Easterly et al. (2004) find that the conditional effect on policy environment found by Burnside and Dollar (2000) is not robust after extending the original sample. Rajan and Subramanian (2008) investigate aid effectiveness using cross-sectional and panel data from 1980-2000 and do not find robust evidence that aid is associated with growth, even when conditioning on good policy or specific geography environments.

Hansen and Tarp (2001) test a specification in which aid effectiveness is conditioned on the aid variable itself, i.e. by including a squared aid term in the regression, which is consistent with diminishing returns to aid. The authors do indeed find that aid exhibits diminishing returns. They also find that aid raises growth rate, but this effect occurs mainly via increased investment.

Angeles and Neanidis (2009) find that aid effectiveness is undermined when the country's economic and political power is concentrated in the hands of a relatively small part of the population – the local elite. They argue that this occurs as aid flows can be converted into goods and services only with the intermediation of this elite, which is likely to lack incentives to improve the welfare of the other social groups. The authors use the share of European settlers in the population at the end of the colonial times as a proxy for the power of the elite, arguing that there should be a positive relationship between the local elite and the extent of European settlement in the aid recipient countries.

The sample of the aid recipient countries where the above relationship applies should be distinguished from certain countries usually not among aid recipients and, thus, not in the sample – namely, Australia, Canada, New Zealand and the United States. In these countries the European settlers constituted a sufficiently large share to become a majority instead of an elite. Thus, the settlers there did not lack the motivation to improve the welfare of the rest of the population, as most of it belonged to their own social group.

Apart from testing for various conditional effects, an important issue is identification of causality. To account for the possibility of unobserved factors correlated with aid and growth, or alternatively reverse causation, a solution would be to use instrumental variable approach. However, strong and valid instruments for aid are difficult to find. Boone (1996) and Rajan and Subramanian (2008) use a measure of donor-recipient political ties and recipient country size as instruments. However, Clemens et al. (2012) show that population size is responsible for most of the power of these instruments. As population size can also directly influence growth, these instruments are likely to be invalid.

A criticism by Clemens et al. (2012) addresses the fact that empirical literature often looks at very aggregate measures of aid, such as the aggregate net Official Development Assistance (ODA). This fails to take into account that different types of aid have different effects over different time horizons. For example, one could expect the effects of humanitarian aid given with the aim to help people in disasters and wars to substantially differ from aid invested in improving infrastructure.

As a response to the above argument, Clemens et al. (2012) build a proxy for only that aid that is expected to have an impact within the next few years. The authors call this 'early impact aid' (or 'early impact ODA') and re-estimate the regressions of influential studies, replacing the aggregate net ODA with this measure.

3.3 Empirical Specification

A common practice in aid effectiveness literature is to investigate whether aid boosts growth in recipient countries. This is usually done by testing the specification:

$$\triangle g_{c,t} = \beta_0 + \beta_1 \, g_{c,t-1} + \beta_2 \, Aid_{c,t} + \boldsymbol{x'_{c,t}} \, \boldsymbol{\alpha} + u_{c,t} \tag{26}$$

where c indexes recipient countries and t indexes time periods; $\triangle$ denotes the change from time period $t-1$ to time period t, i.e. $\triangle g_{c,t} = g_{c,t} - g_{c,t-1}$; $g_{c,t}$ denotes logarithm of GDP per capita. Variable $Aid_{c,t}$ represents the measure of aid (usually net ODA, expressed as ratio of GDP, GNI or population of the recipient country). The term $\boldsymbol{x_{c,t}}$ is a vector of controls; $u_{c,t}$ is a disturbance term, usually assumed to capture country specific fixed effects and time effects; β_0 is a constant; β_1, β_2 and the vector $\boldsymbol{\alpha}$ capture the various effects of the independent variables on the change in the growth rate.

To allow for the possibility of diminishing returns to aid, sometimes equation (26) is supplemented with a squared aid term.[10]

$$\triangle g_{c,t} = \beta_0 + \beta_1\, g_{c,t-1} + \beta_2\, Aid_{c,t} + \beta_3\, Aid^2_{c,t} + \boldsymbol{x'_{c,t}}\, \boldsymbol{\alpha} + u_{c,t} \tag{27}$$

The aim of the regressions testing the equations (26) and (27) is to establish whether, all else equal, more aid is associated with higher growth rates in recipient countries. In other words, these regressions test whether aid is effective in raising the economic growth in these countries.

The aim of the empirical tests in this chapter is to expand this question and to investigate whether, as suggested by the model proposed in Chapter 2, aid is more effective in economically more equal countries. In order to do this, we supplement the specifications in (26) and (27) with a term capturing the interaction between the aid measure and the level of equality in the recipient country: $Aid_{c,t} \times Equality_{c,t}$, where the measure of the level of equality $Equality_{c,t}$ is constructed using income Gini coefficients, i.e. $Equality_{c,t} = 1 - Gini_{c,t}/100$, where $Gini_{c,t}$ is the Gini coefficient of the recipient country c at time t. The baseline specification can be summarised as:

$$\triangle\, g_{ct} = \beta_0 + \beta_1\, g_{c,t-1} + \beta_2\, Aid_{c,t} + \delta_1\, (Aid_{c,t} \times Equality_{c,t}) + \delta_2\, Equality_{c,t} + \boldsymbol{x'_{ct}}\, \boldsymbol{\alpha} + u_{ct} \tag{28}$$

The variant of the specification which allows for diminishing returns to aid (i.e. with a quadratic aid term) is:

$$\triangle\, g_{ct} = \beta_0 + \beta_1\, g_{c,t-1} + \beta_2\, Aid_{c,t} + \beta_3\, Aid^2_{c,t} + \delta_1\, (Aid_{c,t} \times Equality_{c,t}) + \delta_2\, Equality_{c,t} + \boldsymbol{x'_{ct}}\, \boldsymbol{\alpha} + u_{ct} \tag{29}$$

The main coefficients of interest are β_2 (and β_3) and δ_1 in equations (28) and (29). Their estimated magnitudes and significance demonstrate whether there is evidence that aid has an effect on growth and whether this effect is conditional on the level of equality.

After testing the specifications (28) and (29), we test for the possibility that a conditional effect on equality could be driven by other variables that are correlated with equality. More specifically, we check the robustness of our results by taking into account three alternative conditions for aid effectiveness in the aid recipient countries: (i) better policies as represented by trade openness and budget balance; (ii) institutional quality, as represented by the International Country Risk

[10] For example, Hansen and Tarp (2001), Rajan and Subramanian (2008).

Guide (ICRG) Index; (ii) the power of the elites, as represented by the percentage of European settlers. The equations to be tested take the following form:

$$\begin{aligned}\triangle g_{ct} = \beta_0 + \beta_1\, g_{c,t-1} + \beta_2\, Aid_{c,t} + \delta_1\, (Aid_{c,t} \times Equality_{c,t}) + \delta_2\, Equality_{c,t} + \\ + \lambda_1\, (Aid_{c,t} \times h_{c,t}) + \lambda_2\, h_{c,t} + \boldsymbol{x'_{ct}}\, \boldsymbol{\alpha} + u_{ct}\end{aligned} \tag{30}$$

where h_{ct} denotes a variable that represents either policy, institutional quality or the percentage of European settlers.[11]

Previous literature has found better policy environment and less powerful elite to be associated with higher aid effectiveness. In particular, Burnside and Dollar (2000) investigate the interaction of aid effectiveness with policy variables, more specifically, inflation, trade openness and government budget surplus. The authors have found evidence that aid has had a more positive impact on growth in good policy environments. Similarly, Angeles and Neanidis (2009) find that the percentage of European colonial settlers, a proxy for the power of the local elite, undermines the effectiveness of aid. We discuss the link between European colonial settlers and powerful local elite in more detail below (Section 3.4).

3.4 Colonial Settlers and the Power of the Local Elite

Angeles and Neanidis (2009) argue that the local elite undermines aid effectiveness when the following two conditions hold: (a) the elite is not benevolent towards the rest of the population, i.e. it is not willing to help the other social groups; (b) the elite holds too much of the country's political and economic power. Condition (a) implies that the elite would prefer to extract foreign aid and use it to their own benefit, rather than allow it to effectively reach other social groups; condition (b) ensures that the elite can easily do that.

Angeles and Neanidis (2009) further argue that in many of the countries colonised by Europeans, the colonisers and their descendants have formed powerful local elites that lack the interest to contribute to other social groups. Thus, in these countries the conditions (a) and (b) are satisfied which implies that aid should be less effective.

In particular, Angeles and Neanidis (2009) distinguish between three types of countries:
(i) countries where the extent of the European settlement was very high, such that the settlers

[11] As the 'aid-squared' term is not significant when testing (29), we do not supplement (30) with a quadratic aid term.

became the majority of the population; these countries – referred to as the 'New Europes'– are Canada, New Zealand, Australia and the United States;
(ii) countries where the extent of the European settlement was intermediate, such that Europeans settled in large numbers, but did not become the majority of the population; these are represented by most countries in Latin America, Caribbean and southern Africa;
(iii) countries where the European settlement was negligible and/or most colonisers left; such countries are many states in Africa and Asia, for example, Nigeria, Vietnam, Pakistan.

Angeles and Neanidis (2009) argue that the conditions (a) and (b) are likely to be met in countries with the intermediate extent of European settlement. The settlers there had an advantage with respect to the rest of the population in terms of human capital and beneficial cultural linkages to Europe, which allowed them to gather a large share of economic and political power. Besides the settlers in these countries were not concerned about the welfare of the rest of the population, one of the reasons being that they belonged to a different ethnic group, which has been shown to matter in influencing the attitudes of different groups towards each other (Alesina et al., 1999; Easterly and Levine, 1997; Luttmer, 2001).

The countries with negligible European settlement or that were never colonised, may not have developed a European elite, but can instead have local elites, which may or may not satisfy conditions (a) and (b). The authors hypothesise that on average these elites will concentrate less power and be more benevolent toward the rest of the population, that the elites that emerged from the European settlement.

In countries with excessive European settlement, the conditions (a) and (b) do not hold, as the Europeans were sufficiently many to become a majority. Therefore, the power is not in the hands of a few, and the European settlers do not mind contributing to the welfare of the rest of the population, as most of them belong to their own social group.

Given the above, Angeles and Neanidis (2009) propose a non-monotonous relationship between the extent of European settlement and elite's characteristics. Among the aid recipient countries which exclude the 'New Europes', their theory is also consistent with a negative relationship between the European settlement and aid effectiveness.

Angeles and Neanidis (2009) compare their theory to the work by Acemoglu et al. (2001, 2002), who propose a positive and monotonous relationship between European settlement and institutions. The authors argue that their theory should not clash with the one by Acemoglu et al. (2001, 2002) as, given the complexity of the phenomenon, both mechanisms could coexist. In addition, the European settlers can be argued to have established good institutions but limited their benefits to their own social group.

3.5 Choice of the Estimator

A few issues arise, because the equations (26)-(30) include the lagged log of GDP per capita term $g_{c,t-1}$.

As we are estimating a country panel model, the error term $u_{c,t}$ should capture unobserved country specific heterogeneity γ_c, in addition to the time effect v_t and idiosyncratic error $\varepsilon_{c,t}$, i.e. $u_{c,t} = \gamma_c + v_t + \varepsilon_{c,t}$. A common way to take into account the unobserved heterogeneity is to use the fixed effects estimator, which eliminates the unobserved country-specific effects using the *within* transformation by demeaning the variables. For example, the fixed effects estimation of (28) would involve estimating the time-demeaned equation:

$$\triangle\overline{g}_{ct} = \beta_0 + \beta_1\overline{g}_{c\,t-1} + \beta_2\overline{Aid}_{ct} + \delta_1\,\overline{(Aid_{ct} \times Equality_{ct})} + \delta_2\,\overline{Equality}_{ct} + \overline{\boldsymbol{x}}'_{\boldsymbol{ct}}\,\boldsymbol{\alpha} + \overline{u}_{ct} \quad (31)$$

where the line above any variable m_t or the interaction of variables $(m_t \times k_t)$ denotes the time-demeaned transformation: $\overline{m}_t = m_t - T^{-1}\sum_{t=1}^{T} m_t$; $\overline{(m_t \times k_t)} = (m_t \times k_t) - T^{-1}\sum_{t=1}^{T}(m_t \times k_t)$.

However, because of the lagged dependent variable in the model, the term $\overline{g}_{c,t-1} = g_{c,t-1} - T^{-1}\sum_{t=0}^{T-1} g_{c,t}$ is negatively correlated with the error term $\overline{u}_{c,t} = u_{c,t} - T^{-1}\sum_{t=1}^{T} u_{c,t}$ as $g_{c,t}$ depends on $u_{c,t}$ by definition. This is the so called Nickell bias (Nickell, 1981) or the dynamic panel bias. When the time dimension T is small, the correlation between the transformed error and the transformed lagged dependent variable can be substantial. It will be further acerbated in the presence of serially correlated errors.

First differencing data is an alternative to demeaning, in order to remove the unobserved heterogeneity:

$$\begin{aligned}\triangle g_{ct} - \triangle g_{ct-1} = \beta_1 \triangle g_{c\,t-1} + \beta_2 \triangle Aid_{ct} + \beta_3 \triangle (Aid_{ct} \times Equality_{ct}) + \\ + \beta_4 \triangle Equality_{ct} + \boldsymbol{\triangle x}'_{\boldsymbol{ct}}\,\boldsymbol{\alpha} + \triangle\varepsilon_{ct}\end{aligned} \quad (32)$$

In this case the first differenced lagged dependent variable could be instrumented with its second (or further) lag to account for the correlation between g_{ct-1} and ε_{ct-1}. This is the principle behind the Anderson-Hsiao (A-H) estimator by Anderson and Hsiao (1981).

The Difference and System generalised method of moments (GMM) estimators, developed by by Holtz-Eakin et al. (1988), Arellano and Bond (1991), Arellano and Bover (1995), Blundell and Bond (1998) are based on the feature that a more efficient estimator than the A-H estimator can be obtained by taking into account all of the potential internal instruments, based on further lags. More specifically, the Difference GMM estimator first differences data and uses lagged levels to build instruments for all the endogenous variables. System GMM augments the equation estimated by Difference GMM, by estimating simultaneously an equation in levels with suitable lagged differences of endogenous variables as instruments. Arellano and Bover (1995) show how this approach can increase the efficiency of the estimator, which can be especially useful in a case where the lagged levels are poor instruments to variables in first differences.

However, both dynamic panel GMM estimators and in particular the System GMM estimator, are prone to instrument proliferation which can bias the coefficient estimates and weaken the Hansen J test for the joint validity of the instruments (see discussion in Roodman (2009)). Therefore, as pointed out by Roodman (2009) a good practice should be to check the robustness of the results after reducing the number of instruments.

3.6 Data Description

This section describes the data underlying the foreign aid and equality measures used in the estimation of the equations (28) and (29), variables included in the control variable vector $\boldsymbol{x'_{ct}}\,\boldsymbol{\alpha}$, and variables used in the robustness checks part.

Our baseline sample consists of data on 59 aid recipient countries between the years 1971-2005. We use a dataset of 5-year averages, i.e. it consists of up to seven 5-year periods (the first time period corresponds to years 1971-1975 and the last time period – years 2001-2005). The summary statistics of the variables are listed in Table 3.1. More details on the variables and their sources are listed in Table B.1 in the Appendix.

Table 3.1: Summary Statistics

	No. of Obs.	Mean	St.Dev.	Min. Value	Max. Value
GDP, % growth rate	282	1.72	3.00	-6.55	9.70
Aid: net ODA by all donors/GDP (%)	282	3.56	5.03	-0.04	31.55
Aid: early impact ODA by all donors /GDP (%)	267	1.61	2.28	0.00	15.43
Aid: net ODA by DAC donors/GDP (%)	282	2.33	2.97	-0.05	17.96
Aid: early impact ODA by DAC donors /GDP (%)	267	1.36	1.89	0.00	12.57
Repayments	282	0.45	0.64	0.00	4.52
Equality	282	0.54	0.04	0.44	0.70
Income	282	8.14	0.77	6.08	10.19
Life expectancy	282	62.00	9.40	36.55	77.73
Openness	282	0.46	0.50	0.00	1.00
Institutions	282	4.60	1.72	1.60	9.50
Inflation	282	0.22	0.41	-0.00	3.33
Broad money	282	2.72	7.76	0.04	60.76
Budget balance	282	-0.07	0.40	-3.67	2.35
Revolutions	282	0.24	0.43	0.00	2.60
Sub-Saharan Africa (dummy)	282	0.26	0.44	0.00	1.00
South-East Asia (dummy)	282	0.13	0.34	0.00	1.00
Geography	282	-0.43	0.83	-1.04	1.53
Ethnic fractionalisation	282	0.45	0.30	0.00	0.90
Settlers	282	8.31	10.52	0.00	30.00
Polity 2	282	1.23	6.63	-10.00	10.00
Agriculture: value added	246	18.63	12.33	0.13	61.16
Industry: value added	246	31.42	8.93	8.03	63.22

Note: For more details on the variables, see Table B.1 in the Appendix. Dataset a is an unbalanced panel of 59 countries and 7 time periods of 5 years, over 1971-2005, i.e. the first time period corresponds to years 1971-1975 and the last time period – years 2001-2005.

3.6.1 Foreign Aid Measures

This work uses two proxies for foreign aid. Firstly, we follow the common approach in literature and use the net Official Development Assistance (ODA) as the aid measure. Secondly, we build on previous work by Clemens et al. (2012) and use a disaggregated measure of foreign aid that takes into account only that aid which is expected to have an impact in a short time period, i.e. further in text referred to as early impact ODA.

In addition to separately analysing the aid expected to have short term impact, we further disaggregate the aid measure by taking into account only that aid which is given by OECD Development Assistance Committee (DAC) members (representing developed countries). Currently DAC has 30 members, which include European Union institutions, most European Union member states, Australia, Canada, Iceland, Japan, Korea, New Zealand, Norway and the United States. This aid measure is different from the one commonly used in literature which takes into account aid given by all donors, including the developing countries such as India, Russia, China.

In the Baseline Estimation Results section (Section 3.7) we first report the baseline regression results using the aid measure most commonly applied in literature, i.e. the aggregate net ODA (by all donors). We then report the results testing the same specification using early impact ODA by DAC members. In the Appendix, we also report the estimation results of the baseline specification using net ODA by DAC members and early impact ODA by all donors. The results reported in the Robustness Checks and Extensions section (Section 3.8) are all based on using early impact ODA given by DAC members, as we expect this measure to be the most consistent and precise in identifying any positive effect of aid on growth over the 5-year periods that characterise out dataset.

Net Official Development Assistance (ODA)

Data on net ODA are collected and disseminated by the OECD DAC and are available starting from year 1961. The definition of net ODA is government aid designed to promote the economic development and welfare of developing countries. It includes grants, loans with a minimum of 25% grant element and the provision of technical assistance, but excludes loans and credits for military purposes.

We analyse both the aggregate net ODA disbursements summed over all the donors and only those aid disbursements made by the members of DAC (including EU institutions).

Following previous literature, the variable to be used in the aid effectiveness regressions is aid intensity, i.e. aid divided by GDP (both in current USD).

Early Impact ODA

Clemens et al. (2012) classify aid according to whether it is expected to have a long term or a short term impact. They use industry-level disagregated aid data and classify the industries according to the expected time horizon of the impact. Following this, the second strategy of this chapter is to use only that portion of aid which is expected to have an impact within a few years and would be the most suitable for estimation using data over 5-year time periods. This means that our measure includes aid given for investments in infrastructure, transportation, communications, energy, banking, agriculture and industry; it excludes humanitarian aid, most social sector aid and technical cooperation (see Clemens et al. (2012) for more details on the classification).

As purpose disaggregated aid disbursement data is not sufficiently available, following Clemens et al. (2012) we approximate the purpose disaggregated aid disbursements using the available data on aid commitments. More specifically, we build the measure of early impact ODA using two types of data: (i) the gross ODA disbursements (net ODA plus repayments) disaggregated by donor and recipient country, as reported by OECD-DAC; (ii) the purpose disaggregated ODA commitments by donor and recipient country from the Creditor Reporting System (CRS) database.

The procedure is first to calculate the ratio of early impact ODA commitments over the total ODA commitments for each donor-recipient pair in each specific year; then multiply this ratio by the aggregate gross ODA disbursements for each donor-recipient pair in each specific year. Finally we aggregate this variable over the relevant set of donors to obtain an observation for each recipient-year.

The relevant set of donors are (i) DAC members when we build an aid measure that takes into account aid given by only the donors that represent developed countries; (ii) all donors when we build an aid measure that does not distinguish between the different types of donors.

As discussed in Clemens et al. (2012), the early impact ODA measure is based on aid commitment data which do not take into account the repayments on aid, i.e. they represent gross aid flows (gross flows = net flows + repayments on aid). To make the regression results consistent and comparable with the ones based on net flows, it is required to take into account a variable representing repayments. We construct this variable using data on ODA repayments for each recipient year, as reported by OECD DAC. We use ODA repayments to DAC donors when analysing early impact ODA by DAC donors and ODA repayments to all donors when analysing early impact ODA by all donors.

The repayment variable is included as a separate regressor alongside the aid variable in all the regressions that use early impact ODA as the aid measure. In the case where the regression equation includes a quadratic aid term, we also include a square of the repayment variable as an additional regressor. Similarly, when the regression equation includes an interaction of aid with some variable, we also include an interaction of the repayment with the same variable as a regressor.

3.6.2 Equality Measure

The equality variable is constructed using inccome inequality data made available by the University of Texas Inequality Project, which is a cross country panel dataset of Gini coefficients based on an estimated relationship between the UNIDO industrial pay data, Gini coefficients from the World Bank's Deininger & Squire data set and other determinants.[12]

The variable used in our regressions represents the level of equality instead of inequality. It is standardised to range from 0 to 1, where 1 represents perfect equality. The variable is calculated for every country year for which data is available as (100-Gini Coefficient)/100. We then take averages over the 5 year-periods used in our regressions. If for any country-year data is missing, we use the available observations to calculate the 5-year averages. We then use linear interpolation to fill in the gaps in our averaged dataset that are no more than one time period (5 years) long.

3.6.3 Control Variables

Following Rajan and Subramanian (2008) and Clemens et al. (2012) we include a set of commonly used variables as controls, which include initial income, initial life expectancy, openness, a proxy for institutional quality, inflation, broad money, budget balance, number of revolutions, a proxy for ethnic fractionalisation, a geography variable and dummies for recipient countries in Sub-Saharan Africa and South-East Asia. A more detailed description of the variables is found in Section B of the Appendix.

3.6.4 Data on European Colonial Settlers

The data on European settlement in colonial times is from Angeles (2007), which the authors have compiled based on Etemad (2000) and McEvedy et al. (1978). The variable we use is the percentage of European settlers in the total population of the recipient country in colonial times. For countries that have not been colonised, the variable takes the value of zero. See more details about the link between the percent of European Settlers and aid effectiveness in Section 3.4.

3.7 Baseline Estimation Results

In this section we report the estimation results using the aggregate net ODA by all donors (Table 3.2) and early impact ODA by DAC donors (Table 3.3) as basis for our aid measures. Regression

[12]See Galbraith and Kum (2005) for more on the technique.

results using net ODA by DAC donors and early impact ODA by all donors are included in the Appendix. The dependent variable in our regressions is the growth rate of real GDP per capita. All of the regression results reported in the main text are based on taking into account the full set of control variables, but for brevity, we report only the coefficients on the main variables of interest. The estimated full set of coefficients together with the estimated coefficients for specifications without the full set of control variables can be found in the Appendix.

We first estimate the model without the aid-equality interaction term as in equations (26) and (27), and then re-estimate it after including the interaction term as in equations (28) and (29). Panels A in Table 3.2 and Table 3.3 present the estimated results without the aid-equality interaction term, and panels B of these tables present the results with the aid-equality interaction term. In each table, the columns denoted by (a) report the estimated results of a specification with a linear aid term only; the columns denoted by (b) – the results of a specification with both a linear and squared aid terms, to allow for diminishing returns to aid.

We start the estimation by using the OLS estimator with time dummies, but no country fixed effects. To capture some of the country specific heterogeneity, we include the following time invariant country-specific variables as controls: ethnic fractionalisation, a geography variable representing the average number of frost days and tropical land area, as well as regional dummies for countries in Sub-Saharan Africa and South-East Asia. In the columns I(a) of panels A in both Table 3.2 and Table 3.3, one can see that the coefficient on aid enters with a negative sign and is significant at 5% level. In addition, the coefficient representing the negative effect is of a greater magnitude when using the early impact ODA as the aid measure. In columns I(b) of the both tables, adding the quadratic aid term makes the coefficients on aid become insignificant.

To investigate what happens when accounting for a conditional effect on the level of equality, see the columns I(a) and I(b) in Table 3.2 and Table 3.3 that report the OLS estimation results of the regression after including the aid-equality interaction. Including the interaction does not change the sign of the aid coefficient, and returns a positive coefficient for the aid-equality interaction. In addition, both coefficients are significant when using early impact ODA as the aid measure.

The OLS estimation assumes that all of the country specific heterogeneity is captured by the time invariant controls, but does not allow for any unobservable country specific effects. We proceed by estimating our model using the fixed effects estimator, which removes the unobservable country heterogeneity that the OLS estimator did not take into account. In columns II(a) and II(b) of the panels A of Table 3.2 and Table 3.3, one can see that the coefficients on aid remain negative and insignificant without the aid-equality interaction. After taking into account the aid-equality interaction, in the columns II(a), II(b) in panel B of Table 3.2 representing the results using net ODA, the aid coefficients remain insignificant. However, in columns II(a), II(b) in panel B of Table 3.3 representing the results using early impact ODA, the coefficient on aid increases in magnitude exceeding -5.7 and is significant at 1% level. Furthermore, the coefficient on the aid-equality interaction is positive and significant at 1% level.

Table 3.2: The Effect of Aid on Growth: Net ODA by All Donors as the Aid Measure

PANEL A: Without Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.076**	-0.077	-0.002	-0.197	-0.055	-0.036	0.133	-0.357**	-0.052	-0.381**	-0.182	-0.651
	(0.035)	(0.609)	(0.976)	(0.236)	(0.300)	(0.809)	(0.195)	(0.012)	(0.702)	(0.044)	(0.330)	(0.108)
Aid^2		0.000		0.007		-0.001		0.018***		0.010		0.015
		(0.994)		(0.306)		(0.909)		(0.000)		(0.155)		(0.107)
Income	-1.406***	-1.408***	-3.735***	-4.150***	-1.398***	-1.372**	-5.340***	-6.241***	-11.518***	-11.788***	-22.950*	-24.314*
	(0.001)	(0.006)	(0.000)	(0.000)	(0.009)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)	(0.080)	(0.082)
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
EI ODA?	No	No	No	No	No	No	No	No	No	No	No	No
DAC donors?	No	No	No	No	No	No	No	No	No	No	No	No
Sample	a	a	a	a	b	b	b	b	b	b	b	b

PANEL B: With Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.753	-0.867	-0.532	-1.215**	-0.493	-0.559	1.185	-0.063	-0.220	-1.273*	0.401	-0.956
	(0.114)	(0.119)	(0.423)	(0.048)	(0.411)	(0.350)	(0.181)	(0.940)	(0.798)	(0.075)	(0.735)	(0.420)
Aid^2		0.002		0.009		0.001		0.018***		0.012*		0.016*
		(0.777)		(0.199)		(0.880)		(0.000)		(0.092)		(0.091)
Aid×Equality	1.311	1.448	1.018	1.854*	0.848	0.926	-2.007	-0.578	0.332	1.611	-1.203	0.425
	(0.153)	(0.132)	(0.395)	(0.085)	(0.456)	(0.399)	(0.199)	(0.675)	(0.824)	(0.204)	(0.607)	(0.845)
Equality	-3.808	-3.990	-3.373	-5.985	5.271	5.201	29.081**	25.149**	14.586	7.945	34.455	26.278
	(0.466)	(0.434)	(0.738)	(0.540)	(0.316)	(0.319)	(0.017)	(0.024)	(0.261)	(0.531)	(0.140)	(0.253)
Income	-1.305***	-1.356**	-3.620***	-4.058***	-1.402**	-1.432**	-6.332***	-7.099***	-11.702***	-11.893***	-28.009*	-28.642*
	(0.004)	(0.011)	(0.000)	(0.000)	(0.011)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)	(0.088)	(0.089)
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The full set of coefficient estimates are reported in Table B.2, Table B.3 in the Appendix. Standard errors are robust. Measure of aid is net ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). Regressions also include a constant, time period dummies and the following control variables: Policy, Institutions, Broad money, Budget balance, Revolutions, Life expectancy, Ethnic fractionalisation, Geography; dummies for countries in Sub-Saharan Africa, South-East Asia. For more details on the variables, see Table B.1 in the Appendix. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table 3.3: The Effect of Aid on Growth: Early Impact ODA by DAC Donors as the Aid Measure

PANEL A: Without Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.346**	-0.020	-0.324	-0.154	-0.298*	0.230	-0.248	-0.946	-0.488*	-0.356	-0.525	-0.416
	(0.025)	(0.955)	(0.137)	(0.752)	(0.071)	(0.473)	(0.360)	(0.114)	(0.063)	(0.562)	(0.182)	(0.612)
Aid^2		-0.034		-0.018		-0.054**		0.108*		-0.015		-0.011
		(0.202)		(0.707)		(0.028)		(0.080)		(0.794)		(0.869)
Income	-1.632***	-1.597***	-4.390***	-4.454***	-1.695***	-1.609***	-5.203***	-5.748***	-11.810***	-11.795***	-13.134	-13.018
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.153)	(0.131)
Observations	267	267	267	267	207	207	207	207	207	207	207	207
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

PANEL B: With Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-2.579**	-1.643	-5.748***	-5.211**	-2.090*	-0.532	-4.395	-3.515	-5.150**	-4.968*	-5.078**	-4.931**
	(0.043)	(0.313)	(0.003)	(0.013)	(0.082)	(0.711)	(0.261)	(0.374)	(0.022)	(0.055)	(0.013)	(0.034)
Aid^2		-0.026		-0.014		-0.050*		0.105**		-0.004		-0.002
		(0.360)		(0.760)		(0.054)		(0.047)		(0.946)		(0.975)
Aid×Equality	4.297*	2.977	10.178***	9.396***	3.433	1.366	7.719	4.842	8.628**	8.359**	8.443**	8.223**
	(0.074)	(0.277)	(0.003)	(0.008)	(0.123)	(0.571)	(0.263)	(0.502)	(0.028)	(0.045)	(0.025)	(0.032)
Equality	-1.596	-1.365	-8.727	-7.902	2.650	3.244	15.259	20.191*	6.072	6.218	7.420	7.249
	(0.783)	(0.816)	(0.405)	(0.459)	(0.650)	(0.577)	(0.182)	(0.097)	(0.626)	(0.621)	(0.678)	(0.658)
Income	-1.554***	-1.558***	-4.290***	-4.423***	-1.656***	-1.614***	-6.003***	-6.619***	-11.905***	-11.954***	-12.854	-12.717
	(0.001)	(0.001)	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.205)	(0.168)
Observations	267	267	267	267	207	207	207	207	207	207	207	207
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The full set of coefficient estimates are reported in Table B.4, Table B.5 in the Appendix. Standard errors are robust. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). Regressions also include a constant, time period dummies and the following control variables: Repayment, Repayment^2 (in the specifications with Aid^2), Repayment×Equality (in the specifications with Aid×Equality interaction), Policy, Institutions, Broad money, Budget balance, Revolutions, Life expectancy, Ethnic fractionalisation, Geography; dummies for countries in Sub-Saharan Africa, South-East Asia. For more details on the variables, see Table B.1 in the Appendix. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

This finding is consistent with equality having a positive impact on aid effectiveness. More specifically, these coefficient values imply that aid is negatively associated with growth in unequal recipient countries, but positively associated with growth in equal recipient countries. In other words, in the hypothetical case of a perfectly unequal country with equality level of zero one percentage point increase in aid/GDP would decrease growth rate by 5.74 percentage points, but in the case of a perfectly equal country (with equality of unity) one percentage point increase in aid would raise growth rate by 4.43 percentage points.

However, as discussed in Section 3.5, applying the within transformation to a specification like this when estimating a short panel causes a bias, as the demeaned error term is correlated with the demeaned lagged dependent variable. We proceed by removing the unobserved heterogeneity by first-differencing the series, and estimating the equations (26), (27), (28) and (29) in first-differences using both OLS and Anderson-Hsiao estimator, where in the latter case the first-difference in initial income is instrumented with its lag. Results of these regressions are reported in the columns V(a), V(b), VI(a) and VI(b) of Table 3.2 and Table 3.3. Columns III(a), III(b), IV(a) and IV(b) in these tables report results using the OLS and fixed effects estimators on non-differenced data as before, but for comparison purpose using the same sample that is available for the estimation in first differences.

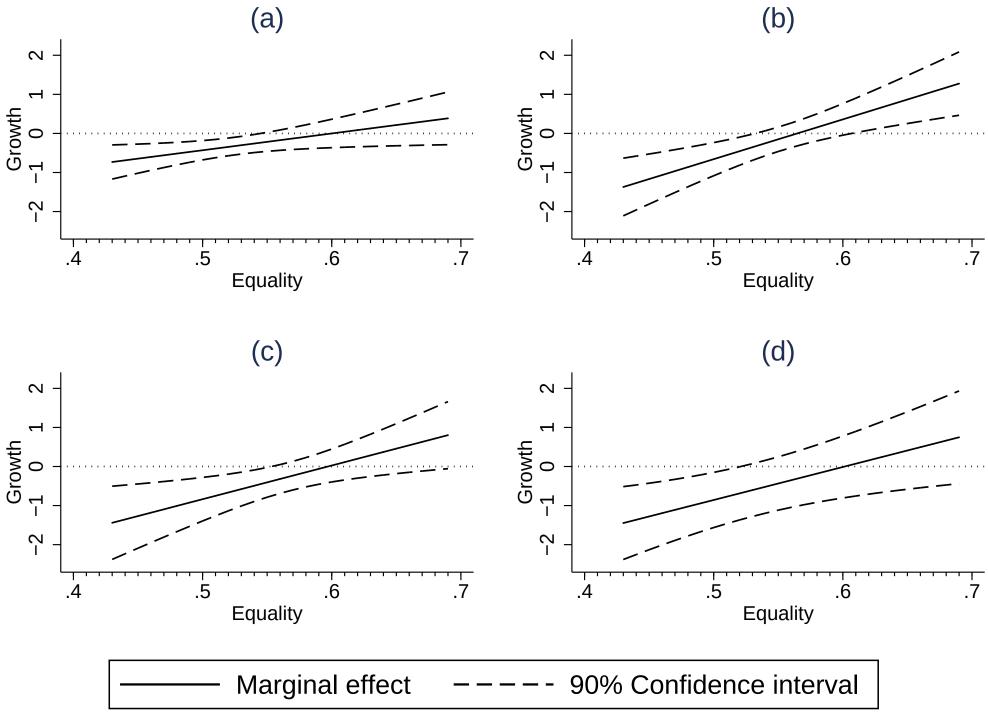
In the columns V(a)-VI(b) in panels A of both tables, one can observe that when not taking into account the aid-equality interaction the coefficients on aid remain negative, the coefficients are significant at 5% level when using the OLS estimator on first-differenced data (in the specification with aid-squared using net ODA and linear specification using early impact ODA), but is insignificant at conventional levels when using the Anderson-Hsiao estimator.

However, after taking into account the aid-equality interaction and in particular when using early impact ODA as the aid measure, the coefficient on aid increases in magnitude and is significant at 1% level. The coefficient on the interaction term is positive and significant at 5% level. This holds for both cases: when instrumenting income with its lag and when not instrumenting income with its lag.

Figure 3.1 graphically depicts the marginal effect of increasing aid/GDP by one percentage point conditional on the level of equality in the recipient country, using all three of the estimators: OLS on data in levels in panel (a), fixed effects in panel (b), OLS on data in first differences in panel (c) and Anderson-Hsiao estimator in panel (d). The graph depicts the relationship for the range of equality from 0.4 to 0.7 as that corresponds to the minimums and maximum values of equality characterizing the countries in the estimation sample.

As one can observe in the marginal effects graph, the results suggest that equality has a positive impact on aid effectiveness. Aid is negatively associated with growth in countries with relatively low levels of equality and positively associated with growth in countries with high levels of equality. The negative effect in relatively unequal countries is especially pronounced, as it is significant when using the OLS and fixed effects estimators, as well first-differencing to remove

Figure 3.1: The Marginal Effect of Aid Conditional on Equality



Note: (a) is based on results using OLS estimator; (b) – fixed effects estimator; (c) – first differenced data and OLS estimator; (d) – first differenced data and Anderson–Hsiao estimator. Results in (a) and (b) are based on the regression reported in columns I(a) and II(a) of Panel B in Table 3.3, (c) and (d)–V(a) and VI(a) of Panel B in Table 3.3. Equality is defined as a score from 0 to 1, with 1 representing perfect equality. It is calculated as (100-Gini coefficient)/100.

unobserved country heterogeneity. The positive effect in relatively equal countries is significant when using the fixed effects estimator.

To give a better idea of the findings, the results imply that all else equal, a one standard deviation increase in the aid/GDP ratio is estimated to boost recipient growth by 1.25 percentage points in a relatively equal aid recipient with Gini coefficient around 32, but decrease recipient growth in an unequal country with a Gini coefficient around 55 by 2.42 percentage points.[13]

Finally, note that the conditional effect of aid on equality becomes much more apparent when using the early impact ODA as the aid measure, as opposed to the more commonly used net ODA. The coefficients on the aid-equality interaction are not significant at conventional levels when using net ODA in almost all the columns in Table 3.2, but are highly significant when using early impact ODA when running regressions using both data in levels and in first differences.

[13]This is based on the estimated coefficients in column VI (a) in panel B of Table 3.3

3.8 Robustness Checks and Extensions

3.8.1 Interaction with Other Variables

Previous literature has found that aid effectiveness can be influeced by a set of other variabes in the recipient country. For example, Burnside and Dollar (2000) find that aid is effective in countries pursuing good policies; Angeles and Neanidis (2009) find evidence that the power of the local elites caused by European settlement in colonial times is negatively associated with aid effectiveness. Both, good policies and European colonial settlement are variables that are correlated with inequality. In addition, institutional quality is another variable correlated with equality that could potentially influence aid effectiveness. This implies that the impact of equality on aid effectiveness as suggested by the previous regression results could be driven by more equal countries having better policy environment, institutions or lower levels of past European colonial settlement.

We investigate whether our results change, after accounting for these mechanisms. In other words we test the specification in equation (30) including the following interaction terms in addition to the aid-equality interaction: (i) aid-trade openness interaction; (ii) aid-government budget balance interaction; (iii) aid-institutional quality interaction; (iv) interaction between aid and the power of the local elites in recipient country, as represented by the percentage of European colonial settlers in colonial times (see more details in Section 3.4); The results are reported in Table 3.4. Once again, the full set of coefficient estimates are reported in the Appendix. As the 'aid-squared' term was mostly insignificant when estimating the baseline specification, in particular when using early impact ODA as the aid measure, we do not report results for a specification with aid-squared alongside the various interaction terms in Table 3.4.

The results in Table 3.4 suggest that none of the additionally included interaction terms substantially change the coefficients on aid and aid-equality interaction. The coefficients of these interaction terms are mostly insignificant, however the conditional effect on equality remains significant when estimating data in both levels and first differences.

Table 3.4: Aid and Growth: Conditional Effect with Other Variables

PANEL A

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Aid	-2.669*	-5.779***	-2.474*	-5.149	-4.821**	-4.758**	-2.653**	-5.782***	-2.176*	-4.363	-5.325**	-5.246**
	(0.075)	(0.006)	(0.065)	(0.265)	(0.039)	(0.024)	(0.040)	(0.003)	(0.077)	(0.282)	(0.022)	(0.014)
Aid×Equality	4.392	10.218***	3.887	8.721	8.186**	8.043**	4.446*	10.246***	3.590	7.668	8.899**	8.695**
	(0.101)	(0.005)	(0.103)	(0.268)	(0.041)	(0.034)	(0.065)	(0.003)	(0.112)	(0.281)	(0.029)	(0.027)
Equality	-1.455	-8.673	2.329	16.496	6.197	7.167	-1.913	-8.936	2.294	15.382	6.087	7.614
	(0.808)	(0.460)	(0.695)	(0.210)	(0.653)	(0.690)	(0.746)	(0.400)	(0.701)	(0.180)	(0.630)	(0.676)
Income	-1.567***	-4.285***	-1.686***	-6.011***	-12.019***	-12.680	-1.550***	-4.325***	-1.651***	-6.122***	-11.954***	-13.028
	(0.002)	(0.000)	(0.001)	(0.000)	(0.000)	(0.212)	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)	(0.208)
Aid×Openness	0.089	0.016	0.610**	0.350	-0.129	-0.138						
	(0.778)	(0.956)	(0.020)	(0.524)	(0.719)	(0.663)						
Aid×Budget balance							0.095	-0.051	0.026	0.011	-0.410	-0.415
							(0.597)	(0.816)	(0.893)	(0.966)	(0.173)	(0.143)
Observations	267	267	207	207	207	207	267	267	207	207	207	207
Estimator	OLS	F-E	OLS	F-E	OLS	A-H	OLS	F-E	OLS	F-E	OLS	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Sample	c	c	d	d	d	d	c	c	d	d	d	d

PANEL B

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Aid	-2.463**	-5.425***	-1.809	-4.356	-4.646**	-4.489**	-2.457*	-5.695***	-2.006*	-4.279	-5.203**	-5.145**
	(0.045)	(0.004)	(0.104)	(0.239)	(0.028)	(0.029)	(0.053)	(0.004)	(0.096)	(0.306)	(0.021)	(0.011)
Aid×Equality	4.733*	10.374***	4.387*	8.422	8.735**	8.436**	4.081*	10.263***	3.278	7.511	8.867**	8.719**
	(0.054)	(0.004)	(0.051)	(0.306)	(0.036)	(0.036)	(0.078)	(0.003)	(0.130)	(0.297)	(0.021)	(0.018)
Equality	-2.085	-8.509	0.710	13.723	4.459	6.541	-0.482	-9.000	3.122	15.317	6.665	7.648
	(0.707)	(0.424)	(0.900)	(0.297)	(0.730)	(0.708)	(0.934)	(0.388)	(0.609)	(0.188)	(0.597)	(0.664)
Income	-1.672***	-4.385***	-1.809***	-6.031***	-11.979***	-13.552	-1.377***	-4.228***	-1.354**	-6.069***	-11.850***	-12.563
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.200)	(0.008)	(0.000)	(0.022)	(0.000)	(0.000)	(0.230)
Aid×Institutions	-0.074	-0.095	-0.193*	-0.105	-0.134	-0.144						
	(0.482)	(0.472)	(0.053)	(0.695)	(0.379)	(0.387)						
Aid×Settlers							-0.001	-0.027*	0.005	-0.007	-0.010	-0.010
							(0.960)	(0.097)	(0.703)	(0.784)	(0.586)	(0.585)
Observations	267	267	207	207	207	207	267	267	207	207	207	207
Estimator	OLS	F-E	OLS	F-E	OLS	A-H	OLS	F-E	OLS	F-E	OLS	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	Yes	Yes	No	No	No	No	Yes	Yes
Sample	c	c	d	d	d	d	c	c	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The full set of coefficient estimates are reported in Table B.6, Table B.7, Table B.8 and Table B.9 in the Appendix. Standard errors are robust. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). Regressions also include a constant, time period dummies and the following control variables: Repayment, Repayment×Equality, Repayment×Openness (in the specifications with Aid×Openness), Repayment×Budget balance (in the specifications with Aid×Budget balance), Repayment×Institutions (in the specifications with Aid×Institutions), Settlers and Repayment×Settlers (in the specifications with Aid×Settlers), Policy, Institutions, Broad money, Budget balance, Revolutions, Life expectancy, Ethnic fractionalisation, Geography; dummies for countries in Sub-Saharan Africa, South-East Asia. For more details on the variables, see Table B.1 in the Appendix. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

3.8.2 Split Sample by Equality

Next we test the relationship between aid effectiveness and equality running regressions using subsamples with different average levels of equality. This is done by carrying out the following procedure:

(i) order the 267 observations on country-time periods in the baseline sample in ascending order by the variable $Equality_{ct}$ – the level of equality characterising the country-time period ct;

(ii) calculate the lower quartile, median and upper quartile values for the equality distribution of the sample; denote them $Equality^{lower}$, $Equality^{median}$, $Equality^{upper}$;

(iii) create five subsamples from the original sample by dropping observations on country-time periods, such that subsample 1 contains country-time periods for which $Equality_{tc} > Equality^{median}$, subsample 2 – $Equality_{tc} > Equality^{lower}$, subsample 3 – is the entire sample, subsample 4 – $Equality_{tc} \leq Equality^{lower}$ and subsample 5 – $Equality_{tc} \leq Equality^{median}$.

Table 3.5: Aid on Growth: Samples with Different Mean Equality Levels

PANEL A

Subsample	1	2	3	4	5	1	2	3	4	5
Aid	0.167	0.129	-0.344**	-0.509***	-0.855***	0.269	-0.0640	-0.324	-0.676**	-1.875***
	(0.634)	(0.474)	(0.025)	(0.002)	(0.000)	(0.278)	(0.818)	(0.138)	(0.015)	(0.002)
Observations	65	131	267	136	66	65	131	267	136	66
Average Equality	0.59	0.57	0.53	0.51	0.49	0.59	0.57	0.53	0.51	0.49
Estimator	OLS	OLS	OLS	OLS	OLS	F-E	F-E	F-E	F-E	F-E
Include controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First difference?	No	No	No	No	No	No	No	No	No	No

PANEL B

Subsample	1	2	3	4	5	1	2	3	4	5
Aid	0.268	0.189	-0.520**	-0.898***	-1.334***	1.157	0.561	-0.622	-1.255*	-1.747**
	(0.637)	(0.492)	(0.046)	(0.006)	(0.005)	(0.269)	(0.294)	(0.157)	(0.056)	(0.013)
Observations	45	97	207	110	54	45	97	207	110	54
Average Equality	0.59	0.57	0.53	0.51	0.49	0.59	0.57	0.53	0.51	0.49
Estimator	OLS	OLS	OLS	OLS	OLS	A-H	A-H	A-H	A-H	A-H
Include controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First difference?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The full set of coefficient estimates are reported in Table B.10 and Table B.11 in the Appendix. Regressions are run using 5 subsamples, constructed by dropping observations on country-time periods such that the average equality rises from subsample 1 to subsample 5; subsample 1 includes the country-time periods in the top 50% of the equality distribution, subsample 2 – in the top 75% of the equality distribution, subsample 4 – in the bottom 75% of the equality distribution and subsample 5 – in the bottom 50% of the equality distribution; subsample 3 includes the entire sample of country-time periods. Standard errors are robust. Measure of aid is early impact ODA, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). Regressions also include a constant, time period dummies and the following control variables: Repayment, Equality, Income, Policy, Institutions, Broad money, Budget balance, Revolutions, Life expectancy, Ethnic fractionalisation, Geography; dummies for countries in Sub-Saharan Africa, South-East Asia. For more details on the variables, see Table B.1 in the Appendix.

The above procedure creates five subsamples, characterised by rising average level of inequality as one moves from subsample 1 to subsample 5, i.e. if $mean(Equality_i)$ is the mean equality level in subsample i, it should hold that $mean(Equality_1) > mean(Equality_2) > mean(Equality_3) > mean(Equality_4) > mean(Equality_5)$.

Notice that the subsample 1 includes the country-time period observations in the top half of the equality distribution, subsample 2 – the top 75% of the equality distribution, subsample 4 – the bottom 75% of the equality distribution and subsample 5 – the bottom 50% of the equality distribution. Subsample 3 includes the entire sample.

Table 3.5 presents the estimation results using the five different subsamples using the different estimators: OLS, fixed effects estimator on data in levels and OLS and Anderson-Hsiao estimators using data in first-differences.[14] The estimated coefficients on aid are positive among the country-time periods with high average equality, but becomes negative as the average equality in the estimation dataset drops. In addition, many of the the negative coefficients are significant at 5% level.

3.8.3 Dynamic GMM Estimation

Table 3.6 reports estimation results using the dynamic GMM system estimator by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998).[15] The results are for the specification with a linear aid term and also the specification which takes into account the quadratic aid term.

We restrict the estimation to using lags starting from lag 3, as the AR(2) results suggests that second order serial correlation may be a problem, so instruments based on the second lag may not be valid. Table 3.6 reports the results when using different sets of lags to further guard against the problem of invalid instruments, which may happen if there is serial correlation.

To avoid the problem of instrument proliferation discussed by Roodman (2009), we instrument only the initial income variable and assume that all the other variables are exogenous. To further reduce the instrument count, we follow the suggestion by Roodman (2009) and use a collapsed instrument matrix. The instrument count in all of the estimation cases is below the number of groups. The P-values for the Hansen statistic are not suggesting that the instruments are invalid.

The estimated coefficients of aid and aid-equality interaction enter with the same signs as before and are of a similar magnitude to the coefficients estimated using the Anderson-Hsiao estimator

[14] As the 'aid-squared' term is mostly insignificant when estimating the baseline specification using early impact ODA, we do not include a specification with aid-squared in Table 3.5.

[15] Additional dynamic GMM estimation results in Table B.21 in the Appendix.

in Table 3.3. Furthermore, the estimated coefficients of aid and aid-equality interaction are significant at 5% level in most of the cases. This provides further support for the hypothesis that the level of equality can be a condition for aid effectiveness.

Table 3.6: Aid and Growth: Dynamic GMM Estimation

	I		II		III		IV	
	a	b	a	b	a	b	a	b
Aid	-5.329***	-3.549	-5.436***	-3.671*	-5.805***	-3.826*	-5.893**	-4.746*
	(0.007)	(0.111)	(0.004)	(0.086)	(0.002)	(0.069)	(0.021)	(0.073)
Aid^2		-0.0651		-0.0654*		-0.0705*		-0.0630
		(0.106)		(0.096)		(0.069)		(0.117)
Aid×Equality	9.987**	7.513*	10.21***	7.768**	11.04***	8.187**	11.06**	9.875*
	(0.011)	(0.060)	(0.007)	(0.041)	(0.004)	(0.026)	(0.040)	(0.067)
No. of IVs	29	31	30	32	28	30	28	30
Observations	233	233	233	233	233	233	233	233
Groups	51	51	51	51	51	51	51	51
Hansen test	1.618	2.047	1.620	2.107	0.469	1.040	0.003	0.002
P-value (Hansen)	0.445	0.359	0.655	0.551	0.493	0.308	0.960	0.969
AR(2) (ser. cor.)	0.035	0.036	0.033	0.034	0.038	0.035	0.046	0.049
AR(3)	0.145	0.120	0.147	0.121	0.162	0.125	0.162	0.160
AR(4)	0.533	0.448	0.555	0.475	0.578	0.456	0.570	0.563
Estimator	system	system	system	system	system	system	system	system
Instr. growth?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instr. other vars?	No	No	No	No	No	No	No	No
Lags as IVs	3-4	3-4	3-5	3-5	3	3	4	4

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: The full set of coefficient estimates are reported in Table B.12 in the Appendix. Dependent variable is annual % change in real economic growth (5-year average). Standard errors are robust. Measure of aid is early impact ODA, as defined in Section 3.6.1. Regressions also include a constant, time period dummies and the following control variables: Repayment, $Repayment^2$ (in the specifications with Aid^2), Equality, Repayment×Equality, Policy, Institutions, Broad money, Budget balance, Revolutions, Life expectancy, Ethnic fractionalisation, Geography; dummies for countries in Sub-Saharan Africa, South-East Asia, Polity 2, Agriculture: value added, Industry: value added. For more details on the variables, see Table B.1 in the Appendix. 'Yes' to 'Instr. income?' means that the income is instrumented using its own lags and lagged differences; 'Yes' to 'Instr. other vars?' means that all the other independent variables besides income are instrumented using their own lags and lagged differences. All the results are based on a collapsed instrument matrix.

3.9 Conclusion

Following the hypothesis proposed in Chapter 2, this chapter investigates the effect of foreign aid on growth conditional on the level of equality in the recipient country. We analyse a sample of 59 aid recipient countries during the period 1971-2005. To disentangle that part of foreign aid which is expected to have an effect on growth within the 5-year periods characterising our dataset, we use an aid measure that takes into account only that proportion of aid which is given by DAC donors and expected to have a short term impact.

We find that the economic equality in the recipient country positively influences aid effectiveness. It is estimated that an increase in the aid-GDP ratio by one standard deviation is associated with an increase in the percentage growth rate by 1.25 percentage points among the most equal recipient countries and a detraction by 2.42 percentage points among the least equal recipient countries. In particular, the negative effect of aid among the relatively unequal countries is highly significant and robust, even after removing the country-specific heterogeneity and addressing the dynamic panel bias.

These results also remain robust after controlling for the interaction terms with other variables previously shown to have a conditional effect on aid effectiveness, more specifically, good institutions and policy environment and a high proportion of European settlers in colonial times.

The author is not aware of empirical literature suggesting that inequality can be a condition for aid effectiveness, so this finding is novel and contributes well to the established literature investigating the conditions crucial for aid effectiveness.

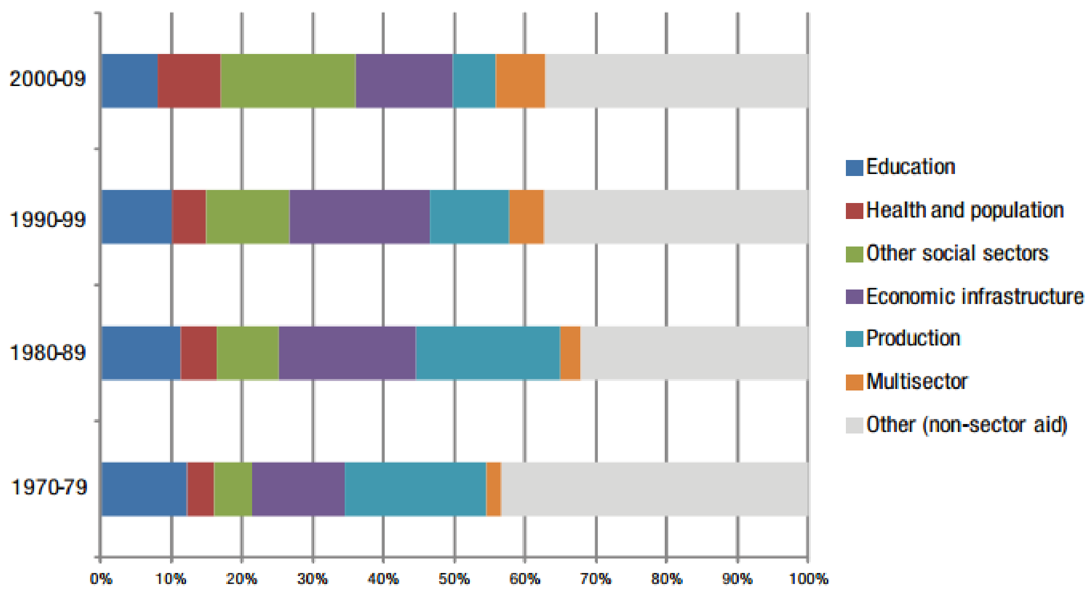
4 Allocation of Foreign Aid: Is Investment in Social Projects Better for Welfare?

4.1 Introduction

Recently literature has criticized the tendency of foreign aid research to ignore the heterogeneity of aid (Clemens et al., 2012; Mavrotas and Nunnenkamp, 2007; Thiele et al., 2007). Different types of aid are expected to have different effects, so it makes sense not to generalize them as being identical. For example, humanitarian aid to help civilians during a conflict is given with a completely different aim than aid invested in building roads. It is expected that the implications of these two types of aid will also differ.

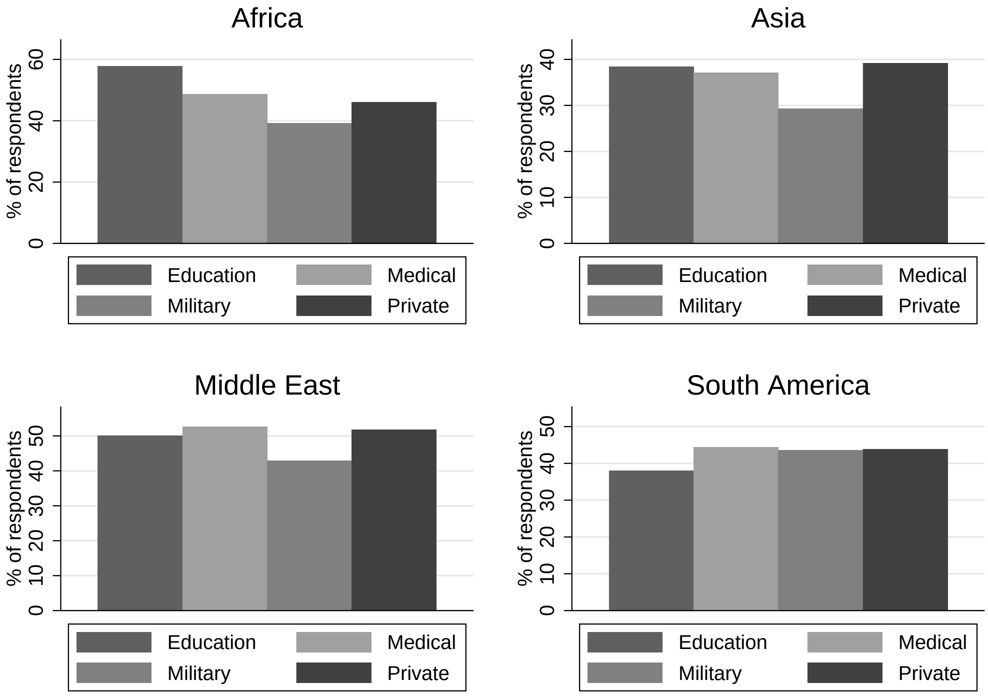
Figure 4.1 depicts aid flows into different sectors over time. The composition of aid flows has changed substantially over the recent decades. In particular, there has been a shift towards the so-called social sector aid. In contrast, less aid is invested in production and economic infrastructure projects. For example, in the first decade of the millennium the proportion of the sector specific aid invested in health and population projects was around three times larger than in the 1970s. Similarly, in the last decade there has been a massive increase in the amount of aid aimed at strengthening governance and institutions, especially in fragile states and post-conflict situations.

Figure 4.1: Trends in Sector-Specific Aid



Source: Measuring aid: 50 years of DAC statistics (OECD, April 2011)

Figure 4.2: Perceptions of Corruption, by Institution



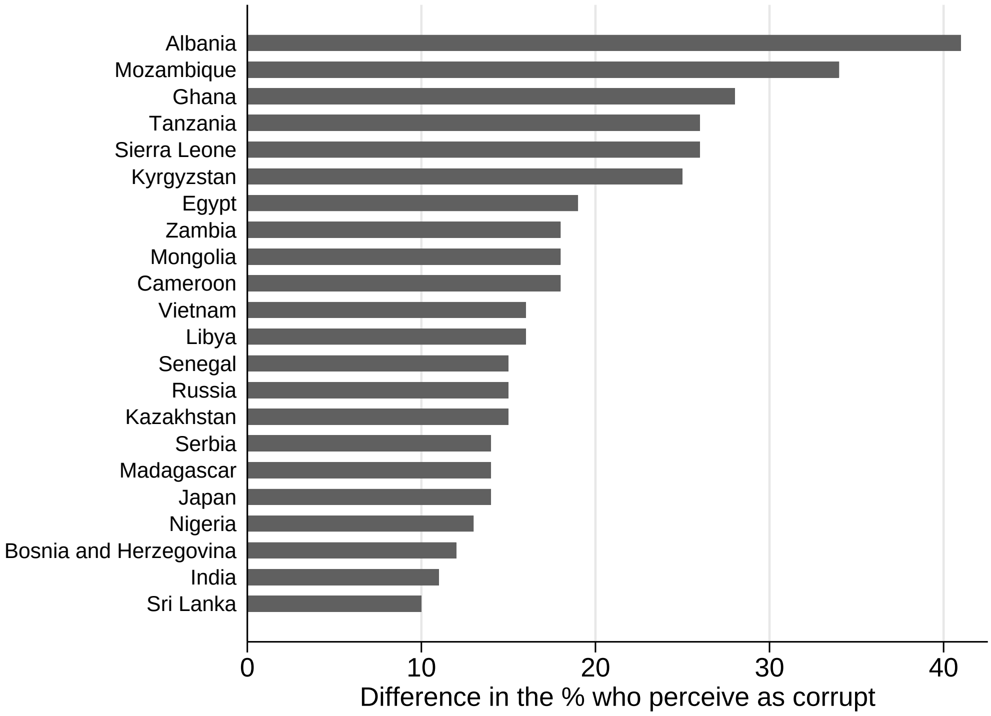
Note: Data from the section on Perceptions of corruption, by institution. The bar represents the (region-average) % of respondents who think the corresponding sector is corrupt or extremely corrupt.
Source: Global Corruption Barometer (Transparency International, 2013)

An interesting question to ask is whether the surge in social sector aid has been justified and efficient. On one hand the increase in social project aid is well motivated by the literature presenting evidence that foreign aid has had a positive effect on social outcomes such as health, education and fertility (Addison et al., 2005; Birchler and Michaelowa, 2016; Fielding et al., 2007; Michaelowa, 2004). This evidence is more unanimous and robust than the contradictory results yielded by studies investigating the effects of aid on economic outcomes, such as productivity and growth.

If these findings are true, it would have made sense for aid donors to shift aid away from economic infrastructure projects and production and towards social projects. These latter projects besides boosting productivity are expected to also directly increase the welfare of the households in the aid recipient country, for example, by improving health care, increasing education opportunities as well as strengthening governance and institutions.

On the other hand, there is evidence that social sectors across the developing word can suffer from corruption. Figure 4.2 shows that the sectors of education and health are perceived as substantially corrupt all over the world. Particularly, in Africa they are perceived as even more

Figure 4.3: Countries with Large Difference in Perceptions of Corruption Between the Education and Private Sectors



Note: Data from the section on Perceptions of corruption, by institution. The bar represents the difference in the % of respondents who think the education system is corrupt or extremely corrupt and the % of respondents who think the business/private sector is corrupt or extremely corrupt. *Source: Global Corruption Barometer (Transparency International, 2013)*)

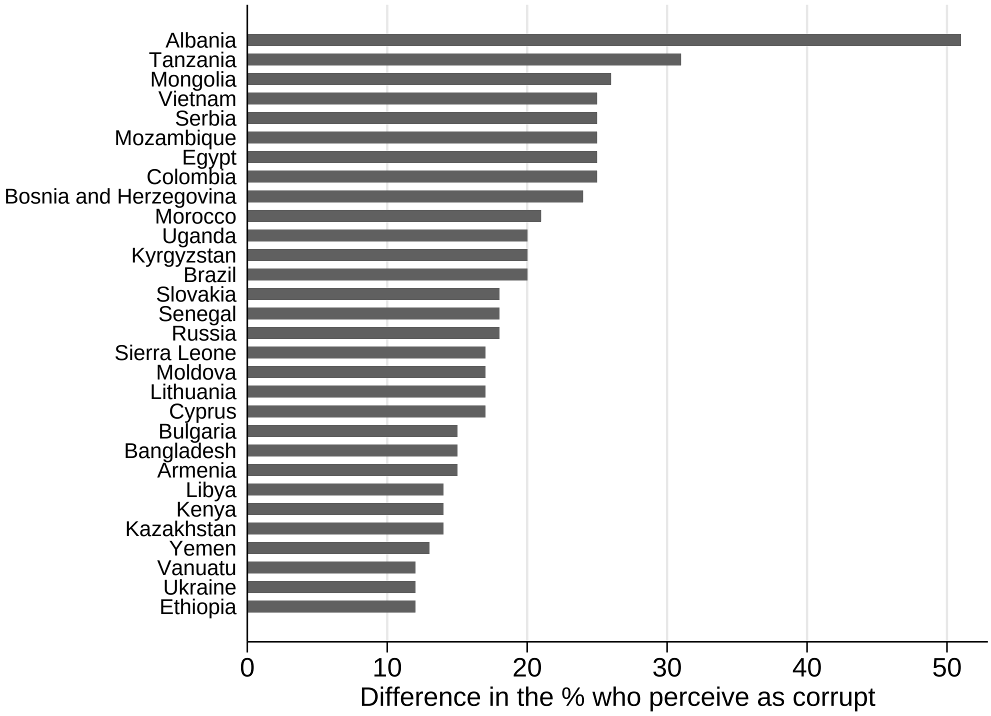
corrupt than the private sector.

Figure 4.3 and Figure 4.4 lists some of the countries where the education and medical sectors are perceived as much more corrupt than the private sector, representing the difference in the perception of corruption between the corresponding social and private sectors. In some countries this difference is substantial, for example, in Albania there is a 40 percentage point difference between the proportion of people perceiving the education sector as corrupt or extremely corrupt and proportion of people perceiving the private sector as corrupt or extremely corrupt.

This highlights that aid wastage because of corrupt social sectors is a potential concern, when investing in the social sectors in the developing world. The question is whether the aid wastage in the social sector can reach such a level that despite its potential to improve social outcomes by directly contributing to the welfare of the households, it is more efficient to invest in the economic infrastructure and production rather than the social projects.

To answer this question, we build a growth model that integrates the economies of the foreign

Figure 4.4: Countries with Large Difference in Perceptions of Corruption Between the Medical and Private Sectors



Note: Data from the section on Perceptions of corruption, by institution. The bar represents the absolute percentage point difference in the proportion of respondents who think the medical sector is corrupt or extremely corrupt and the proportion of respondents who think the business/private sector is corrupt or extremely corrupt. *Source: Global Corruption Barometer (Transparency International, 2013)*

aid donor (the North) and recipient (the South), where a Northern planner maximises the weighted global welfare of the households in the North and South. We assume that there is a choice between two types of aid: aid that increases the productivity (and, thus, output) in the recipient economy and aid that besides increasing productivity also has a direct impact on the utility of the households in the recipient country. The former projects are consistent with economic infrastructure projects and production (further in text, economic projects), but the latter is consistent with social projects, such as education, health care and institutions, governance. The two projects are also allowed to differ in terms of their productivity and levels of aid wastage.

It is found that, assuming productivity and aid wastage are equal across the two sectors, the welfare maximising aid share invested in the social project is higher than the share invested in the economic project. In contrast, the output maximising shares of the two types of aid are equal. However, when the social sector has a relatively higher level of aid wastage than the economic sector, for example, as a result of corruption in the social sector, then these results no longer hold, and, in fact, economic infrastructure aid can be more beneficial to welfare than social infrastructure aid. So the advantage of social aid when compared to economic aid is dependent on the relative aid wastage in the two sectors.

Furthermore, we show that the welfare-maximising share invested in social projects is higher than the output-maximising share. This reflects the additional direct effect that social aid has on welfare (supplementary to the indirect effect that occurs via increasing output). We also show that the difference between the welfare-maximising and output-maximising shares invested in social projects is decreasing in social aid wastage, when aid wastage in the social sector is already high. This means that this 'social dividend' or the additional benefit of social aid as a result of the direct welfare effect is undermined by aid wastage in the social sector when the aid wastage in this sector is already high.

The problem of maximising welfare vs. maximising growth/output has been investigated before, and the optimal amount of investment that maximises welfare need not be always maximising growth/output, and vice versa. For example, Barro (1990) using an endogenous growth model with investment in public goods shows that the growth maximizing tax rate is the same as the welfare maximizing tax rate, however, later work shows that maximizing growth is not always equal to maximizing welfare when it comes to choosing tax rate, or investment in various types of public goods. The same principle can hold for choosing between the different forms of foreign aid, as a particular type of foreign aid can have more benefits in terms of increasing welfare but not necessarily growth.

The framework is similar to the model by Carter et al. (2015), who study dynamic aid allocation over time subject to an exogenous constraint of aid absorption, i.e. a function determining how much of aid is not wasted and actually ends up in the economy. One difference of the framework studied here is that instead of an exogenous aid absorption function, we model aid that enters as investment in public goods. Another difference is that in this model the economy of the aid donor grows endogenously, and thus makes the recipient country grow, as a result of the aid transfers invested in increasing productivity.

The rest of the chapter is structured as follows. Section 4.2 briefly reviews relevant literature. Section 4.3 introduces the model, establishes conditions for the equilibrium and balanced growth path. Section 4.4 carries out welfare analysis in terms of the investments of the two types of project aid. Section 4.5 concludes.

4.2 Literature Review

Criticism directed at foreign aid research that ignores the heteregeneity of foreign aid is not new (see Singer (1965); Cassen et al. (1994)), but recently there has been a particular stress on the importance of distinguishing between the different types of aid (Clemens et al., 2012; Mavrotas and Nunnenkamp, 2007; Thiele et al., 2007). This call for a change comes after years of empirical literature ignoring the heterogeneity of aid, and instead analysing aggregate figures with inconclusive results. As pointed out by Mavrotas and Nunnenkamp (2007), if the different types of aid have different effects, it is no wonder that empirical research using aggregated aid figures has been unable to reach an unanimous conclusion about whether foreign aid works.

Theoretical research has previously attempted to investigate the heterogeneity of aid, for example, contrasting tied aid vs. untied aid (Kemp and Kojima, 1985; Schweinberger, 1990) or budget support and project aid (Cordella and Dell'Ariccia, 2007). However, little is known about the effects of aid flowing into the different sectors of the recipient economy, for example, the economic sectors and social sectors.

Social sector aid differs from economic sector aid in that it not only raises the productivity but also directly improves the welfare of the households, for example, by improving education opportunities, health care, strengtheting governance and increasing safety. Contrary to there being no consensus about whether aid has improved growth, the evidence supporting that aid has been beneficial for social outcomes is more robust. For example, Fielding et al. (2007) find that aid positively influences various human development indicators including measures of health, education and fertility. Similar conclusions are reached by Addison et al. (2005). Other examples are Birchler and Michaelowa (2016); Michaelowa (2004) who find a positive impact of aid on education enrolment.

Accounting for the direct effect of social aid on welfare is in some way similar to accounting for the additional welfare from military investments in Shieh et al. (2002), where the additional welfare obtained directly from peace as a result of military investments is represented by a wedge term in the utility function.

Aid investments in projects that raise productivity can be modeled as part of growth framework similar to the model of investment in public goods by Barro (1990). Indeed, project aid can be viewed as a public good, but the investments are made by a foreign aid donor instead of a local government.

4.3 The Model

4.3.1 The Economies of South and North

It is assumed that there are two economies, the South and the North, where the South is the foreign aid recipient country and the North is the aid donor country. In both countries there is a continuum of infinitely lived, identical households. There is no population growth, so labour endowment can be normalised to unity. The households in the South are maximising their inter-temporal welfare by choosing their consumption and investment in capital over time. The planner in the North, however, is choosing not only the consumption and investment of the northern households, but also how much aid transfers to allocate to the South.

Contrary to many papers that analyse aid in the form of budget support, this analysis focuses on project aid, taking into account two different ways how it can contribute to the aid recipient. The first type of aid (denoted by a_1 or referred to as economic aid) solely enters as an input in the production technology. This kind of aid is consistent with economic infrastructure project aid (e.g. aid invested in the sectors of transport, storage, communications and energy), as it has a positive impact on private production, but does not contribute to welfare via any other mechanism. The second type of aid (denoted by a_2 or referred to as social aid) besides positively impacting private production provides an extra welfare benefit to the households, which is reflected by an extra term in the utility function of the South that represents the feature that households derive an additional utility from social aid besides via increased output. Social aid represents aid invested in social infrastructure sectors, such as health, education, water supply and sanitation, as well as projects to strengthen government and civil society. In all these latter cases aid contributes to increased productivity of households, but also increases utility by means other than that. Having a high quality health-care system, good governance or strong national defence increases the welfare of households directly, not only in terms of higher productivity. Later in the text, this additional utility from social aid that occurs via the wedge term in utility function will be referred to as the direct welfare effect of social aid.

Output in the South is assumed to be produced using a constant returns to scale technology that uses the southern private capital stock k_{St} and the two types of project aid a_1 and a_2 as inputs. The production function is assumed to take a Cobb-Douglas form:

$$f_S(k_{St}, a_{1t}, a_{2t}) = A\, k_{St}^{1-\alpha_1-\alpha_2} \left(a_{1t}^{\beta_1}\right)^{\alpha_1} \left(a_{2t}^{\beta_2}\right)^{\alpha_2} = A\, k_{St} \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} \tag{33}$$

where $\alpha_i \in (0,1)$ for $i = 1,2$ and A is a constant technology parameter. The above implies that both types of project aids are non-rival and non-excludable, and positively contribute to the productivity of the South.

The parameter $\beta_i \in (0,1]$ for $i = 1,2$ reflects the feature that aid can be wasted in the sector i. The special case of $\beta_i = 1$ represents no aid wastage in sector i. The specification when $\beta_1 \neq \beta_2$ assumes that aid wastage can differ across the economic infrastructure and social infrastructure sectors.

The southern households' instantaneous preferences are represented by:

$$u_S(c_{St}, a_t) = \ln(c_{St}) + \eta\, \ln(a_{2t}^{\beta_2}) \tag{34}$$

where c_{St} is per capita consumption of the South at time t, a_{2t} is the social project aid at time t and η represents the direct impact of social aid on the preferences of the South. The additional term reflects the above discussed feature that social aid also contributes to welfare of the households directly besides just increasing output.

The above model is consistent with the following inter-temporal budget constraint for the households of the South, where the over-dot represents first derivative of the variable with respect to time:

$$\dot{k}_{St} = A\, k_{St} \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} - c_{St} - \delta\, k_{St} \tag{35}$$

(35) states that the rate of change in capital with respect to time equals the output produced in the South minus consumption and capital that has depreciated at the rate δ (all in the South at the relevant time period).

The North differs from the South in two crucial ways. Firstly, the economy produces a single consumption good using a linear constant returns to scale technology:

$$f_N(k_{Nt}) = B\, k_{Nt} \tag{36}$$

This is consistent with capital being defined in a broader sense, for example, including human capital, knowledge, public infrastructure. This kind of specification will induce endogenous growth in the economy of the North, which will also make the economy of South grow via the aid transfers.

The other difference is that the Northern planner not only cares about the welfare of its own country (the North), but also about the welfare of the South, so it incorporates this in its instantaneous utility function represented by:

$$u_N(c_{Nt}, c_{St}, a_t) = \ln(c_{Nt}) + \omega L_S \left\{ \ln(c_{St}) + \eta \ln(a_{2t}^{\beta_2}) \right\} \tag{37}$$

where the term $\omega\, L_S$ represents the impact of the welfare of the South on the utility of the North. This impact consists of two parts: L_S represents the relative population of the South, assuming that a larger Southern population indicates a higher weight for the welfare of South; ω represents how important the welfare of the South is for the North, as a result of other considerations, which here are not specified in more detail. This specification of a weighted utility of the households in the North and South is consistent with Carter et al. (2015).

The inter-temporal budget constraint of the North constrains that the rate of change in the northern capital should be equal to the output produced by the North, minus the capital depreciated at the rate δ, the amount consumed by northern households and the total aid investment in the South (all at the relevant time period). It can be represented by:

$$\dot{k}_{Nt} = B\, k_{Nt} - c_{Nt} - a_t - \delta\, k_{Nt} \tag{38}$$

where $a_t = a_{1t} + a_{2t}$, is the total investment in both types of project aid, economic project aid and social project aid.

4.3.2 Equilibrium

Assuming the time discount rate is represented by ρ, households in the South choose their consumption and investment over time to solve:

$$max_{\{c_{St}\}} \int_0^\infty \left\{ \ln(c_{St}) + \eta\, \ln(a_{2t}^{\beta_2}) \right\}\, e^{-\rho t}\, dt \tag{39}$$

subject to the budget constraint (35) and for a given initial value of southern capital k_{S0}.

See Section C.1.1 in the Appendix for the optimal conditions necessary for the optimisation problem of the South and how using these conditions it is possible to derive the optimal change in the southern consumption as represented by the following Euler equation:

$$\frac{\dot{c}_{St}}{c_{St}} = (1-\alpha_1-\alpha_2)\, A \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} - \rho - \delta \tag{40}$$

Furthermore, if a_t is the total amount of aid invested by the North and if θ_1 represents the share of aid invested in economic projects, and consequently $\theta_2 = 1-\theta_1$ represents the share of aid invested in social projects, then can express:

$$a_{1t} = a_t\, \theta_1 \tag{41}$$

$$a_{2t} = a_t\, \theta_2 \tag{42}$$

Consequently, assuming that the northern planner anticipates that the South chooses its consumption over time as governed by (40) it will choose the total amount of aid investment and northern consumption to solve the following:

$$max_{\{c_{Nt},a_t\}} \int_0^{\infty} \Big(\ln(c_{Nt}) + \omega L_S \left\{\ln(c_{St}) + \eta \ln(\theta_2^{\beta_2}\, a_t^{\beta_2})\right\}\Big)\, e^{-\rho t}\, dt \tag{43}$$

subject to the budget constraint of the North (38), the budget constraint of the South (35), the Euler equation of the South (40) and for given initial values of capital in the South and North k_{S0}, k_{N0}.

The Euler equation of the South enters as a constraint, as the Northern planner anticipates the agents in the South to choose their consumption path in an optimal way.

To solve the above problem define the current value Hamiltonian of the North H_N as:

$$\begin{aligned} H_N \equiv & \Big(ln(c_{Nt}) + \omega L_S \left\{ln(c_{St}) + \eta\, ln(\theta_2^{\beta_2}\; a_t^{\beta_2})\right\}\Big) + x_{Nt}\cdot(B\, k_{Nt} - c_{Nt} - a_t - \delta\, k_{Nt}) + \\ & + x_{St}\left\{A\, k_{St}\theta_1^{\beta_1\alpha_1}\; \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} - c_{St} - \delta\, k_{St}\right\} + \\ & + z_{St}\cdot c_{St}\left\{(1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\; \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} - \rho - \delta\right\} \end{aligned} \tag{44}$$

where x_{Nt} is the costate variable for capital of North, x_{St} – the costate variable for capital of South and z_{St} – the costate variable for consumption of South.

Following the maximum principle (Pontryagin et al., 1962) the necessary conditions for the optimal choice of the Northern planner can be shown to satisfy the following (see more in Section C.1.2 of the Appendix):

$$\frac{1}{c_{Nt}} = x_{Nt} \tag{45}$$

$$\begin{aligned} &\frac{\beta_2\, \omega\, L_S\, \eta}{a_t} + x_{St}\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, (\beta_1\, \alpha_1 + \beta_2\, \alpha_2) \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} \left(\frac{k_{St}}{a_t}\right) + \\ &+ z_{St}\left\{ c_{St} \cdot (1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, (\beta_1\, \alpha_1 + \beta_2\, \alpha_2) \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} \frac{1}{a_t} \right\} = x_{Nt} \end{aligned} \tag{46}$$

$$x_{Nt}\, (-B + \delta + \rho) = \dot{x}_{Nt} \tag{47}$$

$$\begin{aligned} &x_{St} \left(-(1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} + \delta + \rho \right) + \\ &+ z_{St}\, c_{St}\, (\alpha_1+\alpha_2)(1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{1+\alpha_1+\alpha_2}} = \dot{x}_{St} \end{aligned} \tag{48}$$

$$-\frac{\omega\, L_S}{c_{St}} + x_{St} + z_{St}\{-(1-\alpha_1-\alpha_2)\,, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} + \delta + \rho\} = \dot{z}_{St} + \rho\, z_{St} \tag{49}$$

together with the budget constraints (38) and (35), and the following transversality conditions:

$$\lim_{t\to\infty} \left(x_{Nt}\, \mathrm{e}^{-\rho\, t} \cdot k_{Nt} \right) = 0 \tag{50}$$

$$\lim_{t\to\infty} \left(x_{St}\, \mathrm{e}^{-\rho\, t} \cdot k_{St} \right) = 0 \tag{51}$$

$$z_{S0} = 0 \tag{52}$$

where x_{Nt} is the shadow price for the capital of the North, x_{St}– the shadow price for the capital of the South and z_{St}– the shadow price for the consumption of the South, according to the Northern planner. (52) is the additional transversality condition, which arises because c_{S0} is free in (43)-(42).

As in Carter et al. (2015) there is a solution with $z_{St} = 0$ for all t. The intuition is that as the South and North value the consumption of the South in the same way, i.e. attach the same shadow price, the Euler equations for the consumption of the South that arise from solving the problem of the South and the problem of the North are identical. Thus, the Euler equation (40) as a constraint is not binding, as when $z_{St} = 0$ an identical Euler equation arises from combining the dynamic optimality conditions (48) and (49). (45)-(49) can be combined together with transversality condition (52), rearranged. In combination with the capital accumulation equations this will define the equilibrium of the model.

Definition 1. *(Equilibrium). Given the exogenous parameters* $(A, B, \alpha_1, \alpha_2, \rho, \delta, \omega, L_S, \eta, \theta_1, \beta_1, \beta_2)$ *and the initial values of capital in North and South* (k_{N0}, k_{S0}) *an equilibrium is a path of* (c_{St}, c_{Nt}, k_{St}, k_{Nt}, a_t)*, for* $t \geq 0$*, such that:*

$$\begin{cases} \dot{k}_{Nt} = Bk_{Nt} - c_{Nt} - a_t - \delta\, k_{Nt} \\ \dot{k}_{St} = A\, \theta_1^{\beta_1 \alpha_1}\, (1-\theta_1)^{\beta_2 \alpha_2}\, k_{St}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1 + \alpha_2}} - c_{St} - \delta\, k_{St} \\ \frac{\dot{c}_{Nt}}{c_{Nt}} = B - \rho - \delta \\ \frac{\dot{c}_{St}}{c_{St}} = (1 - \alpha_1 - \alpha_2)\, A\theta_1^{\beta_1 \alpha_1}\, (1-\theta_1)^{\beta_2 \alpha_2}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1 + \alpha_2}} - \rho - \delta \\ \frac{1}{c_{Nt}} = \frac{\beta_2\, \omega\, L_S\, \eta}{a_t} + \frac{\omega\, L_S}{c_{St}}\, A\theta_1^{\beta_1 \alpha_1}\, (1-\theta_1)^{\beta_2 \alpha_2}\, (\beta_1\, \alpha_1 + \beta_2\, \alpha_2) \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1 + \alpha_2}}\, \left(\frac{k_{St}}{a_t}\right) \end{cases} \tag{53}$$

and the transversality conditions (50) *and* (51) *hold.*

The last equation in this system implies that aid is allocated in such a way that the loss of marginal utility because of decreased northern consumption is compensated by a gain from increased southern welfare.

4.3.3 Balanced Growth Path

We will assume the case where the North is already on its balanced growth path (BGP), as it is plausible to assume that the economy of the donor is a developed economy that has already converged to its long term growth rate. Furthermore, as it will be shown later, in this model the North being on the BGP requires the condition that the South also is on the BGP. Therefore, both countries start from being on the BGP from the initial time period.

Below we define the conditions for the BGP of the South and North, and impose the assumptions that ensure that both countries are on the BGP starting from the initial time period.

Definition 2. *A BGP for the North is defined as a solution to the system* (53)*, such that for a suitable growth rate* $\gamma_N \in \times\Re_+$*,* $c_{Nt} = c_{N0}e^{\gamma_N t}$*;* $k_{Nt} = k_{N0}e^{\gamma_N t}$ *and* $a_t = a_0 e^{\gamma_N t}$ *for any* $t \geq 0$*.*

Assumption 6. The economy of the North is on the BGP at the initial time period $t = 0$, as characterized by Definition 2.

Definition 3. *A BGP for the South is defined as a solution to the system* (53)*, such that for a suitable growth rate* $\gamma_S \in \times\Re_+$*,* $c_{St} = c_{S0}e^{\gamma_S t}$ *and* $k_{St} = k_{S0}e^{\gamma_S t}$*.*

Assumption 7. The economy of the South is on the BGP at the initial time period $t = 0$, as characterized by Definition 3.

From (53) can see that the growth rate of the northern consumption $\frac{\dot{c}_{Nt}}{c_{Nt}}$ is a constant, so the time path of the Northern consumption can be characterised by:

$$c_{Nt} = c_{N0}e^{\gamma t} \tag{54}$$

for all $t \geq 0$ where

$$\gamma \equiv B - \delta - \rho \tag{55}$$

and c_{N0} is the consumption of the North at $t = 0$.

Thus, northern consumption grows at the constant rate γ from the initial time period, so there is not transitional dynamics for consumption of the North.

Notice that from this arises the requirement that in order for this growth rate to be positive, i.e., $\gamma > 0$, it must hold that $B > \delta + \rho$.

Assumption 8.

$$B > \delta + \rho \tag{56}$$

From Definition 2 it arises that if the North is on the BGP it should hold that the capital of the North grows at the same constant rate as the consumption, such that $\frac{\dot{k}_{Nt}}{k_{Nt}} = \frac{\dot{c}_{Nt}}{c_{Nt}}$. As above it was already established that $\frac{\dot{c}_{Nt}}{c_{Nt}} = \gamma$ for all $t \geq 0$, then the North being on the BGP from time zero is consistent with $\frac{\dot{k}_{Nt}}{k_{Nt}} = \gamma$ for all $t \geq 0$.

Furthermore, it can be shown that the above requirement of $\frac{\dot{k}_{Nt}}{k_{Nt}} = \gamma$ for all $t \geq 0$ implies that the North chooses its consumption and total aid investment so as to satisfy the following condition implied by Assumption 9 (see Section C.2.1 of the Appendix for details):

Assumption 9.

$$a_0 + c_{N0} = \rho\, k_{N0} \tag{57}$$

This means that on the BGP the Northern planner chooses the consumption of northern households and aid such that the sum of these two equal the capital of the North adjusted by the time discount rate.

Furthermore, it can be shown that when $\frac{\dot{k}_{Nt}}{k_{Nt}} = \gamma$ for all $t \geq 0$, the total aid investment will also grow at the constant rate γ for all $t \geq 0$, such that $\frac{\dot{a}_t}{a_t} = \gamma$ (see Section C.2.1 of the Appendix).

Moreover, in Section C.2.2 of the Appendix it is shown that if North is on the BGP for all $t \geq 0$, it implies that the ratio of the consumption and capital of the South is constant and satisfies the following at all time $t \geq 0$:

$$\frac{c_{St}}{k_{St}} = \frac{(\beta_1\alpha_1 + \beta_2\alpha_2)\,\gamma + (\delta + \rho)\,(\alpha_1 + \alpha_2)}{(1 - \alpha_1 - \alpha_2)} + \rho \tag{58}$$

Furthermore, when multiply the last equation in the system by a_t (53) and use the fact that when the North is on the BGP it holds that $\frac{a_t}{c_{Nt}} = \frac{a_0}{c_{N0}}$ it can be shown that the equation becomes:

$$\frac{a_0}{c_{N0}} = \beta_2\, \omega\, L_S\, \eta + \omega\, L_S\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, (\beta_1\, \alpha_1 + \beta_2\, \alpha_2) \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1 + \alpha_2}} \left(\frac{k_{St}}{c_{St}} \right) \tag{59}$$

From (58) can see that North being on the BGP implies that the ratio $\frac{c_{St}}{k_{St}}$ is constant for all $t \geq 0$. When this holds, equation (59) is consistent only with the situation where the ratio $\frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1 + \alpha_2}}$ is also constant for all $t \geq 0$. This implies that if the North is on the BGP for all $t \geq 0$ and thus (58) holds, it means that the South is also on the BGP for all $t \geq 0$, and the capital and consumption of the South grow at the constant rate γ_S where:

$$\gamma_S = \frac{(\beta_1\alpha_1 + \beta_2\alpha_2)}{\alpha_1 + \alpha_2}\gamma \tag{60}$$

This means that on the BGP the growth rate of the South equals the growth rate of the North adjusted by a term dependent on the productivity of the two types of aid and aid wastage in the two sectors.

The intuition behind why the North being on the BGP implies that the South is on the BGP is that the economies of the North and South are interlinked by the North investing aid in the South, which is reflected by the last equation in the system (53). This equation governs the optimal allocation of the aid and states that aid is allocated such that the marginal loss of the global welfare from less consumption in the North is offset by the marginal gain from more welfare in the South. The North being on the BGP implies that the foreign aid also grows at the constant growth rate of the North. The economy of the South grows because the North is investing aid in it, so the constant growth of the foreign aid will also put the South on the BGP.

Moreover, the South being on the BGP is consistent with the following relationship between the aid and capital of the South (see Section C.2.2 in the Appendix for details):

$$\frac{a_0^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{S0}^{\alpha_1+\alpha_2}} = \frac{\gamma\,(\alpha_1\,\beta_1+\alpha_2\,\beta_2)+(\delta+\rho)(\alpha_1+\alpha_2)}{(\alpha_1+\alpha_2)\,(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}} \tag{61}$$

(61) is an implication of the growth rate of the southern consumption being equal to the constant growth rate given by (60).

The above conclusions can be summarised by the following two propositions.

Proposition 5. *The solution to the system* (53) *is a BGP for the North with positive growth if and only if the following hold:*

i) Assumption 8

ii) the growth rate of the capital and consumption of the North, as well as aid is given by (55)

iii) given k_{N0}*, the initial consumption of the North* c_{N0} *and aid* a_0 *satisfies* (57)

Proposition 6. *If the solution to the system* (53) *is a BGP for the North, the following hold for the South:*

i) given (57)*, the capital and consumption follow* $c_{St} = c_{S0}e^{\gamma_S\,t}$ *and* $k_{St} = k_{S0}e^{\gamma_S\,t}$ *where* γ_S *satisfies* (60)

ii) given the initial capital of the South k_{S0}*, the initial aid* a_0 *satisfies* (61)

iii) given the initial capital of the South k_{S0}*, the initial consumption of the South* c_{S0} *satisfies* (58)

Furthermore, the assumption that the North is on the BGP, and the implication that the South also should be on the BGP requires a condition to hold between the initial values of the capitals of the South and North:

Assumption 10.

$$k_{S0} = \left(\frac{\eta\,\beta_2 + \frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}{\frac{1}{\omega\,L_S} + \eta\,\beta_2 + \frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}\,\rho\,k_{N0} \right)^{\mu} \left(\frac{(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{\gamma\,\mu+\delta+\rho} \right)^{\frac{1}{\alpha_1+\alpha_2}} \tag{62}$$

where $\mu \equiv \frac{\beta_1\,\alpha_1+\beta_2\,\alpha_2}{\alpha_1+\alpha_2}$.

Using (57), (58), (59) and (61) it is possible to rewrite the expressions for the initial values of aid, consumption levels of the South and North, and the capital of the South all as functions of the initial value of the capital of the North (and the other exogenously given parameters):

$$\begin{cases} a_0 = \frac{\eta\,\beta_2+\frac{(\alpha_1\beta_1+\alpha_2\beta_2)(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}{\frac{1}{\omega\,L_S}+\eta\,\beta_2+\frac{(\alpha_1\beta_1+\alpha_2\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}\,\rho\,k_{N0} \\ c_{N0} = \left\{ \frac{1}{1+\omega\,L_S\,\eta\,\beta_2+\frac{\omega\,L_S\,(\alpha_1\beta_1+\alpha_2\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}} \right\} \rho\,k_{N0} \\ k_{S0} = \left(\frac{\eta\,\beta_2+\frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}{\frac{1}{\omega\,L_S}+\eta\,\beta_2+\frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}\,\rho\,k_{N0} \right)^{\mu} \left(\frac{(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{\gamma\,\mu+\delta+\rho} \right)^{\frac{1}{\alpha_1+\alpha_2}} \\ c_{S0} = \left(\frac{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}{1-\alpha_1-\alpha_2} \right) \left(\frac{(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{\gamma\,\mu+\delta+\rho} \right)^{\frac{1}{\alpha_1+\alpha_2}} \left\{ \frac{\left(\eta\,\beta_2+\frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}\right)\rho}{\frac{1}{\omega\,L_S}+\eta\,\beta_2+\frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}} \right\}^{\mu} k_{N0}^{\mu} \end{cases} \tag{63}$$

See more details in Section C.3 of the Appendix.

4.4 Output and Welfare

In this section we analyse the optimal proportions of aid invested in the social projects and economic projects, if the objectives are to maximise i) the welfare of the South and ii) the output of the South.

It will be shown that even though both project aids have a similar impact on output of the South, the social project aid provides an additional contribution to welfare consistent with the fact that besides being an input in production it is assumed to directly augment the utility of the Southern households. These findings show that given both economic and social projects have the same return to production investment (i.e. $\alpha_1 = \alpha_2$), optimal investment in social projects should be higher than investment in economic projects if the aim is to maximise the welfare of the South. However, then we show that this additional welfare benefit is sensitive to aid wastage, and the higher this aid wastage is, the more similar are the effects of the social and economic project aid on promoting welfare.

Using the expressions governing aid and the consumption of the South over time when the North and South is on the BGP and that $\theta_2 = 1 - \theta_1$ it is possible to express the welfare of the South governed by $WF(c_{St}, a_t) = \int_0^\infty \left\{ \ln c_{St} + \eta \ln a_t^{\beta_2}\, \theta_2^{\beta_2} \right\} e^{-\rho t}\, dt$ as a function of θ_1 – the share of the aid allocated to economic infrastructure projects:

$$WF(\theta_1) = \frac{1}{\rho}\, (\ln c_{S0} + \eta\, \beta_2\, \ln a_0 + \eta\, \beta_2\, \ln(1-\theta_1)) + \frac{\gamma\,(\beta_2\, \eta + \mu)}{\rho^2} \tag{64}$$

Notice from (63) that a_0 is independent from θ_1, so can substitute in (64) the expression for the initial value of southern consumption as a function of aid $c_{S0} = \left(\frac{(\alpha_1+\alpha_2)\,(\mu+\delta+\rho)}{1-\alpha_1-\alpha_2} + \rho\right) \left(\frac{(1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, (1-\theta_1)^{\beta_2\alpha_2}}{\mu+\delta+\rho}\right)^{\frac{1}{\alpha_1+\alpha_2}} a_0^{\mu}$. This allows rewriting expression (64) in terms of a_0 and θ_1:

$$\begin{aligned} WF(\theta_1) = {} & \frac{1}{\rho} \ln\left(\frac{(\alpha_1+\alpha_2)\,(\mu+\rho+\delta)}{1-\alpha_1-\alpha_2} + \rho\right) + \frac{1}{(\alpha_1+\alpha_2)\,\rho} \ln\left(\frac{1-\alpha_1-\alpha_2}{\mu+\rho+\delta}\right) + \\ & + \frac{1}{(\alpha_1+\alpha_2)\,\rho} \ln\left(A\theta_1^{\beta_1\alpha_1}\,(1-\theta_1)^{\beta_2\alpha_2}\right) + \frac{\mu+\eta\,\beta_2}{\rho} \ln a_0 + \frac{\eta\,\beta_2}{\rho} \ln(1-\theta_1) + \frac{(\mu+\eta\,\beta_2)}{\rho^2}\gamma \end{aligned} \tag{65}$$

In order to see how the welfare changes as a response to θ_1 differentiate (65) with respect to θ_1:

$$\frac{\partial WF(\theta_1)}{\partial \theta_1} = \frac{1}{\alpha_1+\alpha_2} \left(\frac{\beta_1\,\alpha_1}{\theta_1} - \frac{\beta_2\,\alpha_2}{1-\theta_1}\right) - \frac{\eta\,\beta_2}{\rho\,(1-\theta_1)} \tag{66}$$

If set (66) equal to zero and express the share of aid invested in economic projects that maximised the welfare of the South:

$$\hat{\theta}_1 = \frac{\alpha_1\,\beta_1}{\alpha_1\,\beta_1 + \left(\alpha_2 + \frac{\eta}{\rho}\right)\,\beta_2} \tag{67}$$

The welfare maximising share of aid invested in social projects can be obtained as $\hat{\theta}_2 = 1 - \hat{\theta}_1$:

$$\hat{\theta}_2 = \frac{\left(\alpha_2 + \frac{\eta}{\rho}\right)\,\beta_2}{\alpha_1\,\beta_1 + \left(\alpha_2 + \frac{\eta}{\rho}\right)\,\beta_2} \tag{68}$$

Notice that as on the BGP it holds that $c_{N0} = \rho\, k_{N0} - a_0$, the consumption of the North does not depend on the shares allocated to each type of aid, θ_1, θ_2. Therefore $\{\hat{\theta}_1, \hat{\theta}_2\}$ will not only be the shares that maximise the welfare of the South, but also the shares that maximise the weighted global welfare.

See that if the aid wastage is identical across the economic and social sectors, i.e. $\beta \equiv \beta_1 = \beta_2$, then the welfare maximising shares do not depend on the aid wastage, i.e. $\hat{\theta}_1 = \frac{\alpha_1}{\alpha_1+\alpha_2+\frac{\eta}{\rho}}$ and $\hat{\theta}_2 = \frac{\alpha_2+\frac{\eta}{\rho}}{\alpha_1+\alpha_2+\frac{\eta}{\rho}}$. In this case is possible to see that $\hat{\theta}_2 > \hat{\theta}_1$ if and only if $\alpha_2 + \frac{\eta}{\rho} > \alpha_1$. Therefore in the special case when $\alpha_1 = \alpha_2$, or the returns from the economic and social projects in terms of increasing production are equal, it is beneficial to invest more in the social projects, as they provide an additional benefit to the welfare, the impact of which depends on the weight η discounted by the time discount rate.

However, when the aid wastage is not equal across the sectors, i.e. $\beta_1 \neq \beta_2$, the relative aid wastage in the social sector will influence how much of the aid it is optimal to invest in the social projects. In other words $\hat{\theta}_2 > \hat{\theta}_1$ if and only if $\left(\alpha_2 + \frac{\eta}{\rho}\right) \beta_2 > \alpha_1\beta_1$, and $\hat{\theta}_2 < \hat{\theta}_1$ if and only if $\left(\alpha_2 + \frac{\eta}{\rho}\right) \beta_2 < \alpha_1\beta_1$. Now, even in the case where both aids have same return on investment in production, i.e. $\alpha_1 = \alpha_2$, a high aid wastage in the social sector (i.e. a relatively low β_2) can make it optimal to invest more in the economic aid, as a high level of aid wastage in the social sector makes the direct welfare effect of the social aid to become relatively small.

When express the difference between the welfare maximising shares invested in the two types of aid and differentiate it with respect to β_2, can see that this expression is positive:

$$\frac{\partial\,(\hat{\theta}_2 - \hat{\theta}_1)}{\partial\,\beta_2} = \frac{2\,(\rho\,\alpha_2 + \eta)\,\alpha_1\,\beta_1\,\rho}{(\alpha_1\,\beta_1\,\rho + (\rho\,\alpha_2 + \eta)\,\beta_2)^2} > 0 \tag{69}$$

Thus, aid wastage in the social sector has a negative effect on the difference between the aid shares allocated to the social and economic sectors. More aid wastage in the social sector as a result of, for example, high corruption in that sector, makes the social aid less preferable in comparison to the economic aid.

It is also possible to see that despite there being differences in how both types of aid affect welfare, both types of aid have an the same impact on output of the South (conditional on the parameter values $\alpha_1, \alpha_2, \beta_1, \beta_2$), so in the case where the sector specific aid wastage and returns to investment in production are equal across the two sectors, the shares of each type of aid that maximise output will be identical. This arises, as the direct welfare effect of social aid does not affect output.

Is is possible to express the output produced in the South as represented by $Y(a_t, k_s) = A\theta_1^{\beta_1 \alpha_1} \theta_2^{\beta_2 \alpha_2} \frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}} k_{St}$ as a function of θ_1:

$$Y(\theta_1) = \left(\frac{1-\alpha_1-\alpha_2}{\gamma\,\mu+\delta+\rho}\right)^{\frac{1-\alpha_1-\alpha_2}{\alpha_1+\alpha_2}} \left(A\theta_1^{\beta_1\alpha_1}\,(1-\theta_1)^{\beta_2\alpha_2}\right)^{\frac{1}{\alpha_1+\alpha_2}} a_0^{\mu} \tag{70}$$

Then when differentiate (70) with respect to θ_1 and set equal to zero obtain:

$$\frac{\partial Y(\theta_1)}{\partial\theta_1} = A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}\left(\frac{\alpha_1\,\beta_1}{\theta_1} - \frac{\alpha_2\,\beta_2}{1-\theta_1}\right) = 0 \tag{71}$$

From this can express the optimal shares invested in economic aid and social aid that maximise the output of the South:

$$\tilde{\theta}_1 = \frac{\alpha_1\,\beta_1}{\alpha_1\,\beta_1+\alpha_2\,\beta_2} \tag{72}$$

$$\tilde{\theta}_2 = \frac{\alpha_2\,\beta_2}{\alpha_1\,\beta_1+\alpha_2\,\beta_2} \tag{73}$$

When aid wastage is equal in the economic and social sectors, the aid wastage parameter cancels out and the output maximising shares are $\tilde{\theta}_1 = \frac{\alpha_1}{\alpha_1+\alpha_2}$ and $\tilde{\theta}_2 = \frac{\alpha_2}{\alpha_1+\alpha_2}$. So in the special case when $\alpha_1 = \alpha_2$ the output maximising shares of both types of aid are identical.

When compare (68) and (73) can see that the welfare maximising share invested in social project aid $\hat{\theta}_2 = \frac{1}{\frac{\alpha_1}{\alpha_2+\frac{\eta}{\rho}}\frac{\beta_1}{\beta_2}+1}$ is higher than the output maximising share $\tilde{\theta}_2 = \frac{1}{\frac{\alpha_1}{\alpha_2}\frac{\beta_1}{\beta_2}+1}$, i.e. $\hat{\theta}_2 > \tilde{\theta}_2$, reflecting the feature that social project aid augments the welfare of the South directly besides just increasing productivity. Thus, the welfare maximising share of aid invested in economic projects is lower than the output maximising share, i.e. $\hat{\theta}_1 < \tilde{\theta}_1$. This is similar to the result in Shieh et al. (2002), who find that within the context of national investments in military there is a so-called ‘peace dividend’ that makes the welfare maximising share of military investment higher than the growth maximising share.

Similarly, can define the expression $\hat{\theta}_2 - \tilde{\theta}_2$ as the ‘social dividend’, i.e. the increment in the share of aid invested in social projects arising because of the direct welfare effect. If differentiate the ‘social dividend’ with respect to β_2 as in (74), can see that the sign of this expression depends on the relative values of β_2/β_1 and α_2/α_1, as well as η. In the special case when $\alpha_1 = \alpha_2$, for sufficiently small values of β_2/β_1 aid wastage has a negative effect on ‘social dividend’. However, for a sufficiently large values of β_2/β_1 (including when $\beta_2 = \beta_1$) aid wastage has a positive effect on ‘social dividend’. So when aid wastage in the social sector is already relatively high, aid wastage in social sector is associated with less welfare gains from social project aid.

$$\frac{\partial\left(\hat{\theta}_2-\tilde{\theta}_2\right)}{\partial \beta_2}=\frac{\left(\rho\,{\beta_1}^2{\alpha_1}^2-\rho\,{\beta_2}^2{\alpha_2}^2-{\beta_2}^2\,\alpha_2\,\eta\right)\eta\,\beta_1\,\alpha_1}{\left(\alpha_1\,\beta_1\,\rho+\left(\rho\,\alpha_2+\eta\right)\beta_2\right)^2\left(\alpha_1\,\beta_1+\beta_2\,\alpha_2\right)^2}>\leq 0 \tag{74}$$

When β_2 and α_2 and η are small relative to β_1 and α_1, then this will be positive. This means that higher aid wastage decreases the difference between the welfare and output maximising shares, as aid wastage has a relatively large negative effect on the direct welfare effect. However, when β_2 and α_2 and η are large relative to β_1 and α_1, this will have a negative sign, as more aid wastage will increase the gap between the output and welfare maximising shares.

Proposition 3: Given the solution to system (53) is a BGP for North:

i) the share of social project aid that maximises welfare is given by (68)

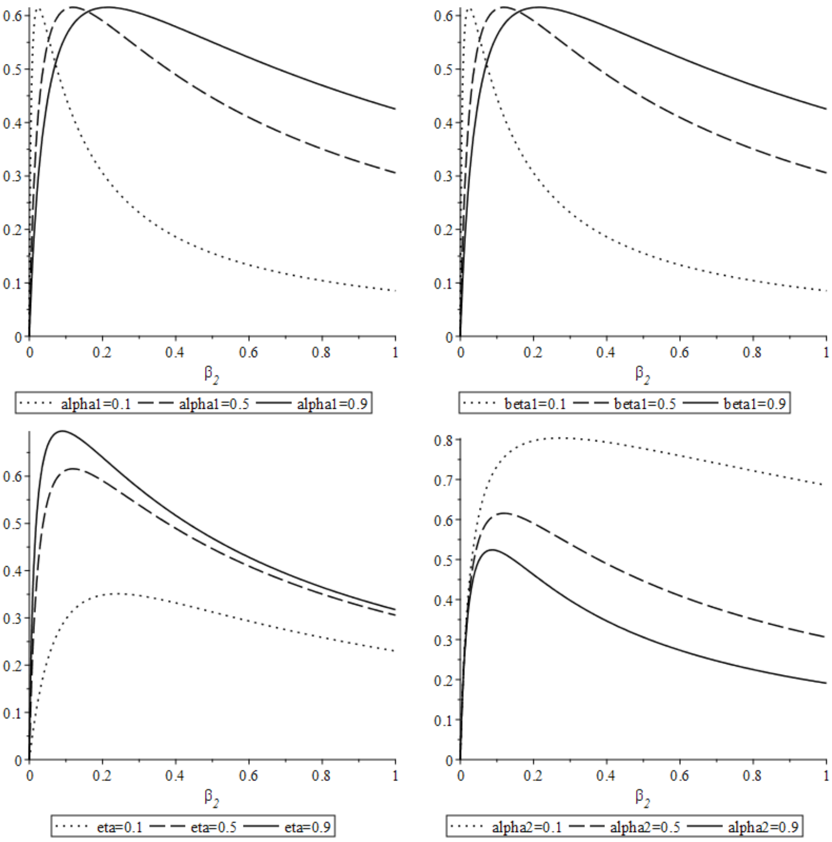
ii) the share of social project aid that maximises output is given by (73)

iii) the difference between the share of social aid and economic aid that maximises welfare is decreasing in the level of social aid wastage (i.e. increasing in parameter β_2 as governed by expression (69))

iv) the difference in the welfare-maximising and output-maximising shares of social aid is decreasing in the level of social aid wastage (increasing in β_2) for sufficiently high relative values of social aid wastage (low β_2/β_1), and increasing in the level of social aid wastage (decreasing in β_2) for sufficiently low relative values of social aid wastage (high β_2/β_1) as governed by expression (74).

Figure 4.5 represents graphically point (iv) of Proposition 3. The curves represents the 'social dividend' or $\hat{\theta}_2-\tilde{\theta}_2$, as the aid wastage in social sector decreases (parameter β_2 increases on the horizontal axis). Each of the four graphs also shows what happens when the parameters α_1, β_1, η or α_2 are shifted. Notice that as the aid wastage is already high (the very left hand side of each graph) increasing it further has a large negative effect on the 'social dividend'. This graphically demonstrates that the difference between the welfare and output maximizing shares invested in social aid is sensitive to social aid wastage when it is already relatively high.

Figure 4.5: The Impact of Social Aid Wastage on the 'Social Dividend'



Note: The vertical axis represents $\hat{\theta}_2 - \tilde{\theta}_2$.

4.5 Conclusion

We use a growth model integrating the economies of the foreign aid donor and recipient, where the foreign aid donor maximises the weighted global welfare: the utility of the households in the North and South. We assume that the donor has a choice between investing in two types of projects: a project that increases the productivity (and, thus, output) in the recipient economy and a project that besides increasing the productivity also has a direct impact on the utility of the recipient country's households. The latter investments are consistent with social aid, for example aid invested in improving education, healthcare or strengthening governance. The two projects are also allowed to differ in terms of their productivity and aid wastage.

It is found that, assuming productivity and aid wastage are equal across the two projects, the welfare-maximising share invested in social project is higher than the welfare-maximising share invested in economic project. In contrast, the output-maximising shares of the two types of aid are equal. However, when the social sector has a higher level of aid wastage than the economic sector, then the welfare-maximising share invested in economic aid can exceed the share invested in social aid. So the difference between the welfare maximising shares invested in the social and economic sector is decreasing in social aid in aid wastage.

Furthermore, the welfare-maximising share invested in social aid always exceeds the output-maximising share. The difference between the welfare and output-maximising shares invested in social aid is decreasing in the level of social aid wastage when this wastage is sufficiently high. In contrast, when this wastage is sufficiently low, then the difference between the welfare and output-maximising shares invested in social aid is increasing in social aid wastage.

These findings stress the implications of aid wastage in the recipient economy, when deciding between the investment in different types of projects. Social aid has an additional direct effect on welfare, which can make it more efficient in increasing welfare (vs. output), however this effect is sensitive to the relative aid wastage in the social sector. In particular, when aid wastage is already high, the welfare benefit of social aid is very small.

5 Conclusions

The theory and empirical evidence presented in this thesis contribute to a better understanding of the effects of foreign aid in the aid recipient countries.

A substantial focus of this work is on investigating the link between economic inequality and aid effectiveness. Chapter 2 develops a theoretical framework modelling the social groups in a typical foreign aid recipient country, and a foreign aid donor that decides on the amount of aid to allocate. The hypothesis proposed by the theory presented in Chapter 2 is used as a basis for the empirical tests presented in Chapter 3.

Central to the model presented in Chapter 2 is an ongoing contest between the relatively rich and rent-seeking elite, and the poor rest of the population (the masses) in the recipient country. A framework based on a contest allows modelling the misalignment between the interests of the two opposing social groups. It is plausible to assume that such conflict commonly arises in aid recipient countries, as many of these countries do not have sufficiently strong democratic institutions to allow an equal representation of the society's interests.

Model presented in Chapter 2 implies that the elite can extract the foreign aid in two ways: (i) before the funds reach the masses, as implied by the exogenously assumed elite's ability to extract; this ability to extract is consistent with the elite controlling the governmental institutions and agencies which participate in distributing aid; (ii) after the funds have reached the masses via competing in the contest.

The conclusion is that if the elite can extract a sufficiently high share of aid before it reaches the masses, it is not optimal for a foreign aid donor to give any aid at all, as money will disproportionately accrue to the elite, further increasing their contesting power and welfare, but decreasing the contesting power and welfare of the majority of population. However, if the elite's ability to extract aid before it reaches the masses is sufficiently constrained, then it is optimal for a donor to give a strictly positive amount of aid, and this amount is increasing in the level of economic equality between the elite and masses. This finding implies that aid should be more effective in raising the welfare of the masses in more equal recipient countries.

Chapter 3 analyses a panel dataset of 59 countries over the years 1971-2005, and finds that the level of economic equality in recipient country positively influences aid effectiveness. This effect is robust after controlling for other conditions previously established in the literature as crucial for aid effectiveness. This helps to rule out the possibility that the results are being driven by the correlation between equality and any of these other conditions. In particular, the effect is robust after controlling for the variables representing policy environment in the recipient country, which have been found to be a condition for aid effectiveness by the influential paper of Burnside and Dollar (2000).

The effect is also robust after controlling for the proportion of European colonial settlers – a proxy for the power of the elite. Angeles and Neanidis (2009) argue that European colonial settlement created powerful local elites in a set of aid recipient countries, which undermine aid effectiveness. The fact that the findings in Chapter 3 remain robust after controlling for the interaction between aid and European settlers, suggests that the findings of Angeles and Neanidis (2009) could be explained by higher economic inequality in the countries with more powerful elites.

While our results are based on using a disaggregated aid measure, a rich set of control variables, differencing data to remove any unobserved county heterogeneity as well as accounting for the dynamic panel bias, we do not address the potential endogeneity of aid. It is possible that a higher growth rate attracts more aid, or there could be unobserved variables in the model biasing our estimates. Future research should address these issues by implementing a strategy to identify the exogenous effect of aid on growth.

Another limitation stems from the fact that the Gini coefficients represent the inequality between all of the individuals in the recipient country, not the specific inequality between the elite and masses. An extension of this work could test the relationship between aid, welfare and inequality, using other proxies for welfare of the poor and measures of inequality.

Chapter 4 starts by noting that over the recent decades there has been a surge in the so called social aid (e.g. aid invested in education and health care sectors) relative to the economic aid (e.g. aid invested in infrastructure sectors). It uses a growth model integrating the economies of the aid donor and recipient to analyse the welfare implications and trade-offs when investing in the two types of aid.

Chapter 4 distinguishes the social aid from economic aid, by allowing the former to have an additional direct effect on individual welfare. In addition, the model allows the two types of aid to differ in terms of their productivity and wastage.

When productivity and aid wastage are equal across the two sectors, it is optimal to invest a higher share in the social project, as it has the additional direct effect on welfare. However, for sufficiently high aid wastage levels in the social sector it can happen that this advantage of social aid diminishes and it is welfare-improving to invest a higher share in the economic aid.

Secondly, Chapter 4 demonstrates that the advantage of social aid in terms of its ability to raise welfare is steeply decreasing in the level of aid wastage, when the aid wastage is already high. This implies that in countries where aid wastage in social sectors is high, investing in social aid may deliver little welfare benefit over investing in economic aid.

Chapter 4 has provided some stylized facts and illustrations that show that in several aid recipient countries the social sectors could indeed be plagued by high levels of aid wastage, relative to the economic sectors. A potential extension would be to supplement these stylized facts with econometric analysis. Notably, it is of interest to test whether: (i) outcomes of aid invested in social projects are affected by variables representing the aid wastage in these countries; (ii) donors allocate more social aid to countries with lower aid wastage in the social sectors.

Appendices

A Appendices to Chapter 2

A.1 Property M1 of the Best Response Curve of the Masses

A.1.1 First Order Conditions

Denote $p \equiv p(G_M, G_E)$, $p_g \equiv \frac{d\{p(G_M,G_E)\}}{dG_M}$ and $p_{gg} \equiv \frac{d\{p(G_M,G_E)\}}{dG_M^2}$. The first order conditions for the problem (1) -(4) can be derived by substituting (2) in (1), differentiating the expression with respect to G_M and C_M and setting equal to zero, to get:

$$p_g \cdot F - p = 0 \tag{75}$$

and

$$C_M = F \tag{76}$$

As $\frac{p}{p_g} = \frac{1}{(1-p)\,b\,k}$ (property of the logistic contest function), this implies: $F = C_M = \frac{1}{2} \cdot (R_M + (1-s)X - G_M) = \frac{1}{(1-p)\,b\,k}$, so substitute this in (75) and denote:

$$FOC_M \equiv p_g \cdot (\frac{1}{2} \cdot (R_M + (1-s)X - G_M)) - p = 0 \tag{77}$$

A.1.2 Second Order Condition

It is possible to show that G_M solving (75) always satisfies the second order condition, i.e. it is a maximiser. The second derivative of the objective function of the masses (1) with respect to G_M can be shown to be $\frac{d(ln(p\,AF)+ln(C_M))}{dG_M{}^2} = \frac{F^2 pp_{gg} - F^2 p_g{}^2 - p^2}{p^2 F^2} = \frac{-1+b^2k^2p(p-1)F^2}{F^2}$, where the expression is simplified using the properties of the logistic contest function. As $p \leq 1$ the expression is negative for all non-negative $G_M \in R_M + (1-s)X$, therefore the objective function is concave in G_M for all feasible G_M and the second order condition should also hold at the solution satisfying the first order condition.

Similarly, can check that: $\frac{d(ln(p\,AF)+ln(C_M))}{dC_M{}^2} = -\frac{1}{F^2} - \frac{1}{C_M^2} < 0$

A.1.3 Existence and Uniqueness of Maximiser

To establish the existence and uniqueness of the maximiser, notice that properties of the logistic contest function imply that can rewrite FOC_M in (77) as $\frac{1}{2} \cdot (R_M + (1-s)X - G_M) = \frac{1}{(1-p(G_M,G_E))\,b\,k}$. Denote $f(G_M) \equiv \frac{1}{2} \cdot (R_M + (1-s)X - G_M)$ and $h(G_M) \equiv \frac{1}{(1-p(G_M,G_E))\,b\,k}$. Notice that $f(.)$ and $h(.)$ are characterised by:

(a) $h(0) \leq f(0)$ (implied by Assumption 3),

(b) $f(R_M + (1-s)\,X) = 0$ and

(c) $h(.) > 0$

(d) $\frac{d\,h(.)}{dG_M} > 0$

(e) $\frac{d\,f(.)}{dG_M} < 0$.

Suppose a value of $G_M \leq R_M + (1-s)X$ that satisfies the first order condition (77) does not exist, this implies that for all non-negative $G_M \leq R_M + (1-s)X$ it holds that $h(G_M) \neq f(G_M)$. Because of (a) and both $h(.)$, $f(.)$ being continuous, this implies that $h(.) < f(.)$ for all non-negative $G_M \leq R_M + (1-s)X$. This means $h(R_M + (1-s)X) < f(R_M + (1-s)X)$. However, together with (b) this implies that $h(R_M + (1-s)X) < 0$, which contradicts (c). So a value of $G_M \leq R_M + (1-s)X$ that satisfies the first order condition in (77) (i.e. G_M such that $f(G_M) = h(G_M)$) must exist.

Recall that $\bar{G}_M$ is the value of G_M for which $f(\bar{G}_M) = h(\bar{G}_M)$. To prove uniqueness, suppose there exist another $G'_M > \bar{G}_M$ such that $f(G'_M) = h(G'_M)$. But (d) and (e) implies, $h(G'_M) > f(G'_M)$, which contradicts $f(G'_M) = h(G'_M)$. Similarly, suppose there exist another $G''_M < \bar{G}_M$ such that $f(G''_M) = h(G''_M)$. But (d) and (e) implies, $h(G''_M) < f(G''_M)$, which contradicts $f(G''_M) = h(G''_M)$. So there exists only one feasible value of $\bar{G}_M$ for which $f(\bar{G}_M) = h(\bar{G}_M)$.

A.1.4 Assumption 3

It can be shown that given a sufficient condition, the objective function of the masses is increasing in G_M at $G_M = 0$, which implies $\bar{G}_M > 0$, where $\bar{G}_M$ is the optimal G_M solving the first order condition in (75).

The expression for the slope of the objective function is $\frac{d(ln(p\,AF)+ln(C_M))}{dG_M} = \frac{p_g F - p}{pF} = p\,\{(1-p)kbF - 1\}$ Can see that the slope is increasing in $G_M \in [0, \bar{G}_M)$ iff $(1-p)kbF > 1$ for $G_M \in [0, \bar{G}_M)$. Because of concavity established in Section A.1, in order to show that $\bar{G}_M > 0$, it suffices to show that the function will be increasing at $G_M = 0$. The slope at $G_M = 0$ is $(1-p)kb(R_M + (1-s)X - C_M) = (1-p)kb\frac{1}{2}(R_M + (1-s)X)$ where we use $C_M = F$ from the first order condition. Because $(1 - p(0, G_E)) \in [1/2; 1)$, for this expression to be strictly positive, it suffices that $\frac{1}{2}kb\frac{1}{2}(R_M + (1-s)X) > 1$. As $(1-s)X \geq 0$ sufficient condition for this is $kbR_M > 4$ (Assumption 3).

A.2 Property M2 of the Best Response Curve of the Masses

The best response curve of the masses can be shown to be strictly increasing and concave in the choice of the elite. Recall that $G_M \equiv r(G_E)$. Using implicit differentiation of the first order condition get $\frac{dr(G_E)}{dG_E} = \frac{-2\,pp_{gG}+2\,p_G\,p_g}{2\,pp_{gg}-3\,{p_g}^2} = 2\,\frac{p}{b(1+p)} > 0$. Furthermore, can show that: $\frac{dr(G_E)}{dG_E^2} = -2\,\frac{pk(-1+p)\left(b\,(\frac{dr(G_E)}{dG_E})-1\right)}{b(1+p)^2} = -2\,\frac{pk(p-1)^2}{(1+p)^3 b} < 0$.

A.3 Property E1 of the Best Response Curve of the Elite

A.3.1 The First Order Conditions and Uniqueness of the Maximiser

Denote $p \equiv p(G_M, G_E)$, $p_G \equiv \frac{d\{p(G_M,G_E)\}}{dG_E}$ and $p_{GG} \equiv \frac{d\{p(G_M,G_E)\}}{dG_E^2}$. To get the first order condition for (5)-(7), substitute in (6) in (5), differentiate with respect to G_E, use $p_G = -p(1-p)k$ (property of logistic contest function) and set equal to zero:

$$FOC_E \equiv \frac{-p_G}{(1-p)} - \frac{1}{C_E} = 0 \quad ==> \quad pk = \frac{1}{C_E} \tag{78}$$

A.3.2 Second Order Condition

To establish the second order condition, can check that the second derivative of the objective function of the elite can be expressed as: $\frac{dFOC_E}{dG_E} = \frac{-p_g k}{b} - (pk)^2 = pk(p(1-k)-1)$. For any $k > 0$ it holds that $p(1-k) < 1$, so the objective function is strictly concave in G_E for any $G_E \geq 0$. Consequently, this will also hold at the G_E solving the first order condition, so the second order condition is satisfied and G_E that satisfies the first order condition in (18) is indeed a maximiser.

A.3.3 Existence and Uniqueness of the Maximiser

To establish the existence and uniqueness of the maximiser, notice that the logistic contest function implies that FOC_E in (78) can be rewritten as $p(G_M, G_E)k = \frac{1}{(R_E+sX-G_E)}$. Denote $l(G_E) \equiv p(G_M, G_E)k$ and $z(G_E) \equiv \frac{1}{(R_E+sX-G_E)}$. Notice that $l(.)$ and $z(.)$ are characterised by:

(a) $l(0) \geq z(0)$ (implied by Assumption 4),

(b) As $G_E \longrightarrow R_E + sX$, $z(G_E) \longrightarrow \infty$ and

(c) As $G_E \longrightarrow R_E + sX$, $l(G_E) \longrightarrow 0$ and

(d) $\frac{d\,z(.)}{dG_E} > 0$

(e) $\frac{d\,l(.)}{dG_E} < 0$.

Suppose a value of $G_E \leq R_E + sX$ that satisfies (78) does not exist, this implies that for all non-negative $G_E \leq R_E + sX$, it holds that $z(G_E) \neq l(G_E)$. As (a) and $z(.)$, $l(.)$ are continuous, this implies that $z(.) < l(.)$ for all non-negative $G_E \leq R_E + sX$. This implies $z(R_E+sX) < l(R_E+sX)$. Because of (c), this implies that $z(G_E) \longrightarrow 0$ as as $G_E \longrightarrow R_E+sX$, which contradicts (b). So a non-negative value of $G_E \leq R_E + sX$ that satisfies (78) such that $z(G_E) = l(G_E))$ must exist.

Recall that $\bar{G}_E$ is the value of G_E for which $z(\bar{G}_E) = l(\bar{G}_E)$. To prove uniqueness, suppose there exist another $G'_E > \bar{G}_E$ such that $z(G'_E) = l(G'_E)$. But (d) and (e) implies, $z(G'_E) > l(G'_E)$, which contradict $z(G'_E) = l(G'_E)$. Similarly, suppose there exist another $G''_E < \bar{G}_E$ such that $z(G''_E) = l(G''_E)$. But (d) and (e) implies, $z(G''_E) < l(G''_E)$, which contradict $z(G''_E) = l(G''_E)$. So there exists only one feasible value of $\bar{G}_E$ for which $z(\bar{G}_E) = l(\bar{G}_E)$.

A.3.4 Assumption 4

It can be shown that given a sufficient condition, the objective function of the elite is increasing in G_E at $G_E = 0$ such that $\bar{G}_E > 0$, where $\bar{E}_M$ is the optimal G_E solving (18). The expression characterising the slope of the objective function can be expressed as $\frac{d(ln((1-p)\,AF)+ln(C_E))}{dG_E} = pk - \frac{1}{C}$. Because the objective function is concave (see Section A.3.2 in the Appendix), in order to show that $\bar{G}_E > 0$, it suffices to show that the objective function will be increasing at $G_E = 0$. The slope of the objective function at $G_E = 0$ can be shown to be $p(G_M, 0)k - \frac{1}{R+sX}$. As $p(G_M, 0) \in [1/2; 1)$, for $p(G_M, 0) \cdot k - \frac{1}{R+sX} > 0$ to hold it suffices that $\frac{k}{2} - \frac{1}{R+sX} > 0$. A sufficient condition for this is $kR_E > 2$, which is imposed by Assumption 4.

A.4 Property E2 of the Best Response Curve of the Elite

The best response curve of the elite can be shown to be strictly increasing and concave in the choice of the masses. Recall that $G_E \equiv R(G_M)$. Using implicit differentiation of the first order condition get$\frac{d\,R(G_M)}{G_M} = (1-p)\,b > 0$. Furthermore, can show that $\frac{d\,R(G_M)}{G_M^2} = -p^2 k\,(1-p)\,b^2 < 0$.

A.5 Proposition 1

$r(G_E)$ is continuous, strictly positive and defined for all non-negative $G_E \leq R_E + sX$ and $R(G_M)$ is continuous, strictly positive and defined for all non-negative $G_M \leq R_M + (1-s)X$, so the best response curves should cross and the existence of a set of mutually best responses (G_E^*, G_M^*) is ensured.

Also, it is possible to show that the best response curves will cross only once at (G_E^*, G_M^*) for which $G_M^* = r(G_E^*)$ and $G_E^* = R(G_M^*)$. To see this, suppose there is another set G_E', G_M', such that $G_E' \neq G_E^*, G_M' \neq G_M^*$ and $G_M' = r(G_E')$, $G_E' = R(G_M')$. As $r(G_E) > 0$, $R(G_M) > 0$ (because of Assumption 3 and Assumption 4), at (G_E^*, G_M^*) the best response curve of the elite $R(G_M)$ crosses $r^{-1}(.)$ from above in the space $x = G_M, y = G_E$, as $R(G_M)$ increasing and concave and the inverted best response curve of the masses $r^{-1}(.)$ increasing and convex in G_M. For the curves to cross at (G_E', G_M'), it should be that at least one of the curves changes the sign of the second derivative at some point.

A.6 Proposition 2

A.6.1 First Order Condition for the Problem of the Donor

Denote where $q_x \equiv \frac{dq(X)}{dX}$, $G_x \equiv \frac{dG_E}{dX}$ and $g_x \equiv \frac{dG_M}{dX}$. The first order condition relevant to the problem in (8) can be shown to be $FOC_D \equiv \frac{dI_M}{dX} = -\frac{pA((s+c_x-1)p_g - G_x\,p_G)}{p_g} = q_x$. After substituting in $F = p/p_g$ (from the first order condition of the masses in (16)), expression for G_x from (79) and using the properties of logistic contest function, can simplify this as $\frac{dI_M}{dX} = -\frac{((s-1)b+s)p^2 A}{b(2\,p^2-p+1)} = q_x$.

A.6.2 Second Order Condition for the Problem of the Donor

The expression required for the second order condition can be obtained by differentiating twice the objective function of donor with respect to X and using the properties of the logistic contest function: $SOC_D \equiv \frac{dFOC_D}{dX} = \frac{((s-1)b+s)(p-2)pA(G_x\,p_G+g_x\,p_g)}{b(2\,p^2-p+1)^2} < q_{xx}$. Substitute in G_x and use properties of logistic contest function to write this as $-\frac{k((s-1)b+s)^2(-1+p)^2A(p-2)p^3}{(2\,p^2-p+1)^3 b} < q_{xx}$.

A.7 Note on Deriving Comparative Statics

It is possible to express a comparative static describing the effect of any of the exogenous variables z on the optimal G_M as $\frac{dg(.)}{dz} = -\frac{\frac{dFOC_M}{dz}}{\frac{dFOC_M}{dG^*_M}}$ where $g() = G^*_M$ and FOC_M is as defined in (16) Similarly, using (18) $\frac{dG(.)}{dz} = -\frac{\frac{dFOC_E}{dz}}{\frac{dFOC_E}{G^*_E}}$, where $G() = G^*_E$ and and FOC_E is as defined in (78). Below we use this to derive some comparative statics of interest.

A.8 The Effect of Aid on the Investment in Contest Technology

First, differentiate the first order condition of the masses with respect to X, plug in the first order conditions and simplify using properties of logistic contest function:

$\frac{dFOC_M}{dX} = 1/2\,((-F-C_M)\,p_{gG}+2\,p_G)\,G_x + 1/2\,(s-1)\,p_g$
$==> \frac{dFOC_M}{dX} = \frac{(-pp_{gG}+p_G\,p_g)G_x}{p_g} + 1/2\,(s-1)\,p_g$
$==> \quad \frac{dFOC_M}{dX} = -1/2\,k\,((s-1)\,b\,(-1+p)+2\,pG_x)\,p$

Repeat this with the first order condition of the elite:
$\frac{dFOC_E}{dX} = \frac{g_x\,(pp_{gG}-p_G\,p_g-p_{gG})C_E{}^2+s(-1+p)^2}{(-1+p)^2 C_E{}^2} ==> \frac{dFOC_E}{dX} = \frac{g_x\,((-1+p)p_{gG}-p_G\,p_g)b^2+p_g{}^2 s}{b^2(-1+p)^2}$
$==> \frac{dFOC_E}{dX} = -k^2 p\,((bg_x - s)\,p - bg_x)$

Using the above can express g_x and G_X and solve the system for both of these comparative statics.

$$\begin{cases} g_x = \frac{(1-s)b(1-p)+2\,pG_x}{b(1+p)} \\ G_x = (1-p)\,bg_x + sp \end{cases} ==> \begin{cases} g_x = \frac{(1-s)b(1-p)+2\,p^2 s}{b(2\,p^2-p+1)} \\ G_x = \frac{((1-s)b+s)p^2+((2\,s-2)b+s)p+(1-s)b}{2\,p^2-p+1} \end{cases} \tag{79}$$

A.9 The Effect of Aid on the Output (see footnote 9)

Denote $c_x \equiv \frac{dC_M}{dX}$. The Effect of Aid on Investment in Production and Output: *Given that* G_M^*, G_E^* *are the equilibrium solutions to the problems* (1)-(4) *and* (5)-(7), *the equilibrium level of investment in production* F^* *and the output* AF^* *are marginally increasing in the amount of aid transfers given that the elite's ability to extract aid is below a certain threshold* $\hat{s}$, *and (weakly) decreasing otherwise, i.e. if* $s < \hat{s}$ *then* $\frac{d(AF^*)}{dX} > 0$; *if* $s > \hat{s}$ *then* $\frac{d(AF^*)}{dX} < 0$; *if* $s = \hat{s}$ *then* $\frac{d(AF^*)}{dX} = 0$, *where* $\frac{dAF^*}{dX} = -\frac{((s-1)b+s)p^2 A}{b(2\,p^2-p+1)}$.

To derive the effect differentiate the expression $A(R_M + (1-s)X - g(X))$ with respect to aid. The derivative takes the form $\frac{dAF}{dX} = A\,(1 - s - c_x - g_x)$. Then substitute in g_x and c_x.

A.10 Proposition 3

A.10.1 The Effect of Aid Transfers on the Power in the Contest

To obtain the marginal effect of aid on the power of the masses, differentiate $p(g(X), G(X))$ with respect to X to get: $\frac{dp(.)}{dX} = p_G\,G_x + p_g\,g_x$. Substitute in g_x and G_x to obtain $\frac{dp(.)}{dX} = -\frac{k(-1+p)^2 p^2((s-1)b+s)}{2\,p^2-p+1}$.

A.10.2 The Effect of Aid Transfers on the Second Period Welfare of the Masses

To obtain the marginal effect of aid on the post-contest output of the masses, differentiate $p(g(X), G(X))\cdot A(R_M + (1-s)X - g(X))$ with respect to X to get $\frac{dI_M}{dX} = -\frac{pA((s+c_x-1)p_g - G_x\,p_G)}{p_g}$. Then substitute in expression for G_x and use the properties of logistic contest to get: $\frac{dI_M}{dX} = -\frac{((s-1)b+s)p^2 A}{b(2\,p^2-p+1)}$.

A.10.3 The Effect of Aid Transfers on the Second Period Welfare of the Elite

To obtain the marginal effect of aid on the post-contest output of the elite, differentiate $(1 - p(g(X), G(X)))\cdot A(R_M + (1-s)X - g(X))$ with respect to X to get $\frac{dI_E}{dX} = (-G_x\,p_G - g_x\,p_g)\,AF + (1-p)\,A\,(1 - s - c_x - g_x)$. Substitute in the above $F = \frac{p}{p_g}$ from the first order condition (75) and use the properties of logistic function to show that the effects is zero:

$$\frac{dI_E}{dX} = \frac{(-G_x\,p_G - g_x\,p_g)Ap}{p_g} + (1-p)\,A\,(1 - s - c_x - g_x) \quad ==> \quad \frac{dI_E}{dX} = 0.$$

A.10.4 The Effect of Aid Transfers on the First Period Consumption by the Elite

To obtain the marginal effect of aid on the consumption, and the corresponding utility of consumption, differentiate $R_E + sX - G(X)$ and $ln(R_E + sX - G(X))$ with respect to X. The general expressions for the derivatives with respect to X are $\frac{dC_E}{dX} = s - G_x$ and $\frac{du(.)}{dX} = \frac{s-G_x}{C_E} == \frac{(s-G_x)p_g}{b(1-p)}$. When assuming the logistic contest function they become $\frac{du(.)}{dX} = (s - G_x)\,pk$ which can be written as: $\frac{dC_E}{dX} = \frac{((s-1)b+s)(-1+p)^2}{2\,p^2-p+1}$ and $\frac{du(.)}{dX} = \frac{k(-1+p)^2p((s-1)b+s)}{2\,p^2-p+1}$.

A.10.5 The Effect of Aid Transfers on the First Period Consumption by the Masses

To obtain the marginal effect of aid on the consumption, and the corresponding utility of consumption by the elite, differentiate the expressions $C_M = -1/2\,Xs - 1/2\,g\,(X) + R_M/2 + X/2$ and $ln(-1/2\,Xs - 1/2\,g\,(X) + R_M/2 + X/2)$ with respect to X to get:
$c_x \equiv \frac{dC_M}{dX} = s/2 - g_x/2 + 1/2$ and $\frac{d\ln(C_M)}{dX} = \frac{c_x}{C_M} = \frac{c_x\,p_g}{p}$. When assuming the logistic contest function they become: $\frac{dC_M}{dX} = -\frac{p^2((s-1)b+s)}{b(2\,p^2-p+1)}$ and $\frac{du(.)}{dX} = \frac{k(-1+p)p^2((s-1)b+s)}{2\,p^2-p+1}$.

A.11 Proposition 4

Assuming the second order condition for the problem of the donor holds, the sign of any comparative static on the optimal amount of aid X^* in the form $\frac{dX^*}{dz}$ (where z is any exogenous variable, such as R_M, R_E, b, A) is going to be the same as the sign of $\frac{dFOC_D}{dz} = \frac{dpAF}{dz}$. Investigating the sign of the comparative static $\frac{dX^*}{dz}$ is equivalent to investigating how the slope of the second period welfare of the masses as a function of aid X changes when the parameters R_M, R_E, b, A are shifted.

To derive the sign of the comparative static $\frac{dX^*}{dR_m}$, differentiate $\frac{d\,(p(X)A\frac{1}{2}\,(R_M+(1-s)X-G_M))}{dX}$ with respect to R_M to get $\frac{dpAF}{dXdR_M} = \frac{((s-1)b+s)(p-2)pA(p_G\,G_r+p_g\,g_r)}{b(2\,p^2-p+1)^2}$. Derive and substitute in G_r and g_r, and use the properties of the logistic function to express this as $\frac{dpAF}{dXdR_M} = \frac{k((s-1)b+s)(-1+p)^2A(p-2)p^3}{(2\,p^2-p+1)^3}$.

Notice that the sign of the term $b - s(b + 1)$ is determined by whether the threshold of elite's extractive capacity $\hat{s} = b/(b + 1)$ is exceeded. If $s < b/(b + 1)$ then the term is positive and $\frac{dpAF}{dXdR_M} > 0$. If $s > b/(b + 1)$ then the expression is negative, i.e. $\frac{dpAF}{dXdR_M} < 0$. This would imply that the optimal amount of aid is $X^* = 0$ ($X < 0$ is not allowed in this model).
So as $sign(\frac{dX^*}{dR_M}) = sign(\frac{dpAF}{dXdR_M})$, this implies that $\frac{dX^*}{dR_M} > 0$.

Similarly can express $\frac{dpAF}{dXdR_E} = \frac{((s-1)b+s)(p-2)pA(p_G\, G_R+p_g\, g_R)}{b(2\,p^2-p+1)^2}$.

Substitute in G_R and g_R, and use the properties of logistic function to write this as $\frac{dpAF}{dXdR_E} = -\frac{k((s-1)b+s)(-1+p)^2A(p-2)p^3}{(2\,p^2-p+1)^3b}$. See that as long as $s < b/(b+1)$, $\frac{dpAF}{dXdR_E} < 0$.
So as $sign(\frac{dX^*}{dR_E}) = sign(\frac{dpAF}{dXdR_E})$, this implies that $\frac{dX^*}{dR_E} < 0$.

A.12 Proposition 1

In Section A.11 it was shown that when $s < b/(b+1)$ it holds that $\frac{dX^*}{dR_E} < 0$ and $\frac{dX^*}{dR_M} > 0$. Note that this means $\frac{dX^*}{dR_E} < 0$ and $\frac{dX^*}{d(-R_M)} < 0$, so $\frac{dX^*}{d(R_E-R_M)} < 0$.

B Appendices to Chapter 3

B.1 Detailed Variable Description

Table B.1: Sources and Description of the Variables

Variable	Description	Source
Many variables were made available by courtesy of Rajan and Subramanian (2008) and Clemens et al. (2012). The datasets were accessed via the AidData replication datasets depository online (http://aiddata.org/replication-datasets).		
Real economic growth	Annual average growth rate of real GDP (PPP) per capita; averages are taken over each 5-year period.	Penn World Table, version 6.1
Aid (measure 1)	The ratio of aggregate net development assistance that is disbursed in current U.S. dollars to GDP in current U.S. dollars.	OECD Development Assistance Comittee
Aid (measure 2)	The ratio of early impact ODA by DAC donors built from purpose-specific ODA commitment data and aggregate country gross ODA disbursement data to GDP in current U.S. dollars.	OECD Development Assistance Comittee and OECD Creditor Reporting System (CRS)
Repayment	Data on ODA Loan Repayments	OECD Development Assistance Comittee
Equality	Estimated using Gini coefficients derived from the econometric relationship between UTIP-UNIDO industrial pay data, other conditioning variables, and the World Bank's Deininger. & Squire data set on Gini coefficients.	Estimated Household Income Inequality Data Set (EHII) by Texas Inequality Project
Income	Log of per capita real GDP at the beginning of the 5-year period.	Penn World Table, version 6.1
Life expectancy	Life expectancy at birth at the beginning of the 5-year period or the closest time period for which data is available.	World Development Indicators
Inflation	Annual rate of growth of CPI based inflation averaged over 5 year periods.	Easterly, William [website]: www.nyu.edu/fas/institute/dri/global%20development%20network%20growth%20database.htm Recently, moved to: https://wp.nyu.edu/dri/resources/global-development-network-growth-database/
Broad money	Ratio of M2/GDP averaged over 5 year periods.	Easterly, William [website]
Budget balance	Ratio of general government budget balance over GDP averaged over 5 year periods.	World Development Indicators
Revolutions	Average number of revolutions per year in the 5 year period.	Banks (2004)
Openness	Sachs-Warner trade policy index (updated by Wacziarg and Welch (2008)) at the beginning of the 5-year period or the closest time period for which data is available.	Wacziarg and Welch (2008)
Institutions	Institutional quality as represented by ICRG index, averaged over 5-year periods.	Bosworth and Collins (2003)
Geography	Average number of frost days and tropical land area.	Bosworth and Collins (2003)
Ethnic fractionalisation	Ethnic fractionalisation based on Soviet Atlas, plus estimates for missing in 1964.	Easterly, William [website]
Settlers	Percentage of European settlers in the total population in colonial times.	Table 1 in Angeles and Neanidis (2009); data on Haiti from Etemad (2000)
Agriculture: value added	Agriculture, value added (% of GDP), averaged over 5-year periods.	World Bank national accounts data
Industry: value added	Industry, value added (% of GDP), averaged over 5-year periods.	World Bank national accounts data
Polity 2	Polity 2 time series of democracy index, averaged over 5-year periods.	Polity IV Project: http://www.systemicpeace.org/polity/polity4.htm

B.2 Results Reporting the Full Set of Coefficient Estimates

This section reports the results of the regressions included in the main text of the thesis, but with the full set of coefficient estimates.

Table B.2: The Effect of Aid on Growth:
Net ODA by All Donors as the Aid Measure, Specification without the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.076**	-0.077	-0.002	-0.197	-0.055	-0.036	0.133	-0.357**	-0.052	-0.381**	-0.182	-0.651
	(0.035)	(0.609)	(0.976)	(0.236)	(0.300)	(0.809)	(0.195)	(0.012)	(0.702)	(0.044)	(0.330)	(0.108)
Aid^2		0.000		0.007		-0.001		0.018***		0.010		0.015
		(0.994)		(0.306)		(0.909)		(0.000)		(0.155)		(0.107)
Income	-1.406***	-1.408***	-3.735***	-4.150***	-1.398***	-1.372**	-5.340***	-6.241***	-11.518***	-11.788***	-22.950*	-24.314*
	(0.001)	(0.006)	(0.000)	(0.000)	(0.009)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)	(0.080)	(0.082)
Life expectancy	-0.009	-0.009	-0.054*	-0.052	-0.027	-0.028	-0.034	-0.028	-0.063	-0.046	-0.017	0.011
	(0.810)	(0.815)	(0.097)	(0.130)	(0.562)	(0.563)	(0.390)	(0.395)	(0.361)	(0.528)	(0.891)	(0.935)
Openness	0.951*	0.951*	0.496	0.418	0.872	0.869*	-0.092	-0.451	0.124	-0.002	-0.945	-1.213
	(0.077)	(0.069)	(0.302)	(0.418)	(0.100)	(0.099)	(0.867)	(0.422)	(0.830)	(0.998)	(0.383)	(0.312)
Institutions	0.419***	0.419***			0.508***	0.513***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.564***	-1.564***	-1.305***	-1.383***	-1.352***	-1.340***	-0.897***	-1.160***	-1.048***	-1.188***	-0.950***	-1.136***
	(0.000)	(0.000)	(0.003)	(0.002)	(0.000)	(0.000)	(0.006)	(0.000)	(0.002)	(0.000)	(0.004)	(0.000)
Broad money	0.014	0.014	0.027	0.030	-0.021	-0.022	0.013	0.014	0.023	0.020	0.013	0.008
	(0.596)	(0.588)	(0.263)	(0.270)	(0.311)	(0.287)	(0.540)	(0.529)	(0.538)	(0.595)	(0.729)	(0.843)
Budget balance	0.164	0.164	0.331*	0.348*	0.037	0.041	0.170	0.197	0.301	0.254	0.069	-0.016
	(0.402)	(0.402)	(0.081)	(0.071)	(0.818)	(0.798)	(0.212)	(0.150)	(0.158)	(0.220)	(0.831)	(0.965)
Revolutions	-0.513*	-0.513*	-0.653**	-0.674**	-0.387	-0.383	-0.421	-0.449*	-0.852**	-0.860**	-0.910***	-0.926**
	(0.062)	(0.067)	(0.033)	(0.022)	(0.169)	(0.171)	(0.127)	(0.076)	(0.014)	(0.015)	(0.009)	(0.011)
Sub-Saharan Africa	-2.077***	-2.076***			-1.978**	-2.005**						
	(0.005)	(0.005)			(0.010)	(0.013)						
South-East Asia	1.807***	1.806***			1.835***	1.845***						
	(0.001)	(0.001)			(0.001)	(0.001)						
Geography	0.617***	0.616***			0.915***	0.922***						
	(0.002)	(0.005)			(0.000)	(0.000)						
Ethnic fractionalisation	0.394	0.393			0.112	0.139						
	(0.700)	(0.698)			(0.928)	(0.908)						
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in panel A in Table 3.2 Measure of aid is net ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table B.3: The Effect of Aid on Growth:
Net ODA by All Donors as the Aid Measure, Specification with the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.753	-0.867	-0.532	-1.215**	-0.493	-0.559	1.185	-0.063	-0.220	-1.273*	0.401	-0.956
	(0.114)	(0.119)	(0.423)	(0.048)	(0.411)	(0.350)	(0.181)	(0.940)	(0.798)	(0.075)	(0.735)	(0.420)
Aid^2		0.002		0.009		0.001		0.018***		0.012*		0.016*
		(0.777)		(0.199)		(0.880)		(0.000)		(0.092)		(0.091)
Aid×Equality	1.311	1.448	1.018	1.854*	0.848	0.926	-2.007	-0.578	0.332	1.611	-1.203	0.425
	(0.153)	(0.132)	(0.395)	(0.085)	(0.456)	(0.399)	(0.199)	(0.675)	(0.824)	(0.204)	(0.607)	(0.845)
Equality	-3.808	-3.990	-3.373	-5.985	5.271	5.201	29.081**	25.149**	14.586	7.945	34.455	26.278
	(0.466)	(0.434)	(0.738)	(0.540)	(0.316)	(0.319)	(0.017)	(0.024)	(0.261)	(0.531)	(0.140)	(0.253)
Income	-1.305***	-1.356**	-3.620***	-4.058***	-1.402**	-1.432**	-6.332***	-7.099***	-11.702***	-11.893***	-28.009*	-28.642*
	(0.004)	(0.011)	(0.000)	(0.000)	(0.011)	(0.012)	(0.000)	(0.000)	(0.000)	(0.000)	(0.088)	(0.089)
Life expectancy	-0.002	-0.000	-0.052	-0.047	-0.023	-0.022	-0.026	-0.016	-0.054	-0.038	0.023	0.045
	(0.948)	(0.998)	(0.102)	(0.167)	(0.593)	(0.629)	(0.577)	(0.692)	(0.448)	(0.600)	(0.885)	(0.780)
Openness	0.919*	0.936*	0.454	0.322	1.024**	1.032**	0.181	-0.190	0.276	0.055	-1.009	-1.327
	(0.078)	(0.067)	(0.385)	(0.561)	(0.050)	(0.049)	(0.764)	(0.748)	(0.644)	(0.924)	(0.390)	(0.298)
Institutions	0.417***	0.408***			0.470***	0.463***						
	(0.000)	(0.000)			(0.000)	(0.001)						
Inflation	-1.526***	-1.542***	-1.297***	-1.390***	-1.317***	-1.330***	-0.822**	-1.088***	-0.976***	-1.152***	-0.770**	-0.995***
	(0.000)	(0.000)	(0.003)	(0.002)	(0.000)	(0.000)	(0.020)	(0.000)	(0.005)	(0.000)	(0.045)	(0.007)
Broad money	0.015	0.015	0.027	0.030	-0.019	-0.018	0.003	0.006	0.026	0.024	0.012	0.009
	(0.584)	(0.548)	(0.250)	(0.241)	(0.379)	(0.374)	(0.907)	(0.829)	(0.426)	(0.488)	(0.764)	(0.827)
Budget balance	0.154	0.143	0.333*	0.357*	0.027	0.022	0.182	0.214	0.285	0.235	-0.058	-0.131
	(0.427)	(0.456)	(0.078)	(0.060)	(0.849)	(0.878)	(0.230)	(0.153)	(0.146)	(0.235)	(0.885)	(0.756)
Revolutions	-0.552**	-0.563*	-0.687**	-0.743***	-0.405	-0.413	-0.351	-0.416*	-0.776**	-0.820**	-0.753*	-0.810*
	(0.050)	(0.051)	(0.024)	(0.010)	(0.127)	(0.116)	(0.198)	(0.079)	(0.029)	(0.020)	(0.074)	(0.051)
Sub-Saharan Africa	-1.965***	-1.907**			-2.046***	-2.007***						
	(0.009)	(0.011)			(0.007)	(0.010)						
South-East Asia	1.964***	1.941***			1.527**	1.515**						
	(0.003)	(0.004)			(0.015)	(0.018)						
Geography	0.669***	0.655***			0.888***	0.878***						
	(0.001)	(0.005)			(0.000)	(0.000)						
Ethnic fractionalisation	0.523	0.497			0.641	0.624						
	(0.626)	(0.644)			(0.603)	(0.611)						
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in panel B in Table 3.2. Measure of aid is net ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table B.4: The Effect of Aid on Growth:
Early Impact ODA by DAC Donors as the Aid Measure, Specification without the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.346**	-0.020	-0.324	-0.154	-0.298*	0.230	-0.248	-0.946	-0.488*	-0.356	-0.525	-0.416
	(0.025)	(0.955)	(0.137)	(0.752)	(0.071)	(0.473)	(0.360)	(0.114)	(0.063)	(0.562)	(0.182)	(0.612)
Aid^2		-0.034		-0.018		-0.054**		0.108*		-0.015		-0.011
		(0.202)		(0.707)		(0.028)		(0.080)		(0.794)		(0.869)
Income	-1.632***	-1.597***	-4.390***	-4.454***	-1.695***	-1.609***	-5.203***	-5.748***	-11.810***	-11.795***	-13.134	-13.018
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.153)	(0.131)
Repayment	0.265	1.262	0.204	1.405	0.431	1.654*	0.096	1.609	0.136	0.434	0.125	0.515
	(0.497)	(0.212)	(0.595)	(0.216)	(0.259)	(0.092)	(0.797)	(0.107)	(0.747)	(0.728)	(0.773)	(0.684)
Life expectancy	-0.006	-0.008	-0.062*	-0.065*	-0.014	-0.018	-0.026	-0.027	-0.089	-0.095	-0.084	-0.089
	(0.876)	(0.811)	(0.072)	(0.053)	(0.776)	(0.693)	(0.507)	(0.513)	(0.200)	(0.183)	(0.256)	(0.268)
Openness	0.821	0.763	0.356	0.380	0.665	0.582	-0.426	-0.383	-0.171	-0.183	-0.312	-0.307
	(0.135)	(0.152)	(0.499)	(0.481)	(0.186)	(0.234)	(0.443)	(0.497)	(0.783)	(0.772)	(0.755)	(0.734)
Institutions	0.452***	0.476***			0.508***	0.558***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.448***	-1.387***	-1.299***	-1.289***	-1.350***	-1.230***	-1.175***	-1.265***	-1.140***	-1.131***	-1.135***	-1.131***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.019	0.018	0.045*	0.053*	-0.005	-0.004	0.011	0.028	0.047	0.050	0.046	0.049
	(0.413)	(0.435)	(0.076)	(0.054)	(0.817)	(0.884)	(0.622)	(0.317)	(0.204)	(0.188)	(0.192)	(0.157)
Budget balance	0.078	0.039	0.374*	0.351*	-0.020	-0.052	0.364**	0.394*	0.231	0.241	0.208	0.220
	(0.702)	(0.841)	(0.050)	(0.074)	(0.914)	(0.769)	(0.049)	(0.070)	(0.220)	(0.216)	(0.363)	(0.345)
Revolutions	-0.652**	-0.651**	-0.733**	-0.748**	-0.536**	-0.528**	-0.648**	-0.702**	-0.959***	-0.968***	-0.966***	-0.977***
	(0.012)	(0.016)	(0.013)	(0.012)	(0.030)	(0.037)	(0.025)	(0.014)	(0.010)	(0.008)	(0.004)	(0.003)
Sub-Saharan Africa	-1.858**	-1.988***			-1.590**	-1.829**						
	(0.014)	(0.009)			(0.044)	(0.020)						
South-East Asia	1.890***	1.952***			1.952***	2.071***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Geography	0.614***	0.660***			0.749***	0.835***						
	(0.004)	(0.004)			(0.000)	(0.000)						
Ethnic fractionalisation	0.193	0.343			-0.432	-0.189						
	(0.841)	(0.706)			(0.708)	(0.856)						
Repayment^2		0.307		0.348		0.348		0.376		0.083		0.107
		(0.258)		(0.212)		(0.194)		(0.125)		(0.774)		(0.735)
Observations	267	267	267	267	207	207	207	207	207	207	207	207
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in panel A in Table 3.3. Measure of aid is early impact ODA by DAC donor, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.5: The Effect of Aid on Growth:
Early Impact ODA by DAC Donors as the Aid Measure, Specification with the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-2.579**	-1.643	-5.748***	-5.211**	-2.090*	-0.532	-4.395	-3.515	-5.150**	-4.968*	-5.078**	-4.931**
	(0.043)	(0.313)	(0.003)	(0.013)	(0.082)	(0.711)	(0.261)	(0.374)	(0.022)	(0.055)	(0.013)	(0.034)
Aid^2		-0.026		-0.014		-0.050*		0.105**		-0.004		-0.002
		(0.360)		(0.760)		(0.054)		(0.047)		(0.946)		(0.975)
Aid×Equality	4.297*	2.977	10.178***	9.396***	3.433	1.366	7.719	4.842	8.628**	8.359**	8.443**	8.223**
	(0.074)	(0.277)	(0.003)	(0.008)	(0.123)	(0.571)	(0.263)	(0.502)	(0.028)	(0.045)	(0.025)	(0.032)
Equality	-1.596	-1.365	-8.727	-7.902	2.650	3.244	15.259	20.191*	6.072	6.218	7.420	7.249
	(0.783)	(0.816)	(0.405)	(0.459)	(0.650)	(0.577)	(0.182)	(0.097)	(0.626)	(0.621)	(0.678)	(0.658)
Income	-1.554***	-1.558***	-4.290***	-4.423***	-1.656***	-1.614***	-6.003***	-6.619***	-11.905***	-11.954***	-12.854	-12.717
	(0.001)	(0.001)	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.205)	(0.168)
Repayment	-2.589	1.323	-4.553	-0.273	-0.852	4.257	-9.583**	-8.403	-1.209	0.489	-1.244	0.612
	(0.642)	(0.844)	(0.420)	(0.968)	(0.876)	(0.445)	(0.020)	(0.159)	(0.853)	(0.954)	(0.843)	(0.941)
Repayment^2		0.305		0.347		0.368		0.349		0.135		0.152
		(0.293)		(0.267)		(0.164)		(0.252)		(0.687)		(0.681)
Repayment×Equality	5.401	-0.299	9.046	2.987	2.265	-5.204	18.532**	19.077*	2.273	-0.107	2.324	-0.239
	(0.620)	(0.980)	(0.414)	(0.802)	(0.833)	(0.604)	(0.026)	(0.066)	(0.856)	(0.994)	(0.848)	(0.987)
Life expectancy	-0.002	-0.004	-0.064*	-0.067*	-0.010	-0.015	-0.006	-0.008	-0.085	-0.086	-0.080	-0.082
	(0.955)	(0.909)	(0.063)	(0.052)	(0.828)	(0.736)	(0.894)	(0.872)	(0.217)	(0.233)	(0.290)	(0.317)
Openness	0.821	0.800	0.141	0.210	0.770	0.716	-0.439	-0.326	-0.293	-0.279	-0.381	-0.346
	(0.122)	(0.120)	(0.795)	(0.706)	(0.122)	(0.141)	(0.442)	(0.594)	(0.616)	(0.640)	(0.714)	(0.712)
Institutions	0.447***	0.463***			0.489***	0.530***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.402***	-1.370***	-1.332***	-1.323***	-1.295***	-1.204***	-1.145***	-1.198***	-1.154***	-1.157***	-1.143***	-1.151***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.022	0.021	0.048*	0.055**	-0.005	-0.005	0.007	0.021	0.054	0.057	0.053*	0.057*
	(0.355)	(0.371)	(0.057)	(0.040)	(0.822)	(0.830)	(0.704)	(0.374)	(0.116)	(0.102)	(0.093)	(0.073)
Budget balance	0.069	0.020	0.354*	0.328*	-0.032	-0.076	0.376**	0.423**	0.171	0.172	0.154	0.158
	(0.732)	(0.916)	(0.052)	(0.079)	(0.849)	(0.631)	(0.026)	(0.033)	(0.366)	(0.366)	(0.536)	(0.520)
Revolutions	-0.672***	-0.679**	-0.811***	-0.836***	-0.550**	-0.545**	-0.671***	-0.681**	-0.957***	-0.971***	-0.956***	-0.972***
	(0.009)	(0.011)	(0.003)	(0.003)	(0.020)	(0.023)	(0.009)	(0.010)	(0.009)	(0.008)	(0.004)	(0.003)
Sub-Saharan Africa	-1.804**	-1.907**			-1.597**	-1.824**						
	(0.019)	(0.015)			(0.042)	(0.024)						
South-East Asia	1.939***	1.956***			1.774***	1.830***						
	(0.002)	(0.002)			(0.004)	(0.002)						
Geography	0.654***	0.680***			0.771***	0.840***						
	(0.003)	(0.003)			(0.000)	(0.000)						
Ethnic fractionalisation	0.472	0.561			0.046	0.210						
	(0.647)	(0.576)			(0.968)	(0.849)						
Observations	267	267	267	267	207	207	207	207	207	207	207	207
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in panel B in Table 3.3. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.6: The Effect Aid on Growth: Colonial Settlers

	(1)	(2)	(3)	(4)	(5)	(6)
Aid	-2.457*	-5.695***	-2.006*	-4.279	-5.203**	-5.145**
	(0.053)	(0.004)	(0.096)	(0.306)	(0.021)	(0.011)
Aid^2						
Repayment	-3.226	-5.547	-1.219	-10.293**	-1.544	-1.578
	(0.546)	(0.335)	(0.810)	(0.028)	(0.830)	(0.818)
Repayment^2						
Aid×Equality	4.081*	10.263***	3.278	7.511	8.867**	8.719**
	(0.078)	(0.003)	(0.130)	(0.297)	(0.021)	(0.018)
Repayment×Equality	6.968	11.238	3.321	19.681**	3.332	3.367
	(0.507)	(0.317)	(0.741)	(0.046)	(0.810)	(0.798)
Equality	-0.482	-9.000	3.122	15.317	6.665	7.648
	(0.934)	(0.388)	(0.609)	(0.188)	(0.597)	(0.664)
Aid×Settlers	-0.001	-0.027*	0.005	-0.007	-0.010	-0.010
	(0.960)	(0.097)	(0.703)	(0.784)	(0.586)	(0.585)
Repayment×Settlers	0.014	0.012	0.008	-0.015	0.025	0.023
	(0.690)	(0.698)	(0.782)	(0.516)	(0.465)	(0.549)
Settlers	-0.036		-0.054			
	(0.200)		(0.103)			
Income	-1.377***	-4.228***	-1.354**	-6.069***	-11.850***	-12.563
	(0.008)	(0.000)	(0.022)	(0.000)	(0.000)	(0.230)
Life expectancy	-0.006	-0.061*	-0.015	-0.005	-0.083	-0.080
	(0.867)	(0.067)	(0.737)	(0.920)	(0.228)	(0.287)
Openness	0.896	0.162	0.953*	-0.390	-0.323	-0.387
	(0.118)	(0.761)	(0.076)	(0.494)	(0.576)	(0.708)
Institutions	0.469***		0.518***			
	(0.000)		(0.000)			
Inflation	-1.220***	-1.424***	-1.027***	-1.202***	-1.187***	-1.179***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.022	0.051*	-0.014	0.007	0.055	0.055*
	(0.398)	(0.052)	(0.483)	(0.705)	(0.117)	(0.096)
Budget balance	0.147	0.325*	0.080	0.378**	0.172	0.159
	(0.448)	(0.084)	(0.592)	(0.028)	(0.372)	(0.528)
Revolutions	-0.608**	-0.863***	-0.489*	-0.687***	-0.953***	-0.952***
	(0.030)	(0.001)	(0.063)	(0.008)	(0.008)	(0.003)
Sub-Saharan Africa	-2.085**		-1.976**			
	(0.015)		(0.031)			
South-East Asia	1.426*		0.981			
	(0.092)		(0.257)			
Geography	0.494**		0.525**			
	(0.041)		(0.048)			
Ethnic fractionalisation	0.454		0.029			
	(0.657)		(0.979)			
Observations	267	267	207	207	207	207
Estimator	OLS	F-E	OLS	F-E	OLS	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	Yes	Yes
Sample	c	c	d	d	d	d

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in the columns 1-6 of panel A in Table 3.4 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.7: The Effect Aid on Growth: Institutional Quality

	(1)	(2)	(3)	(4)	(5)	(6)
Aid	-2.463**	-5.425***	-1.809	-4.356	-4.646**	-4.489**
	(0.045)	(0.004)	(0.104)	(0.239)	(0.028)	(0.029)
Aid^2						
Repayment	-3.016	-5.624	-1.268	-9.977**	-1.218	-1.222
	(0.583)	(0.293)	(0.827)	(0.010)	(0.837)	(0.834)
$Repayment^2$						
Aid×Equality	4.733*	10.374***	4.387*	8.422	8.735**	8.436**
	(0.054)	(0.004)	(0.051)	(0.306)	(0.036)	(0.036)
Repayment×Equality	5.328	10.587	3.420	19.243**	2.732	2.795
	(0.618)	(0.319)	(0.760)	(0.016)	(0.818)	(0.809)
Equality	-2.085	-8.509	0.710	13.723	4.459	6.541
	(0.707)	(0.424)	(0.900)	(0.297)	(0.730)	(0.708)
Aid×Institutions	-0.074	-0.095	-0.193*	-0.105	-0.134	-0.144
	(0.482)	(0.472)	(0.053)	(0.695)	(0.379)	(0.387)
Repayment×Institutions	-0.152	-0.103	0.017	-0.020	0.044	0.055
	(0.368)	(0.517)	(0.936)	(0.913)	(0.854)	(0.810)
Income	-1.672***	-4.385***	-1.809***	-6.031***	-11.979***	-13.552
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.200)
Life expectancy	0.003	-0.065*	0.004	-0.003	-0.071	-0.063
	(0.931)	(0.072)	(0.920)	(0.953)	(0.327)	(0.478)
Openness	0.729	0.119	0.520	-0.471	-0.374	-0.528
	(0.181)	(0.828)	(0.252)	(0.418)	(0.515)	(0.638)
Institutions	0.544***		0.642***			
	(0.000)		(0.000)			
Inflation	-1.424***	-1.268***	-1.291***	-1.098***	-1.103***	-1.082***
	(0.000)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.015	0.050**	-0.006	0.011	0.053	0.052*
	(0.526)	(0.039)	(0.799)	(0.668)	(0.113)	(0.096)
Budget balance	0.017	0.367**	-0.052	0.392**	0.172	0.142
	(0.936)	(0.049)	(0.762)	(0.028)	(0.338)	(0.578)
Revolutions	-0.684**	-0.778***	-0.534**	-0.667***	-0.968***	-0.968***
	(0.015)	(0.008)	(0.032)	(0.010)	(0.007)	(0.002)
Sub-Saharan Africa	-1.666**		-1.225*			
	(0.021)		(0.090)			
South-East Asia	1.903***		1.905***			
	(0.003)		(0.002)			
Geography	0.650***		0.803***			
	(0.004)		(0.000)			
Ethnic fractionalisation	0.413		0.026			
	(0.685)		(0.982)			
Observations	267	267	207	207	207	207
Estimator	OLS	F-E	OLS	F-E	OLS	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	Yes	Yes
Sample	c	c	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in the columns 7-12 of panel A in Table 3.4 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in text. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.8: The Effect Aid on Growth: Openness

	(1)	(2)	(3)	(4)	(5)	(6)
Aid	-2.669*	-5.779***	-2.474*	-5.149	-4.821**	-4.758**
	(0.075)	(0.006)	(0.065)	(0.265)	(0.039)	(0.024)
Aid^2						
Repayment	-3.095	-4.755	-1.991	-13.615***	1.693	1.762
	(0.652)	(0.516)	(0.776)	(0.007)	(0.842)	(0.830)
Repayment^2						
Aid×Equality	4.392	10.218***	3.887	8.721	8.186**	8.043**
	(0.101)	(0.005)	(0.103)	(0.268)	(0.041)	(0.034)
Repayment×Equality	6.055	9.351	3.740	24.915**	-2.564	-2.679
	(0.632)	(0.493)	(0.771)	(0.011)	(0.870)	(0.860)
Equality	-1.455	-8.673	2.329	16.496	6.197	7.167
	(0.808)	(0.460)	(0.695)	(0.210)	(0.653)	(0.690)
Aid×Openness	0.089	0.016	0.610**	0.350	-0.129	-0.138
	(0.778)	(0.956)	(0.020)	(0.524)	(0.719)	(0.663)
Repayment×Openness	-0.263	-0.074	-0.606	-1.049	0.755	0.784
	(0.745)	(0.923)	(0.478)	(0.194)	(0.410)	(0.393)
Income	-1.567***	-4.285***	-1.686***	-6.011***	-12.019***	-12.680
	(0.002)	(0.000)	(0.001)	(0.000)	(0.000)	(0.212)
Life expectancy	-0.002	-0.065*	-0.006	-0.007	-0.080	-0.077
	(0.963)	(0.059)	(0.904)	(0.882)	(0.239)	(0.307)
Openness	0.839	0.164	0.173	-0.266	-0.547	-0.611
	(0.123)	(0.844)	(0.775)	(0.795)	(0.501)	(0.637)
Institutions	0.447***		0.563***			
	(0.000)		(0.000)			
Inflation	-1.408***	-1.330***	-1.260***	-1.143***	-1.176***	-1.169***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.022	0.048*	-0.018	0.007	0.047	0.046
	(0.370)	(0.050)	(0.441)	(0.737)	(0.160)	(0.145)
Budget balance	0.056	0.353*	-0.028	0.392**	0.134	0.120
	(0.775)	(0.055)	(0.865)	(0.043)	(0.505)	(0.649)
Revolutions	-0.679**	-0.815***	-0.522**	-0.667**	-0.942***	-0.942***
	(0.017)	(0.008)	(0.027)	(0.015)	(0.010)	(0.004)
Sub-Saharan Africa	-1.799**		-1.484*			
	(0.022)		(0.062)			
South-East Asia	1.914***		1.978***			
	(0.003)		(0.003)			
Geography	0.637***		0.777***			
	(0.006)		(0.001)			
Ethnic fractionalisation	0.453		-0.273			
	(0.674)		(0.821)			
Observations	267	267	207	207	207	207
Estimator	OLS	F-E	OLS	F-E	OLS	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	Yes	Yes
Sample	c	c	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in the columns 1-6 of panel B in Table 3.4 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.9: The Effect Aid on Growth: Budget Balance

	(1)	(2)	(3)	(4)	(5)	(6)
Aid	-2.653**	-5.782***	-2.176*	-4.363	-5.325**	-5.246**
	(0.040)	(0.003)	(0.077)	(0.282)	(0.022)	(0.014)
Aid^2						
Repayment	-3.022	-4.667	-1.262	-9.718**	-1.183	-1.225
	(0.583)	(0.415)	(0.817)	(0.024)	(0.857)	(0.846)
Repayment^2						
Aid×Equality	4.446*	10.246***	3.590	7.668	8.899**	8.695**
	(0.065)	(0.003)	(0.112)	(0.281)	(0.029)	(0.027)
Repayment×Equality	6.349	9.310	3.125	18.863**	2.164	2.228
	(0.557)	(0.409)	(0.772)	(0.032)	(0.865)	(0.855)
Equality	-1.913	-8.936	2.294	15.382	6.087	7.614
	(0.746)	(0.400)	(0.701)	(0.180)	(0.630)	(0.676)
Aid×Budget balance	0.095	-0.051	0.026	0.011	-0.410	-0.415
	(0.597)	(0.816)	(0.893)	(0.966)	(0.173)	(0.143)
Repayment×Budget balance	-0.972**	-0.544	-0.686	-0.762	-0.161	-0.194
	(0.035)	(0.219)	(0.107)	(0.109)	(0.755)	(0.757)
Income	-1.550***	-4.325***	-1.651***	-6.122***	-11.954***	-13.028
	(0.001)	(0.000)	(0.002)	(0.000)	(0.000)	(0.208)
Life expectancy	-0.006	-0.067*	-0.014	-0.009	-0.087	-0.082
	(0.875)	(0.057)	(0.769)	(0.850)	(0.211)	(0.282)
Openness	0.833	0.160	0.772	-0.427	-0.308	-0.408
	(0.119)	(0.772)	(0.121)	(0.463)	(0.601)	(0.697)
Institutions	0.442***		0.486***			
	(0.000)		(0.000)			
Inflation	-1.385***	-1.324***	-1.286***	-1.151***	-1.156***	-1.144***
	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.030	0.050	0.002	0.014	0.034	0.034
	(0.233)	(0.117)	(0.933)	(0.585)	(0.474)	(0.446)
Budget balance	0.731*	0.824**	0.472	0.959**	0.673	0.684
	(0.100)	(0.022)	(0.231)	(0.023)	(0.119)	(0.118)
Revolutions	-0.706***	-0.823***	-0.573**	-0.686***	-0.954**	-0.954***
	(0.005)	(0.003)	(0.014)	(0.009)	(0.011)	(0.005)
Sub-Saharan Africa	-1.831**		-1.617**			
	(0.016)		(0.042)			
South-East Asia	1.969***		1.813***			
	(0.002)		(0.004)			
Geography	0.641***		0.762***			
	(0.003)		(0.000)			
Ethnic fractionalisation	0.419		-0.002			
	(0.686)		(0.999)			
Observations	267	267	207	207	207	207
Estimator	OLS	F-E	OLS	F-E	OLS	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	Yes	Yes
Sample	c	c	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in the columns 7-12 of panel B in Table 3.4 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.10: Aid on Growth: Samples with Different Mean Equality Levels I

PANEL A

	Sample									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Aid	0.167	0.129	-0.344**	-0.509***	-0.855***	0.269	-0.064	-0.324	-0.676**	-1.875***
	(0.634)	(0.474)	(0.025)	(0.002)	(0.000)	(0.278)	(0.818)	(0.138)	(0.015)	(0.002)
Income	-2.221***	-2.351***	-1.656***	-0.999**	-0.414	-9.677***	-7.287***	-4.440***	-5.127***	-7.943
	(0.005)	(0.000)	(0.000)	(0.044)	(0.589)	(0.000)	(0.000)	(0.000)	(0.004)	(0.101)
Equality	-18.691	-11.903	2.419	16.818	22.865	-29.083	-15.488	2.327	23.564	97.946
	(0.444)	(0.253)	(0.598)	(0.230)	(0.351)	(0.232)	(0.350)	(0.783)	(0.337)	(0.139)
Repayment	2.967	2.467**	0.241	-0.374	-0.223	4.931**	2.232	0.198	-0.440	0.023
	(0.133)	(0.021)	(0.548)	(0.475)	(0.701)	(0.011)	(0.185)	(0.604)	(0.348)	(0.962)
Life expectancy	0.064	0.068	-0.005	-0.057	-0.213**	-0.745**	-0.403***	-0.060*	-0.036	-0.291
	(0.623)	(0.322)	(0.900)	(0.136)	(0.034)	(0.019)	(0.003)	(0.073)	(0.489)	(0.222)
Openness	1.219	1.029	0.880*	1.250	0.663	-3.668**	-1.289	0.392	1.205	-0.462
	(0.275)	(0.189)	(0.098)	(0.120)	(0.468)	(0.036)	(0.198)	(0.478)	(0.261)	(0.732)
Institutions	0.226	0.446***	0.443***	0.370**	0.349*					
	(0.547)	(0.008)	(0.000)	(0.024)	(0.099)					
Inflation	-2.918*	-1.576**	-1.433***	-1.546***	-1.190**	0.625	-1.966*	-1.294***	-0.972**	-0.541
	(0.090)	(0.014)	(0.000)	(0.000)	(0.037)	(0.867)	(0.081)	(0.002)	(0.022)	(0.608)
Broad money	0.012	0.078**	0.019	0.002	-0.024	0.000	0.100**	0.045*	0.005	-0.122
	(0.782)	(0.042)	(0.413)	(0.961)	(0.674)	(0.999)	(0.012)	(0.084)	(0.927)	(0.378)
Budget balance	1.456	-0.337	0.079	0.124	-0.189	10.351**	0.145	0.378*	0.427	1.012
	(0.583)	(0.266)	(0.694)	(0.748)	(0.415)	(0.015)	(0.756)	(0.054)	(0.311)	(0.209)
Revolutions	-0.344	-0.710	-0.650**	-0.360	-0.233	-6.459***	-1.675***	-0.735**	0.188	2.019
	(0.766)	(0.112)	(0.011)	(0.262)	(0.789)	(0.000)	(0.001)	(0.012)	(0.741)	(0.247)
Sub-Saharan Africa	-2.497	-2.996*	-1.888**	-1.479	-1.827*					
	(0.281)	(0.050)	(0.014)	(0.155)	(0.055)					
South-East Asia	3.368*	1.988**	1.772***	0.713	1.511					
	(0.078)	(0.042)	(0.002)	(0.307)	(0.242)					
Geography	0.777*	0.817***	0.609***	0.228	-0.589					
	(0.060)	(0.001)	(0.005)	(0.514)	(0.412)					
Ethnic fractionalisation	-0.784	0.609	0.329	0.949	-2.170					
	(0.646)	(0.545)	(0.743)	(0.388)	(0.308)					
Observations	65	131	267	136	66	65	131	267	136	66
Mean Equality	0.59	0.57	0.53	0.51	0.49	0.59	0.57	0.53	0.51	0.49
Estimator	OLS	OLS	OLS	OLS	OLS	F-E	F-E	F-E	F-E	F-E
Include controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First difference?	No	No	No	No	No	No	No	No	No	No

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in the panel A in Table 3.5 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.11: Aid on Growth: Samples with Different Mean Equality Levels II

PANEL A

	Sample									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Aid	0.268	0.189	-0.520**	-0.898***	-1.334***	1.157	0.561	-0.622	-1.255*	-1.747**
	(0.637)	(0.492)	(0.046)	(0.006)	(0.005)	(0.269)	(0.294)	(0.157)	(0.056)	(0.013)
Income	-12.904***	-12.670***	-12.139***	-11.122***	-11.367**	6.667	-4.157	-15.706	-34.931	-33.497*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.013)	(0.562)	(0.681)	(0.131)	(0.282)	(0.087)
Equality	12.818	10.177	18.993**	25.947	-1.439	-24.850	-2.583	22.945	40.666	18.304
	(0.611)	(0.530)	(0.035)	(0.113)	(0.963)	(0.550)	(0.918)	(0.116)	(0.150)	(0.609)
Repayment	3.373	3.507**	0.064	-0.461	0.261	4.578	3.147*	0.021	-0.515	-0.080
	(0.132)	(0.017)	(0.878)	(0.314)	(0.701)	(0.191)	(0.065)	(0.964)	(0.508)	(0.944)
Life expectancy	-0.232	0.066	-0.077	-0.126*	-0.132	-0.625	-0.011	-0.061	-0.030	-0.038
	(0.585)	(0.680)	(0.282)	(0.059)	(0.364)	(0.244)	(0.958)	(0.494)	(0.906)	(0.866)
Openness	-1.527	-0.274	-0.061	0.375	0.718	1.260	0.546	-0.412	-1.788	-1.373
	(0.401)	(0.789)	(0.918)	(0.657)	(0.664)	(0.641)	(0.713)	(0.685)	(0.541)	(0.564)
Inflation	3.277	-1.127	-1.058***	-0.989***	-0.945**	12.585	-1.207*	-1.026***	-0.741	-0.326
	(0.587)	(0.122)	(0.000)	(0.001)	(0.045)	(0.346)	(0.073)	(0.000)	(0.125)	(0.697)
Broad money	-0.553	0.146***	0.051*	0.034	0.020	-0.187	0.162***	0.049*	0.039	0.008
	(0.380)	(0.000)	(0.087)	(0.455)	(0.796)	(0.832)	(0.001)	(0.068)	(0.524)	(0.921)
Budget balance	21.139	0.338*	0.198	-0.082	-0.280	15.959	0.555***	0.131	-0.209	-0.463
	(0.227)	(0.057)	(0.254)	(0.820)	(0.476)	(0.486)	(0.004)	(0.618)	(0.770)	(0.387)
Revolutions	-2.785*	-1.541***	-0.884**	-0.133	-0.237	0.236	-1.527***	-0.888***	-0.331	-0.224
	(0.083)	(0.000)	(0.018)	(0.767)	(0.860)	(0.936)	(0.000)	(0.009)	(0.645)	(0.887)
Observations	45	97	207	110	54	45	97	207	110	54
Mean Equality	0.59	0.57	0.53	0.51	0.49	0.59	0.57	0.53	0.51	0.49
Estimator	OLS	OLS	OLS	OLS	OLS	A-H	A-H	A-H	A-H	A-H
Include controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
First difference?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in the panel B in Table 3.5 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.12: The Effect of Aid on Growth: Dynamic GMM Estimation

	I		II		III		IV	
	a	b	a	b	a	b	a	b
Aid	-5.329***	-3.549	-5.436***	-3.671*	-5.805***	-3.826*	-5.893**	-4.746*
	(0.007)	(0.111)	(0.004)	(0.086)	(0.002)	(0.069)	(0.021)	(0.073)
Aid^2		-0.0651		-0.0654*		-0.0705*		-0.0630
		(0.106)		(0.096)		(0.069)		(0.117)
Repayment	-3.113	-1.938	-3.016	-1.859	-3.591	-2.440	-3.443	-3.397
	(0.526)	(0.716)	(0.535)	(0.721)	(0.497)	(0.625)	(0.556)	(0.598)
Repayment^2		-0.0431		-0.0523		-0.0996		-0.0998
		(0.859)		(0.827)		(0.657)		(0.696)
Aid×Equality	9.987**	7.513*	10.21***	7.768**	11.04***	8.187**	11.06**	9.875*
	(0.011)	(0.060)	(0.007)	(0.041)	(0.004)	(0.026)	(0.040)	(0.067)
Repayment×Equality	6.102	3.548	5.877	3.280	6.980	4.044	6.593	5.759
	(0.519)	(0.705)	(0.531)	(0.721)	(0.496)	(0.649)	(0.557)	(0.612)
Equality	-5.401	-0.658	-5.909	-1.304	-7.062	-1.284	-5.817	-3.653
	(0.457)	(0.922)	(0.384)	(0.838)	(0.358)	(0.840)	(0.595)	(0.723)
Polity 2	-0.0180	-0.00926	-0.0183	-0.00948	-0.0217	-0.0111	-0.0186	-0.0149
	(0.657)	(0.822)	(0.651)	(0.817)	(0.579)	(0.773)	(0.655)	(0.712)
Aggriculture: value added	0.122	0.0891	0.132	0.102	0.170	0.120	0.142	0.161
	(0.263)	(0.410)	(0.173)	(0.279)	(0.194)	(0.213)	(0.483)	(0.424)
Industry: value added	0.0987**	0.109**	0.0987**	0.108**	0.0998**	0.113***	0.106**	0.120***
	(0.029)	(0.017)	(0.028)	(0.016)	(0.022)	(0.008)	(0.018)	(0.008)
Income	0.893	-0.114	1.155	0.266	2.126	0.656	1.256	1.757
	(0.773)	(0.971)	(0.668)	(0.921)	(0.554)	(0.812)	(0.826)	(0.756)
Life expectancy	-0.0849	-0.0832	-0.0882*	-0.0889	-0.0957	-0.0885*	-0.0865	-0.109
	(0.117)	(0.158)	(0.083)	(0.106)	(0.111)	(0.096)	(0.420)	(0.307)
Openness	1.173**	1.027**	1.183***	1.038**	1.186**	1.015**	1.244**	1.150**
	(0.010)	(0.024)	(0.010)	(0.024)	(0.017)	(0.030)	(0.015)	(0.025)
Institutions	0.398**	0.518***	0.390**	0.507***	0.353*	0.505***	0.386	0.438
	(0.026)	(0.002)	(0.024)	(0.002)	(0.097)	(0.002)	(0.193)	(0.110)
Inflation	-1.478***	-1.296***	-1.501***	-1.327***	-1.497***	-1.279***	-1.423***	-1.345***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.005)	(0.007)
Broad money	0.0498	0.0363	0.0532*	0.0412	0.0383	0.0227	0.0441	0.0353
	(0.184)	(0.345)	(0.097)	(0.207)	(0.332)	(0.577)	(0.278)	(0.357)
Budget balance	0.00313	0.0442	-0.00420	0.0358	-0.0561	0.00734	-0.0233	0.000153
	(0.982)	(0.728)	(0.975)	(0.768)	(0.737)	(0.955)	(0.878)	(0.999)
Revolutions	-0.544*	-0.537*	-0.533*	-0.520*	-0.540*	-0.549*	-0.545	-0.487
	(0.080)	(0.082)	(0.077)	(0.078)	(0.085)	(0.064)	(0.135)	(0.199)
Sub-Saharan Africa	-1.751**	-2.321***	-1.720**	-2.277***	-1.575**	-2.178***	-1.696*	-1.954**
	(0.018)	(0.008)	(0.016)	(0.006)	(0.037)	(0.001)	(0.078)	(0.036)
South-East Asia	1.447**	1.410**	1.409**	1.367**	1.390*	1.341*	1.383*	1.316*
	(0.047)	(0.047)	(0.042)	(0.043)	(0.060)	(0.051)	(0.051)	(0.059)
Geography	0.529**	0.631**	0.513**	0.606***	0.529**	0.652***	0.539*	0.603**
	(0.029)	(0.012)	(0.022)	(0.009)	(0.038)	(0.005)	(0.060)	(0.029)
Ethnic fractionalisation	0.344	0.259	0.390	0.322	0.558	0.412	0.468	0.429
	(0.735)	(0.804)	(0.682)	(0.744)	(0.536)	(0.658)	(0.586)	(0.594)
No. of IVs	29	31	30	32	28	30	28	30
Observations	233	233	233	233	233	233	233	233
Groups	51	51	51	51	51	51	51	51
Hansen test	1.618	2.047	1.620	2.107	0.469	1.040	0.003	0.002
P-value (Hansen)	0.445	0.359	0.655	0.551	0.493	0.308	0.960	0.969
AR(2) (ser. cor.)	0.035	0.036	0.033	0.034	0.038	0.035	0.046	0.049
AR(3)	0.145	0.120	0.147	0.121	0.162	0.125	0.162	0.160
AR(4)	0.533	0.448	0.555	0.475	0.578	0.456	0.570	0.563
Estimator	system	system	system	system	system	system	system	system
Instr. growth?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instr. other vars?	No	No	No	No	No	No	No	No
Lags as IVs	3-4	3-4	3-5	3-5	3	3	4	4

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: These are the full set of estimated coefficients for the estimation results reported in Table 3.6 in the main text. Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average); Regressions also include constant, time period dummies. For more details on the variables, see Table B.1 in Section B of the Appendix; standard errors are robust; 'Yes' to 'Instr. income?' means that initial income was instrumented using its own lags and lagged differences; Yes' to 'Instr. other vars?' means all other variables beside initial income were instrumented using their own lags and lagged differences. All results are based on the collapsed instrument matrix.

B.3 Results Reporting the Coefficient Estimates when Testing Specification Without the Full Set of Control Variables

This section reports results when testing a specification without the full set of control variables.

Table B.13: The Effect of Aid on Growth:
Net ODA by All Donors as the Aid Measure, Specification without the Full Set of Control Variables

PANEL A: Without Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.104**	-0.201	0.026	-0.131	-0.067	-0.155	0.158*	-0.253*	-0.027	-0.311*	-0.148	-0.543
	(0.042)	(0.208)	(0.714)	(0.415)	(0.312)	(0.338)	(0.065)	(0.063)	(0.833)	(0.093)	(0.364)	(0.116)
Aid^2		0.004		0.006		0.004		0.015***		0.009		0.012
		(0.537)		(0.385)		(0.617)		(0.000)		(0.197)		(0.130)
Income	-0.067	-0.214	-4.034***	-4.346***	0.201	0.065	-5.606***	-6.287***	-11.967***	-12.161***	-23.075**	-24.132**
	(0.860)	(0.642)	(0.000)	(0.000)	(0.661)	(0.897)	(0.000)	(0.000)	(0.000)	(0.000)	(0.042)	(0.044)
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

PANEL B: With Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.163	-0.513	-0.536	-1.077*	0.039	-0.301	1.261	0.241	-0.146	-1.035	0.619	-0.453
	(0.782)	(0.360)	(0.416)	(0.078)	(0.952)	(0.595)	(0.135)	(0.780)	(0.857)	(0.148)	(0.592)	(0.699)
Aid^2		0.005		0.008		0.005		0.016***		0.011		0.013
		(0.434)		(0.264)		(0.486)		(0.002)		(0.143)		(0.142)
Aid×Equality	0.116	0.557	1.079	1.727	-0.218	0.204	-2.102	-0.966	0.231	1.304	-1.574	-0.302
	(0.918)	(0.595)	(0.370)	(0.112)	(0.858)	(0.852)	(0.165)	(0.491)	(0.871)	(0.293)	(0.489)	(0.889)
Equality	8.114	7.160	-4.792	-6.586	17.529**	16.868**	29.928***	27.816***	18.268	13.263	41.360*	35.802
	(0.302)	(0.351)	(0.613)	(0.477)	(0.022)	(0.028)	(0.008)	(0.006)	(0.135)	(0.277)	(0.069)	(0.120)
Income	-0.254	-0.407	-3.861***	-4.192***	-0.260	-0.424	-6.717***	-7.335***	-12.249***	-12.356***	-28.518**	-29.065**
	(0.520)	(0.395)	(0.000)	(0.000)	(0.611)	(0.459)	(0.000)	(0.000)	(0.000)	(0.000)	(0.046)	(0.047)
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is net ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table B.14: The Effect of Aid on Growth:
Net ODA by DAC Donors as the Aid Measure, Specification without the Full Set of Control Variables

PANEL A: Without Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.289***	-0.307	-0.111	-0.149	-0.228**	-0.164	-0.062	-0.694**	-0.254	-0.343	-0.430*	-0.606
	(0.004)	(0.179)	(0.427)	(0.620)	(0.030)	(0.462)	(0.666)	(0.015)	(0.110)	(0.392)	(0.089)	(0.263)
Aid^2		0.002		0.003		-0.006		0.060***		0.007		0.014
		(0.921)		(0.874)		(0.731)		(0.001)		(0.786)		(0.624)
Income	-0.377	-0.386	-4.385***	-4.407***	-0.116	-0.084	-6.084***	-6.350***	-12.337***	-12.359***	-22.284**	-22.436**
	(0.393)	(0.402)	(0.000)	(0.000)	(0.813)	(0.866)	(0.000)	(0.000)	(0.000)	(0.000)	(0.023)	(0.025)
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

PANEL B: With Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.175	-0.176	-1.830*	-1.941*	-0.122	0.113	-0.060	0.054	-1.258	-1.501	-0.259	-0.601
	(0.848)	(0.847)	(0.063)	(0.061)	(0.889)	(0.893)	(0.974)	(0.977)	(0.223)	(0.211)	(0.860)	(0.690)
Aid^2		0.000		0.006		-0.008		0.056***		0.009		0.013
		(0.998)		(0.719)		(0.570)		(0.000)		(0.720)		(0.661)
Aid×Equality	-0.221	-0.219	3.254*	3.324*	-0.267	-0.533	-0.076	-1.394	1.890	2.130	-0.461	-0.118
	(0.901)	(0.898)	(0.077)	(0.073)	(0.874)	(0.735)	(0.981)	(0.671)	(0.327)	(0.278)	(0.877)	(0.967)
Equality	9.057	9.053	-8.506	-8.812	18.898**	19.569**	21.292**	21.894**	14.020	13.063	34.386	32.974
	(0.262)	(0.256)	(0.360)	(0.334)	(0.019)	(0.015)	(0.036)	(0.026)	(0.254)	(0.299)	(0.115)	(0.123)
Income	-0.591	-0.591	-4.229***	-4.267***	-0.659	-0.627	-6.947***	-7.136***	-12.543***	-12.553***	-26.623**	-26.581**
	(0.200)	(0.219)	(0.000)	(0.000)	(0.250)	(0.282)	(0.000)	(0.000)	(0.000)	(0.000)	(0.028)	(0.027)
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is net ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table B.15: The Effect of Aid on Growth:
Early Impact ODA by All Donors as the Aid Measure, Specification without the Full Set of Control Variables

PANEL A: Without Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.386***	-0.267	-0.249	-0.143	-0.309*	-0.180	-0.043	-0.761	-0.357*	-0.321	-0.415	-0.439
	(0.004)	(0.394)	(0.159)	(0.714)	(0.059)	(0.615)	(0.840)	(0.178)	(0.095)	(0.502)	(0.184)	(0.493)
Aid^2		-0.011		-0.011		-0.017		0.089*		-0.005		0.001
		(0.575)		(0.726)		(0.432)		(0.096)		(0.881)		(0.990)
Repayment	0.299	0.394	0.162	0.569	0.275	-0.588	0.187	1.200	0.131	-0.464	0.117	-0.306
	(0.266)	(0.617)	(0.596)	(0.502)	(0.386)	(0.563)	(0.574)	(0.140)	(0.698)	(0.617)	(0.750)	(0.756)
$Repayment^2$		0.021		0.105		-0.239		0.229		-0.142		-0.100
		(0.918)		(0.590)		(0.331)		(0.200)		(0.512)		(0.677)
Income	-0.439	-0.389	-4.593***	-4.589***	-0.191	0.007	-5.080***	-5.663***	-12.169***	-12.093***	-14.904*	-15.169*
	(0.342)	(0.455)	(0.000)	(0.000)	(0.722)	(0.990)	(0.000)	(0.000)	(0.000)	(0.000)	(0.094)	(0.066)
Observations	266	266	266	266	207	207	207	207	206	206	206	206
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

PANEL B: With Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.971	-0.717	-4.437***	-4.289**	0.252	0.380	-3.143	-1.710	-3.303*	-3.542*	-3.084*	-3.387*
	(0.407)	(0.586)	(0.005)	(0.012)	(0.842)	(0.781)	(0.316)	(0.635)	(0.058)	(0.057)	(0.069)	(0.057)
Aid^2		-0.014		-0.008		-0.018		0.114**		0.001		0.007
		(0.496)		(0.782)		(0.389)		(0.040)		(0.987)		(0.863)
Repayment	-3.703	-4.866	-4.232	-3.733	3.704	0.112	-9.725**	-10.961**	0.389	-1.868	-0.141	-1.691
	(0.482)	(0.468)	(0.350)	(0.481)	(0.502)	(0.987)	(0.010)	(0.042)	(0.939)	(0.792)	(0.979)	(0.825)
$Repayment^2$		-0.073		0.024		-0.249		0.179		-0.143		-0.086
		(0.762)		(0.910)		(0.368)		(0.342)		(0.554)		(0.754)
Aid×Equality	1.111	0.866	7.889***	7.743***	-1.211	-1.180	5.819	1.463	5.398*	5.829*	4.815	5.253*
	(0.632)	(0.716)	(0.007)	(0.009)	(0.634)	(0.634)	(0.296)	(0.828)	(0.083)	(0.053)	(0.123)	(0.070)
Repayment×Equality	7.582	9.398	8.351	7.554	-7.096	-1.793	19.084***	23.292**	-0.892	2.383	0.087	2.442
	(0.461)	(0.438)	(0.343)	(0.432)	(0.510)	(0.887)	(0.010)	(0.016)	(0.928)	(0.848)	(0.993)	(0.855)
Equality	14.266	15.542	-5.863	-5.767	16.310	18.408*	20.720*	28.628**	14.189	14.565	20.743	20.599
	(0.154)	(0.127)	(0.587)	(0.593)	(0.120)	(0.077)	(0.076)	(0.026)	(0.251)	(0.249)	(0.271)	(0.238)
Income	-0.677	-0.606	-4.443***	-4.431***	-0.597	-0.431	-6.054***	-6.840***	-12.442***	-12.397***	-16.596*	-16.483*
	(0.141)	(0.233)	(0.000)	(0.000)	(0.307)	(0.491)	(0.000)	(0.000)	(0.000)	(0.000)	(0.089)	(0.062)
Observations	266	266	266	266	207	207	207	207	206	206	206	206
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is early impact ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

Table B.16: The Effect of Aid on Growth:
Early Impact ODA by DAC Donors as Aid Measure, Specification without the Full Set of Control Variables

PANEL A: Without Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.478***	-0.300	-0.261	-0.010	-0.369*	-0.105	-0.090	-0.625	-0.375	-0.236	-0.425	-0.343
	(0.004)	(0.412)	(0.231)	(0.983)	(0.051)	(0.788)	(0.730)	(0.285)	(0.138)	(0.686)	(0.212)	(0.649)
Aid^2		-0.023		-0.030		-0.035		0.084		-0.018		-0.010
		(0.427)		(0.485)		(0.221)		(0.168)		(0.740)		(0.882)
Income	-0.373	-0.304	-4.525***	-4.501***	-0.136	0.020	-5.100***	-5.534***	-12.140***	-12.069***	-14.494*	-14.474*
	(0.393)	(0.524)	(0.000)	(0.000)	(0.791)	(0.971)	(0.000)	(0.000)	(0.000)	(0.000)	(0.088)	(0.074)
Repayment	0.180	0.195	0.165	1.059	0.337	-0.014	0.175	1.377	0.166	0.096	0.163	0.289
	(0.614)	(0.856)	(0.667)	(0.357)	(0.355)	(0.991)	(0.643)	(0.144)	(0.685)	(0.935)	(0.700)	(0.817)
Repayment^2		0.008		0.263		-0.105		0.301		-0.017		0.035
		(0.980)		(0.341)		(0.746)		(0.189)		(0.951)		(0.910)
Observations	267	267	267	267	207	207	207	207	207	207	207	207
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

PANEL B: With Aid-Equality Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.857	-0.287	-5.442***	-4.910**	-0.455	0.282	-3.451	-2.709	-4.438**	-4.264*	-4.057**	-3.961*
	(0.559)	(0.858)	(0.005)	(0.018)	(0.760)	(0.856)	(0.384)	(0.498)	(0.037)	(0.080)	(0.049)	(0.072)
Aid^2		-0.028		-0.025		-0.038		0.090*		-0.009		-0.001
		(0.309)		(0.554)		(0.167)		(0.080)		(0.871)		(0.982)
Aid×Equality	0.701	0.010	9.759***	9.118**	0.036	-0.823	6.277	3.823	7.508**	7.315*	6.658*	6.514*
	(0.808)	(0.997)	(0.005)	(0.011)	(0.990)	(0.767)	(0.370)	(0.602)	(0.046)	(0.064)	(0.087)	(0.089)
Equality	11.616	13.024	-7.851	-7.248	15.248	16.792*	19.148	23.427*	12.629	12.835	17.342	17.242
	(0.232)	(0.189)	(0.455)	(0.495)	(0.134)	(0.097)	(0.105)	(0.055)	(0.321)	(0.320)	(0.346)	(0.316)
Income	-0.570	-0.500	-4.318***	-4.366***	-0.506	-0.372	-5.974***	-6.537***	-12.296***	-12.281***	-15.350	-15.285*
	(0.181)	(0.277)	(0.000)	(0.000)	(0.349)	(0.516)	(0.000)	(0.000)	(0.000)	(0.000)	(0.106)	(0.082)
Repayment	0.892	0.423	-5.283	-2.087	3.408	2.701	-10.540***	-9.768*	-1.293	-0.792	-1.078	0.143
	(0.873)	(0.952)	(0.324)	(0.738)	(0.547)	(0.693)	(0.008)	(0.087)	(0.841)	(0.923)	(0.871)	(0.987)
Repayment^2		-0.049		0.234		-0.110		0.288		0.022		0.101
		(0.878)		(0.426)		(0.734)		(0.287)		(0.943)		(0.783)
Repayment×Equality	-1.753	-1.154	10.441	5.724	-6.494	-5.807	20.612**	21.450**	2.499	1.664	2.059	0.373
	(0.873)	(0.928)	(0.318)	(0.610)	(0.558)	(0.641)	(0.011)	(0.036)	(0.841)	(0.910)	(0.872)	(0.981)
Observations	267	267	267	267	207	207	207	207	207	207	207	207
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	No	No	No	No	No	No	No	No	No	No	No	No
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is early impact ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample c is an unbalanced panel of 55 countries and 7 time periods; sample d is an unbalanced panel of 51 countries and 6 time periods.

B.4 Additional Results using Other Aid Measures and Estimators

Table B.17: The Effect of Aid on Growth:
Net ODA by DAC Donors as the Aid Measure, Specification without the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.202**	-0.094	-0.165	-0.223	-0.168*	0.111	-0.148	-0.794***	-0.319**	-0.403	-0.520*	-0.720
	(0.014)	(0.618)	(0.227)	(0.484)	(0.055)	(0.493)	(0.323)	(0.007)	(0.041)	(0.339)	(0.077)	(0.252)
Aid^2		-0.009		0.005		-0.023**		0.060***		0.007		0.015
		(0.438)		(0.821)		(0.046)		(0.001)		(0.810)		(0.618)
Income	-1.538***	-1.488***	-4.164***	-4.203***	-1.556***	-1.459***	-5.909***	-6.243***	-11.988***	-12.016***	-21.855**	-22.048*
	(0.001)	(0.003)	(0.000)	(0.000)	(0.005)	(0.007)	(0.000)	(0.000)	(0.000)	(0.000)	(0.049)	(0.052)
Life expectancy	-0.007	-0.010	-0.053	-0.052	-0.027	-0.037	-0.035	-0.022	-0.066	-0.062	-0.022	-0.013
	(0.847)	(0.777)	(0.121)	(0.129)	(0.555)	(0.416)	(0.349)	(0.511)	(0.313)	(0.346)	(0.843)	(0.915)
Openness	0.886*	0.829	0.389	0.385	0.787	0.665	-0.167	-0.268	-0.161	-0.169	-1.164	-1.196
	(0.098)	(0.116)	(0.431)	(0.436)	(0.129)	(0.196)	(0.777)	(0.639)	(0.787)	(0.777)	(0.271)	(0.275)
Institutions	0.424***	0.442***			0.512***	0.580***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.573***	-1.544***	-1.386***	-1.391***	-1.378***	-1.281***	-1.116***	-1.155***	-1.190***	-1.200***	-1.146***	-1.169***
	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.015	0.013	0.029	0.030	-0.019	-0.022	0.002	-0.002	0.023	0.022	0.014	0.012
	(0.549)	(0.599)	(0.255)	(0.264)	(0.338)	(0.284)	(0.933)	(0.928)	(0.541)	(0.552)	(0.700)	(0.754)
Budget balance	0.126	0.139	0.356*	0.360*	0.009	0.044	0.253*	0.242*	0.266	0.259	0.068	0.050
	(0.507)	(0.459)	(0.061)	(0.062)	(0.952)	(0.775)	(0.077)	(0.087)	(0.205)	(0.217)	(0.815)	(0.870)
Revolutions	-0.571**	-0.571**	-0.715**	-0.716**	-0.446	-0.437	-0.474*	-0.427	-0.925***	-0.920**	-0.968***	-0.956***
	(0.038)	(0.040)	(0.016)	(0.015)	(0.110)	(0.111)	(0.068)	(0.103)	(0.010)	(0.011)	(0.005)	(0.006)
Sub-Saharan Africa	-1.861**	-1.951**			-1.823**	-2.097***						
	(0.016)	(0.011)			(0.022)	(0.007)						
South-East Asia	1.800***	1.851***			1.848***	1.963***						
	(0.002)	(0.001)			(0.001)	(0.001)						
Geography	0.531***	0.555***			0.837***	0.908***						
	(0.009)	(0.008)			(0.000)	(0.000)						
Ethnic fractionalisation	0.275	0.336			-0.086	0.073						
	(0.789)	(0.742)			(0.946)	(0.953)						
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is net ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table B.18: The Effect of Aid on Growth:
Net ODA by DAC Donors as the Aid Measure, Specification with the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-1.029	-0.844	-1.980**	-2.134**	-0.827	-0.236	-0.361	-0.246	-1.574	-1.850	-0.892	-1.375
	(0.146)	(0.236)	(0.046)	(0.041)	(0.296)	(0.717)	(0.841)	(0.894)	(0.128)	(0.125)	(0.536)	(0.348)
Aid^2		-0.006		0.008		-0.021**		0.056***		0.010		0.018
		(0.573)		(0.654)		(0.039)		(0.000)		(0.703)		(0.574)
Aid×Equality	1.588	1.373	3.426*	3.531*	1.247	0.613	0.342	-0.980	2.377	2.649	0.605	1.091
	(0.238)	(0.280)	(0.065)	(0.058)	(0.395)	(0.595)	(0.915)	(0.757)	(0.219)	(0.175)	(0.836)	(0.684)
Equality	-2.801	-2.437	-8.119	-8.554	6.084	7.289	20.307**	20.976**	8.171	7.053	24.049	21.979
	(0.596)	(0.638)	(0.393)	(0.359)	(0.247)	(0.142)	(0.031)	(0.022)	(0.509)	(0.579)	(0.256)	(0.282)
Income	-1.486***	-1.459***	-4.091***	-4.150***	-1.604***	-1.537***	-6.675***	-6.906***	-12.080***	-12.108***	-25.282*	-25.211*
	(0.004)	(0.006)	(0.000)	(0.000)	(0.005)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	(0.059)	(0.058)
Life expectancy	-0.002	-0.005	-0.051	-0.048	-0.024	-0.035	-0.021	-0.013	-0.060	-0.055	0.006	0.015
	(0.944)	(0.881)	(0.144)	(0.165)	(0.582)	(0.419)	(0.632)	(0.739)	(0.354)	(0.406)	(0.964)	(0.914)
Openness	0.860	0.824	0.256	0.242	0.943*	0.833	0.038	-0.031	-0.082	-0.108	-1.227	-1.261
	(0.104)	(0.116)	(0.626)	(0.646)	(0.065)	(0.104)	(0.947)	(0.957)	(0.884)	(0.850)	(0.270)	(0.272)
Institutions	0.419***	0.432***			0.470***	0.533***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.547***	-1.531***	-1.393***	-1.402***	-1.348***	-1.270***	-1.074***	-1.100***	-1.141***	-1.161***	-1.018***	-1.052***
	(0.000)	(0.000)	(0.002)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.002)
Broad money	0.016	0.014	0.030	0.031	-0.015	-0.018	-0.005	-0.010	0.028	0.027	0.016	0.014
	(0.537)	(0.569)	(0.201)	(0.207)	(0.446)	(0.369)	(0.828)	(0.660)	(0.409)	(0.430)	(0.653)	(0.701)
Budget balance	0.110	0.121	0.336*	0.342*	-0.009	0.029	0.275*	0.264*	0.247	0.237	-0.022	-0.037
	(0.552)	(0.510)	(0.072)	(0.071)	(0.948)	(0.840)	(0.055)	(0.077)	(0.219)	(0.244)	(0.948)	(0.915)
Revolutions	-0.610**	-0.604**	-0.801***	-0.806***	-0.471*	-0.444*	-0.472**	-0.399*	-0.887**	-0.885**	-0.857**	-0.854**
	(0.030)	(0.034)	(0.005)	(0.005)	(0.064)	(0.074)	(0.037)	(0.087)	(0.013)	(0.014)	(0.024)	(0.024)
Sub-Saharan Africa	-1.788**	-1.859**			-1.895**	-2.181***						
	(0.023)	(0.019)			(0.017)	(0.006)						
South-East Asia	1.917***	1.937***			1.499**	1.558**						
	(0.004)	(0.004)			(0.019)	(0.012)						
Geography	0.558***	0.571**			0.793***	0.851***						
	(0.010)	(0.010)			(0.000)	(0.000)						
Ethnic fractionalisation	0.362	0.390			0.447	0.556						
	(0.739)	(0.719)			(0.725)	(0.655)						
Observations	282	282	282	282	211	211	211	211	211	211	211	211
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	a	a	a	a	b	b	b	b	b	b	b	b

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is net ODA by DAC donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust. Sample a is an unbalanced panel of 59 countries and 7 time periods; sample b is an unbalanced panel of 55 countries and 6 time periods.

Table B.19: The Effect of Aid on Growth:
Early Impact ODA by All Donors as the Aid Measure, Specification without the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-0.285**	-0.012	-0.301*	-0.242	-0.239*	0.184	-0.167	-1.023*	-0.458**	-0.427	-0.502	-0.505
	(0.017)	(0.968)	(0.081)	(0.557)	(0.097)	(0.519)	(0.440)	(0.072)	(0.034)	(0.399)	(0.154)	(0.472)
Aid^2		-0.024		-0.005		-0.037**		0.105**		-0.003		0.000
		(0.213)		(0.887)		(0.035)		(0.048)		(0.935)		(0.994)
Repayment	0.303	0.955	0.242	1.081	0.363	0.744	0.163	1.561**	0.131	0.082	0.108	0.131
	(0.281)	(0.166)	(0.428)	(0.189)	(0.262)	(0.411)	(0.620)	(0.035)	(0.699)	(0.933)	(0.778)	(0.893)
$Repayment^2$		0.175		0.216		0.082		0.321**		-0.012		0.005
		(0.339)		(0.261)		(0.709)		(0.047)		(0.958)		(0.981)
Income	-1.667***	-1.621***	-4.448***	-4.512***	-1.730***	-1.550***	-5.162***	-5.906***	-11.845***	-11.827***	-13.624	-13.602
	(0.000)	(0.001)	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.157)	(0.123)
Life expectancy	-0.004	-0.008	-0.055	-0.061*	-0.015	-0.023	-0.028	-0.034	-0.081	-0.083	-0.075	-0.075
	(0.912)	(0.820)	(0.104)	(0.082)	(0.754)	(0.623)	(0.475)	(0.389)	(0.266)	(0.295)	(0.340)	(0.393)
Openness	0.903	0.874	0.399	0.429	0.726	0.659	-0.363	-0.434	-0.111	-0.112	-0.299	-0.296
	(0.102)	(0.102)	(0.454)	(0.430)	(0.157)	(0.183)	(0.515)	(0.448)	(0.859)	(0.858)	(0.766)	(0.748)
Institutions	0.466***	0.486***			0.516***	0.559***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.451***	-1.399***	-1.307***	-1.318***	-1.343***	-1.218***	-1.153***	-1.304***	-1.167***	-1.159***	-1.161***	-1.163***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.016	0.013	0.041*	0.046*	-0.010	-0.014	0.010	0.019	0.044	0.044	0.042	0.043
	(0.491)	(0.569)	(0.096)	(0.082)	(0.627)	(0.543)	(0.635)	(0.417)	(0.224)	(0.228)	(0.227)	(0.211)
Budget balance	0.045	0.025	0.366*	0.351*	-0.036	-0.013	0.369*	0.371	0.226	0.227	0.194	0.195
	(0.823)	(0.892)	(0.054)	(0.063)	(0.849)	(0.936)	(0.052)	(0.100)	(0.230)	(0.242)	(0.424)	(0.422)
Revolutions	-0.652**	-0.667**	-0.760**	-0.780***	-0.524*	-0.518*	-0.651**	-0.673**	-0.983***	-0.984***	-0.994***	-0.994***
	(0.018)	(0.019)	(0.010)	(0.010)	(0.051)	(0.053)	(0.024)	(0.020)	(0.008)	(0.009)	(0.003)	(0.003)
Sub-Saharan Africa	-1.772**	-1.885**			-1.616**	-1.836**						
	(0.016)	(0.011)			(0.037)	(0.019)						
South-East Asia	1.778***	1.822***			1.869***	1.952***						
	(0.001)	(0.000)			(0.001)	(0.000)						
Geography	0.645***	0.688***			0.754***	0.837***						
	(0.004)	(0.003)			(0.000)	(0.000)						
Ethnic fractionalisation	0.300	0.367			-0.391	-0.228						
	(0.751)	(0.687)			(0.736)	(0.832)						
Observations	266	266	266	266	206	206	206	206	206	206	206	206
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is early impact ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust.

Table B.20: The Effect of Aid on Growth:
Early Impact ODA by All Donors as the Aid Measure, Specification with the Interaction Term

	I		II		III		IV		V		VI	
	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)	(a)	(b)
Aid	-1.963*	-1.177	-4.611***	-4.261**	-1.239	-0.027	-3.619	-1.850	-3.764**	-3.823**	-3.724**	-3.851**
	(0.064)	(0.379)	(0.003)	(0.012)	(0.251)	(0.985)	(0.235)	(0.610)	(0.036)	(0.049)	(0.030)	(0.043)
Aid^2		-0.019		-0.003		-0.035*		0.121**		0.004		0.008
		(0.332)		(0.920)		(0.061)		(0.032)		(0.917)		(0.860)
Repayment	-2.550	0.240	-3.484	-1.037	0.602	3.033	-8.045**	-7.985	0.688	0.872	0.219	0.592
	(0.564)	(0.966)	(0.452)	(0.853)	(0.905)	(0.637)	(0.030)	(0.162)	(0.888)	(0.903)	(0.967)	(0.935)
Repayment^2		0.171		0.172		0.118		0.274		0.019		0.034
		(0.417)		(0.435)		(0.620)		(0.171)		(0.942)		(0.898)
Aid×Equality	3.247	2.159	8.096***	7.498**	1.917	0.354	6.452	1.357	6.084*	6.122*	5.898*	6.009**
	(0.112)	(0.348)	(0.004)	(0.011)	(0.350)	(0.886)	(0.233)	(0.841)	(0.057)	(0.051)	(0.054)	(0.040)
Repayment×Equality	5.448	1.250	7.014	3.534	-0.652	-4.377	15.711**	18.170*	-1.476	-1.683	-0.622	-1.069
	(0.528)	(0.903)	(0.438)	(0.727)	(0.947)	(0.701)	(0.029)	(0.071)	(0.874)	(0.891)	(0.950)	(0.933)
Equality	0.764	0.790	-6.384	-6.298	4.164	4.854	17.208	25.913**	8.081	7.920	11.573	10.774
	(0.898)	(0.895)	(0.557)	(0.566)	(0.488)	(0.412)	(0.131)	(0.047)	(0.503)	(0.521)	(0.533)	(0.524)
Income	-1.616***	-1.602***	-4.388***	-4.468***	-1.709***	-1.589***	-6.056***	-6.944***	-12.049***	-12.070***	-14.433	-14.138
	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.168)	(0.130)
Life expectancy	0.000	-0.004	-0.058*	-0.061*	-0.012	-0.021	-0.008	-0.014	-0.072	-0.070	-0.062	-0.060
	(0.997)	(0.918)	(0.086)	(0.076)	(0.795)	(0.642)	(0.859)	(0.772)	(0.324)	(0.381)	(0.459)	(0.515)
Openness	0.943*	0.938*	0.241	0.286	0.856*	0.811	-0.329	-0.316	-0.164	-0.163	-0.391	-0.358
	(0.082)	(0.075)	(0.666)	(0.618)	(0.099)	(0.110)	(0.578)	(0.616)	(0.783)	(0.787)	(0.704)	(0.704)
Institutions	0.460***	0.472***			0.495***	0.531***						
	(0.000)	(0.000)			(0.000)	(0.000)						
Inflation	-1.401***	-1.372***	-1.323***	-1.332***	-1.288***	-1.194***	-1.092***	-1.202***	-1.154***	-1.165***	-1.131***	-1.155***
	(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Broad money	0.020	0.016	0.045*	0.047*	-0.010	-0.014	0.004	0.009	0.046	0.047	0.045	0.046
	(0.424)	(0.489)	(0.077)	(0.070)	(0.619)	(0.529)	(0.828)	(0.643)	(0.127)	(0.138)	(0.106)	(0.106)
Budget balance	0.040	0.015	0.346*	0.336*	-0.041	-0.030	0.363**	0.393*	0.156	0.155	0.112	0.115
	(0.840)	(0.932)	(0.054)	(0.060)	(0.807)	(0.839)	(0.039)	(0.075)	(0.387)	(0.396)	(0.667)	(0.646)
Revolutions	-0.663**	-0.682**	-0.836***	-0.859***	-0.532**	-0.524**	-0.666**	-0.589**	-0.976***	-0.976***	-0.977***	-0.977***
	(0.014)	(0.015)	(0.003)	(0.003)	(0.032)	(0.037)	(0.010)	(0.029)	(0.008)	(0.009)	(0.003)	(0.004)
Sub-Saharan Africa	-1.750**	-1.849**			-1.654**	-1.887**						
	(0.018)	(0.015)			(0.034)	(0.020)						
South-East Asia	1.730***	1.742***			1.618**	1.649***						
	(0.005)	(0.003)			(0.011)	(0.006)						
Geography	0.673***	0.703***			0.774***	0.842***						
	(0.002)	(0.002)			(0.000)	(0.000)						
Ethnic fractionalisation	0.640	0.659			0.120	0.202						
	(0.525)	(0.502)			(0.918)	(0.856)						
Observations	266	266	266	266	206	206	206	206	206	206	206	206
Estimator	OLS	OLS	F-E	F-E	OLS	OLS	F-E	F-E	OLS	OLS	A-H	A-H
Controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Difference?	No	No	No	No	No	No	No	No	Yes	Yes	Yes	Yes
Sample	c	c	c	c	d	d	d	d	d	d	d	d

p-values in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is early impact ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average). For more details on the variables, see Table B.1 in Section B of the Appendix. Regressions also include a constant and time period dummies. Standard errors are robust.

Table B.21: The Effect of Aid on Growth: Dynamic GMM Estimation

	I		II		III		IV	
	a	b	a	b	a	b	a	b
Aid	-2.051	-1.484	-1.588	-1.956	-5.096*	-4.807	-6.370	-10.24*
	(0.250)	(0.298)	(0.268)	(0.191)	(0.062)	(0.188)	(0.263)	(0.069)
Aid^2		-0.0130		0.0133		-0.0109		0.0701
		(0.708)		(0.645)		(0.824)		(0.379)
Aid×Equality	4.285	3.498	2.148	2.526	10.04*	9.748	12.04	18.03*
	(0.189)	(0.213)	(0.448)	(0.337)	(0.073)	(0.131)	(0.275)	(0.077)
Equality	-15.41	-12.93	13.44	11.58	-33.24	-29.63	7.473	-2.050
	(0.292)	(0.362)	(0.597)	(0.636)	(0.204)	(0.249)	(0.904)	(0.964)
Income	4.241	3.878	-18.48	-18.34	0.483	0.553	-7.464	-5.701
	(0.296)	(0.238)	(0.188)	(0.164)	(0.830)	(0.793)	(0.261)	(0.293)
Life expectancy	-0.0978	-0.0686	0.00695	0.0129	-0.213	-0.194	0.0168	0.0646
	(0.745)	(0.832)	(0.958)	(0.922)	(0.291)	(0.256)	(0.935)	(0.712)
Openness	0.882	0.941	-0.584	-0.601	4.340**	4.687**	6.029*	5.074
	(0.522)	(0.577)	(0.690)	(0.672)	(0.045)	(0.038)	(0.096)	(0.115)
Institutions	-0.213	-0.178			0.460	0.474		
	(0.753)	(0.798)			(0.154)	(0.158)		
Inflation	-1.701**	-1.626**	-1.264***	-1.282***	0.446	0.824	2.152	2.229
	(0.011)	(0.026)	(0.002)	(0.002)	(0.879)	(0.746)	(0.420)	(0.408)
Broad money	0.0322	0.0286	0.0201	0.0181	0.0889	0.0861	0.208	0.144
	(0.405)	(0.504)	(0.570)	(0.607)	(0.297)	(0.331)	(0.220)	(0.348)
Budget balance	0.179	0.242	0.0438	0.0328	2.360	2.506	5.806**	6.620**
	(0.635)	(0.504)	(0.896)	(0.921)	(0.146)	(0.101)	(0.049)	(0.042)
Revolutions	-0.427	-0.515	-0.778**	-0.767**	1.894	2.213	1.054	0.590
	(0.623)	(0.626)	(0.046)	(0.049)	(0.207)	(0.220)	(0.639)	(0.791)
Sub-Saharan Africa	0.589	0.542			-3.069	-3.032		
	(0.889)	(0.903)			(0.245)	(0.178)		
South-East Asia	2.439*	2.384*			1.927	1.521		
	(0.057)	(0.085)			(0.440)	(0.546)		
Geography	0.515	0.566			1.194*	1.133		
	(0.172)	(0.139)			(0.080)	(0.112)		
Ethnic fractionalisation	2.376	2.654			-0.611	-0.0592		
	(0.495)	(0.446)			(0.833)	(0.983)		
Polity 2					0.0282	0.00380	0.0849	0.154
					(0.869)	(0.982)	(0.751)	(0.598)
No. of IVs	24	25	18	19	45	48	29	31
Observations	282	282	224	224	282	282	224	224
Groups	59	59	56	56	59	59	56	56
Hansen test	0.985	1.179	1.408	1.377	17.365	17.511	8.579	7.778
P-value (Hansen)	0.321	0.278	0.235	0.241	0.689	0.783	0.661	0.802
AR(2) (ser. cor.)	0.298	0.484	0.493	0.458	0.057	0.056	0.032	0.026
AR(3)	0.454	0.723	0.221	0.226	0.439	0.396	0.568	0.687
Estimator	system	system	difference	difference	system	system	difference	difference
Instr. income?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instr. other vars?	No	No	No	No	Yes	Yes	Yes	Yes
Lags as IVs	3-4	3-4	3-4	3-4	3-4	3-4	3-4	3-4

p-values in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Note: Measure of aid is net ODA by all donors, as defined in Section 3.6.1. Dependent variable is annual % change in real economic growth (5-year average); Regressions also include constant, time period dummies. For more details on the variables, see Table B.1 in Section B of the Appendix; standard errors are robust; 'Yes' to 'Instr. income?' means that initial income was instrumented using its own lags and lagged differences; Yes' to 'Instr. other vars?' means all other variables beside initial income were instrumented using their own lags and lagged differences. All results are based on the collapsed instrument matrix.

C Appendices to Chapter 4

C.1 The Optimal Decisions of the North and South

C.1.1 The South

To solve the problem of the Southern consumers, define the current value Hamiltonian of the South H_S:

$$H_S = ln(c_{St}) + \eta\, ln(a_{2t}^{\beta_2}) + \lambda \left(A\, k_{St} \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} - c_{St} - \delta\, k_{St} \right) \tag{80}$$

The first order conditions are:

$$\frac{1}{c_{St}} = \lambda_t \tag{81}$$

$$\lambda_t \left\{ (1 - \alpha_1 - \alpha_2)\, A \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} - \delta \right\} = -\dot{\lambda_t} - \rho\, \lambda_t \tag{82}$$

and the capital accumulation equation of the South:

$$\dot{k}_{St} = A\, k_{St} \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} - c_{St} - \delta\, k_{St} \tag{83}$$

Combining (81) and (82) , can obtain the Euler equation of the South as:

$$\frac{\dot{c_{St}}}{c_{St}} = (1 - \alpha_1 - \alpha_2)\, A \left(\frac{a_{1t}^{\beta_1}}{k_{St}}\right)^{\alpha_1} \left(\frac{a_{2t}^{\beta_2}}{k_{St}}\right)^{\alpha_2} - \delta - \rho \tag{84}$$

C.1.2 The North

Using the current value Hamiltonian H_N as defined by (44), can obtain the first order conditions as $\frac{\partial H}{\partial c_{Nt}} = 0$, $\frac{\partial H}{\partial a_t} = 0$, $\frac{\partial H}{\partial k_{Nt}} = -\dot{x}_{Nt} + \rho\, x_{Nt}$, $\frac{\partial H}{\partial k_{St}} = -\dot{x}_{St} + \rho\, x_{St}$, $\frac{\partial H}{\partial c_{St}} = -\dot{z}_{St} + \rho\, z_{St}$ (see (45)-(49)), the capital accumulation equations represented by (38), (35) and the transversality conditions (50)-(52).

Taking into account $z_t = 0$ the set of conditions becomes:

$$\begin{cases} \frac{1}{c_{Nt}} = x_{Nt} \\ \frac{\omega\, L_S\, \eta\, \beta_2}{a_t} + x_{St}\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, (\beta_1\, \alpha_1 + \beta_2\, \alpha_2) \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} \left(\frac{k_{St}}{a_t}\right) = x_{Nt} \\ x_{Nt}\, (-B + \delta + \rho) = \dot{x}_{Nt} \\ x_{St} \left(-(1-\alpha_1-\alpha_2) A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} + \delta + \rho\right) = \dot{x}_{St} \\ x_{St} = \frac{\omega\, L_S}{c_{St}} \\ \dot{k}_{St} = A\, \theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, k_{St}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} - c_{St} - \delta\, k_{St} \\ \dot{k}_{Nt} = Bk_{Nt} - c_{Nt} - a_t - \delta\, k_{Nt} \end{cases} \tag{85}$$

and the transversality conditions in (50) and (51). When combine the first four equations, the system can be rewritten as:

$$\begin{cases} \dot{k}_{Nt} = Bk_{Nt} - c_{Nt} - a_t - \delta\, k_{Nt} \\ \dot{k}_{St} = A\, \theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, k_{St}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} - c_{St} - \delta\, k_{St} \\ \frac{\dot{c}_{Nt}}{c_{Nt}} = B - \rho - \delta \\ \frac{\dot{c}_{St}}{c_{St}} = (1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} - \rho - \delta \\ \frac{1}{c_{Nt}} = \frac{\beta_2\, \omega\, L_S\, \eta}{a_t} + \frac{\omega\, L_S}{c_{St}}\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, (\beta_1\, \alpha_1 + \beta_2\, \alpha_2) \frac{a_t^{\beta_1\, \alpha_1 + \beta_2\, \alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} \left(\frac{k_{St}}{a_t}\right) \end{cases} \tag{86}$$

C.2 BGP

C.2.1 The North on the BGP

We look at the case where the Northern economy is one the BGP and the consumption and capital of the North grow at the same constant rate $\gamma_N \equiv \frac{\dot{k}_{Nt}}{k_{Nt}} = \frac{\dot{c}_{Nt}}{c_{Nt}}$. From the third equation in the system (53) can see that $\frac{\dot{c}_{Nt}}{c_{Nt}} = B - \delta - \rho$, so $\gamma_N \equiv \frac{\dot{k}_{Nt}}{k_{Nt}} = \frac{\dot{c}_{Nt}}{c_{Nt}} = B - \delta - \rho$.

Notice that capital and consumption of the North growing at the same constant rate implies $\gamma \equiv \frac{\dot{a}_t}{a_t} = \gamma_N$, i.e. aid if consumption and capital of the North grow at the rate γ, aid also should grow at the same rate. This is because if on the BGP $\frac{\dot{k}_{Nt}}{k_{Nt}} = B - \frac{c_{Nt}}{k_{Nt}} - \frac{a_t}{k_{Nt}} - \delta = B - \delta - \rho = \frac{\dot{c}_{Nt}}{c_{Nt}}$, then $\frac{a_t}{k_{Nt}} = \rho - \frac{c_{Nt}}{k_{Nt}}$. Because $\frac{\dot{k}_{Nt}}{k_{Nt}} = \frac{\dot{c}_{Nt}}{c_{Nt}}$ this implies $\frac{a_t}{k_{N0}\, e^{\gamma\, t}} = \rho - \frac{c_{N0}}{k_{N0}}$, the ratio of aid and capital of the borth should remain constant. As northern capital grow at the constant rate, this can only be consistent with the case where $a_t = a_0 \mathrm{e}^{\gamma\, t}$. Furthermore, this implies that at time zero:

$$a_0 + c_{N0} = \rho\, k_{N0} \tag{87}$$

So on the BGP the North chooses its consumption and aid such that it equals the capital of North multiplied by the time discount factor.

C.2.2 The South on the BGP

Similarly, when South is on the BGP it must hold that $c_{St} = c_{S0}\mathrm{e}^{\gamma_S\, t}$, $k_{St} = k_{S0}\mathrm{e}^{\gamma_S\, t}$, where $\gamma_S \equiv \frac{\dot{k}_{St}}{k_{St}} = \frac{\dot{c}_{St}}{c_{St}}$. Using that $\frac{\dot{c}_{St}}{c_{St}} = (1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}\, \frac{a_t^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{St}^{\alpha_1+\alpha_2}} - \rho - \delta$ this implies that on the BGP:

$$\frac{a_0^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{S0}^{\alpha_1+\alpha_2}} = \frac{(\gamma_S+\delta+\rho)}{(1-\alpha_1-\alpha_2)\, A\theta_1^{\beta_1\alpha_1}\, \theta_2^{\beta_2\alpha_2}} \tag{88}$$

where γ_S is the constant growth rate of the capital and consumption of South.

C.2.3 The Growth of the South given the North is on the BGP

Can multiply the last equation in the system (86) by a_t and as both aid and consumption of the North grow at rate γ, can use the fact that $\frac{a_t}{c_{Nt}} = \frac{a_0}{c_{N0}}$ simplify and rewrite it as:

$$\frac{a_0}{c_{N0}} = \beta_2\,\omega\, L_S\,\eta + \omega\, L_S\, A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}\,(\beta_1\,\alpha_1+\beta_2\,\alpha_2)\frac{a_t^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{St}^{\alpha_1+\alpha_2}}\left(\frac{k_{St}}{c_{St}}\right) \tag{89}$$

Can express $a_t = \left\{\left(\frac{a_0}{c_{N0}\,\omega\, L_S} - \beta_2\,\eta\right)\cdot \frac{1}{A\,\theta_1{}^{\beta_1\,\alpha_1}\theta_2^{\beta_2\,\alpha_2}(\beta_1\,\alpha_1+\beta_2\,\alpha_2)}\cdot\frac{c_{St}}{k_{St}}\right\}^{\frac{1}{\beta_1\alpha_1+\beta_2\alpha_2}} k_{St}^{\frac{\alpha_1+\alpha_2}{\beta_1\alpha_1+\beta_2\alpha_2}}$. When differentiate it with respect to time, and then use the fact that $\frac{\dot{a}_t}{a_t} = \gamma$, can show that $\frac{c_{St}}{k_{St}}$ equals:

$$\frac{c_{St}}{k_{St}} = \frac{(\beta_1\alpha_1+\beta_2\alpha_2)\,\gamma + (\delta+\rho)\,(\alpha_1+\alpha_2)}{(1-\alpha_1-\alpha_2)} + \rho \tag{90}$$

Now, when substitute this in equation (89) and rearrange get the following equation:

$$\frac{a_0}{c_{N0}}\,\frac{1}{\omega\, L_S} - \eta\,\beta_2 = \frac{A\,\theta_1^{\alpha_1\,\beta_1}\,\theta_2^{\alpha_2\,\beta_2}\,(\alpha_1\beta_1+\alpha_2\beta_2)\,\alpha_3\left(\frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}}\right)}{(\alpha_1\beta_1+\alpha_2\beta_2)\,\gamma + (\delta+\rho)(\alpha_1+\alpha_2) + \rho\,\alpha_3} \tag{91}$$

The left hand side of (91) is a constant and the right hand side is an expression in the ratio

$\frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}}$. So, the only way (91) can hold is when $\frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}}$ is constant for all $t \geq 0$, so $(\alpha_1\beta_1 + \alpha_2\beta_2)\frac{\dot{a}_t}{a_t} = \frac{\dot{k}_{St}}{k_{St}}(\alpha_1 + \alpha_2)$. This implies that the capital of South grows at the rate $\gamma_S \equiv \frac{\dot{k}_{St}}{k_{St}} = \left(\frac{\alpha_1\beta_1+\alpha_2\beta_2}{\alpha_1+\alpha_2}\right)(B - \rho - \delta)$. As $\frac{c_{St}}{k_{St}}$ is constant from (90), this implies that also the consumption of the South grows at this rate, such that $\frac{\dot{c}_{St}}{c_{St}} = \frac{\dot{k}_{St}}{k_{St}} = \left(\frac{\alpha_1\beta_1+\alpha_2\beta_2}{\alpha_1+\alpha_2}\right)(B - \rho - \delta)$.

When substitute in equation (88) the expression for γ_S it simplifies to:

$$\frac{a_0^{\beta_1\,\alpha_1+\beta_2\,\alpha_2}}{k_{S0}^{\alpha_1+\alpha_2}} = \frac{\gamma\,(\alpha_1\,\beta_1 + \alpha_2\,\beta_2) + (\delta+\rho)(\alpha_1+\alpha_2)}{(\alpha_1+\alpha_2)\,(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}} \tag{92}$$

where $\gamma = B - \delta - \rho$

C.2.4 Transitional Dynamics

Notice that the equation (91) must hold for all $t \geq 0$, so the ratio $\frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}}$ should be constant for all $t \geq 0$. This implies that when the North is on the BGP and the capital, consumption of the North and aid grow at the rate γ, the consumption and capital of South must also grow at a constant rate which equals the growth rate of the North adjusted by the sector specific aid wastage and productivity. This means that when the North is on the BGP, the South must automatically be on the BGP as well, so the model does not exhibit any transitional dynamics. This occurs, as the North chooses the level of aid in such a way, so as to place the South on the BGP from the very initial date.

C.3 Initial values as function of the capital of North

C.3.1 The level of aid transfers

When express c_{N0} from (87) and substitute it in equation (89), then rearrange, can show that:

$$\frac{a_0}{\rho\,k_{N0} - a_0} = \beta_2\,\omega\,L_S\,\eta + \frac{\omega\,L_S\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}\,(\beta_1\,\alpha_1 + \beta_2\,\alpha_2)\,\frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}}}{\frac{c_{St}}{k_{St}}} \tag{93}$$

Now can substitute in this the expression for the ratio $\frac{a_t^{\alpha_1\beta_1+\alpha_2\beta_2}}{k_{St}^{\alpha_1+\alpha_2}}$ from (92) and $\frac{c_{St}}{k_{St}}$ from (90) to express the level of aid in the initial date as a function of k_{N0} as:

$$a_0 = \frac{\eta\,\beta_2 + \frac{(\alpha_1\beta_1+\alpha_2\beta_2)(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta+\rho)(\alpha_1+\alpha_2)+\rho(1-\alpha_1-\alpha_2)}}{\frac{1}{\omega\,L_S} + \eta\,\beta_2 + \frac{(\alpha_1\beta_1+\alpha_2\beta_2)(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta+\rho)(\alpha_1+\alpha_2)+\rho(1-\alpha_1-\alpha_2)}}\,\rho\,k_{N0} \tag{94}$$

C.3.2 The consumption of the North

Then when substitute (94) in (87) and express c_{N0} can show that:

$$c_{N0} = \left\{ \frac{1}{1+\omega\,L_S\,\eta\,\beta_2 + \frac{\omega\,L_S\,(\alpha_1\beta_1+\alpha_2\beta_2)(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta+\rho)(\alpha_1+\alpha_2)+\rho(1-\alpha_1-\alpha_2)}} \right\} \rho\,k_{N0} \tag{95}$$

C.3.3 The capital of the South

From (92) can express k_{S0} as:

$$k_{S0} = a_0^{\frac{\beta_1\,\alpha_1+\beta_2\,\alpha_2}{\alpha_1+\alpha_2}} \left(\frac{(\alpha_1+\alpha_2)\,(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{\gamma\,(\alpha_1\,\beta_1+\alpha_2\,\beta_2)+(\delta+\rho)(\alpha_1+\alpha_2)} \right)^{\frac{1}{\alpha_1+\alpha_2}} \tag{96}$$

Then using (94) can rewrite this as:

$$k_{S0} = \left(\frac{\eta\,\beta_2 + \frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}{\frac{1}{\omega\,L_S} + \eta\,\beta_2 + \frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}\,\rho\,k_{N0} \right)^{\mu} \left(\frac{(1-\alpha_1-\alpha_2)\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{\gamma\,\mu+\delta+\rho} \right)^{\frac{1}{\alpha_1+\alpha_2}} \tag{97}$$

where $\mu \equiv \frac{\beta_1\,\alpha_1+\beta_2\,\alpha_2}{\alpha_1+\alpha_2}$.

Therefore, in the model for a given $k_{N0} > 0$ there should be a unique real $k_{S0} > 0$ as pinned down by the above condition.

C.3.4 The consumption of the South

Similarly, if express c_{S0} from (90) (at time zero) as $c_{S0} = \left(\frac{(\gamma\,\mu+\delta+\rho)(\alpha_1+\alpha_2)}{\alpha_3} + \rho \right) k_{S0}$ and use (97) to substitute in for k_{S0}, then can express c_{S0} as a function of a_0:

$$c_{S0} = \left(\frac{(\gamma\,\mu+\delta+\rho)(\alpha_1+\alpha_2)}{\alpha_3} + \rho \right) a_0^{\mu} \left(\frac{\alpha_3\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{(\gamma\,\mu+\delta+\rho)} \right)^{\frac{1}{\alpha_1+\alpha_2}} \tag{98}$$

where $\alpha_3 \equiv 1 - \alpha_1 - \alpha_2$. And as a function of k_{N0}:

$$c_{S0} = \left(\frac{(\gamma\,\mu + \delta)\,(\alpha_1 + \alpha_2) + \rho}{\alpha_3}\right) \left(\frac{\alpha_3\,A\theta_1^{\beta_1\alpha_1}\,\theta_2^{\beta_2\alpha_2}}{\gamma\,\mu + \delta + \rho}\right)^{\frac{1}{\alpha_1+\alpha_2}} \left\{\frac{\left(\eta\,\beta_2 + \frac{(\alpha_1\,\beta_1 + \alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}\right)\rho}{\frac{1}{\omega\,L_S} + \eta\,\beta_2 + \frac{(\alpha_1\,\beta_1+\alpha_2\,\beta_2)\,(\gamma\,\mu+\delta+\rho)}{(\gamma\,\mu+\delta)\,(\alpha_1+\alpha_2)+\rho}}\right\}^{\mu} k_{N0}^{\mu} \tag{99}$$

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