The Political Economy of Foreign Aid Effectiveness: the Role of Economic Inequality

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Abstract

This paper develops a theory that highlights the importance of economic inequality within the context of aid-effectiveness. We model aid-effectiveness when the recipient country is characterised by a rich local elite and poor masses that compete over economic resources. The analysis implies that foreign aid is more effective in raising the welfare of the poor when there is lower economic inequality, because of their weaker contesting ability. This hypothesis is supported by empirical evidence using data from 65 recipient countries over 1960-2000. A one standard deviation increase in the aid/GDP ratio is estimated to boost recipient growth by 0.25 percent in the most equal aid recipients but reduce growth by 2.30 percent in the least equal recipients. Similarly, it is estimated to decrease the Gini coefficient by 0.35 points in the most equal recipients but increases it by 1.45 points in the least equal recipients.

Keywords: Foreign aid, Aid effectiveness, Growth, Inequality, Contest, Elite

JEL Classification: D47, F35, F43, O1, O47

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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 (Easterly, 2003; Rajan and Subramanian, 2008; Chong et al., 2009; Doucouliagos and Paldam, 2009). Some empirical work even suggests that aid is associated with negative outcomes in the recipient countries (Brautigam and Knack, 2004; Svensson, 2000; Nunn and Qian, 2014; Doucouliagos and Paldam, 2009). 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 et al., 2010). Following this, we analyse the impact of economic inequality on aid-effectiveness.

A large proportion of foreign aid recipient countries suffer from low levels of freedom, civil liberties and political rights (see Figure 1). This implies they are often autocratic states characterised by ruling elites holding most of the political power, with citizens unable to easily replace the rulers. 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. This finding is confirmed empirically using a dataset of 65 aid recipient countries over the time period 1960-2000. To the author's knowledge so far the literature has not revealed that economic inequality is an important condition for aid-effectiveness.

More specifically, 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. The optimal aid allocation is thus zero. 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.

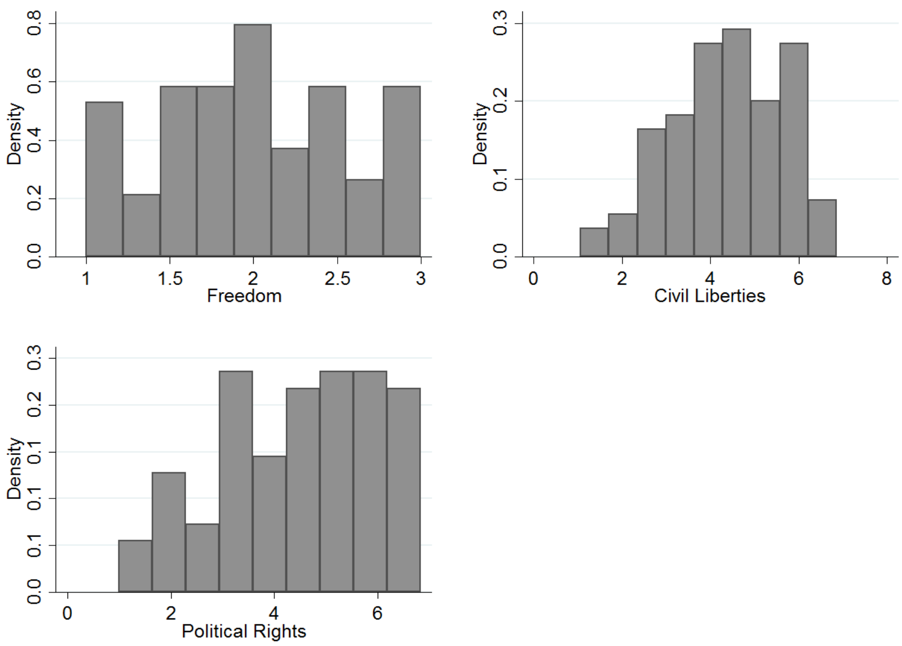
The model generates novel hypotheses which are supported by empirical evidence. Applying the dynamic panel data estimator by Arellano and Bover (1995) and Blundell and Bond (1998), it is found that aid has a positive and statistically significant effect on growth, but only in recipient countries that have sufficiently low Gini coefficients: increasing the aid/GDP ratio by one (cross-sectional) standard deviation is estimated to boost growth by 0.25 percentage points in these countries. On the other hand, in the extremely unequal recipient countries aid is found to have a negative effect on growth: an increase by one standard deviation in the aid/GDP ratio is estimated to reduce growth by 2.30 percentage points. Similar conclusions are reached about the impact of aid on tackling inequality: increasing the aid/GDP ratio by one standard deviation is estimated to decrease the Gini coefficient by 0.35 points in the most equal aid recipient countries but increase it by 1.45 points in the least equal aid recipient countries. Furthermore, all of the above findings remain robust after controlling for the institutional quality in the recipient countries and reducing the number of instrumental variables used in GMM estimation.

Section 2 reviews the relevant literature. Section 3 introduces the model and states the main results. Section 4 presents the empirical evidence to support the theoretical findings. The appendices contain the mathematical derivations and supplementary material related to the empirical part of this work.

2 Literature Review

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 improves development and growth, or instead has a negative impact, e.g. encourages rent-seeking (Svensson, 2000), promotes conflict (Nunn and Qian, 2014) and increases the size of the government (Boone, 1996). Doucouliagos and Paldam (2009) conduct a meta-study of research literature

Figure 1: Freedom, Political Rights and Civil Liberties Among the Aid Recipient Countries



Note: data from Freedom House; sample includes 127 foreign aid recipient countries as reported by the OECD Development Assistance Committee. Scores are averaged over 5 year periods; Freedom: 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.

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 as a basis for determining optimal aid-allocation. Generally speaking, 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 conflicting findings of 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 development aid helps to tackle poverty and inequality.

A further strand of the literature proposes structural models analysing the effects of development aid, exploiting 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) 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 of 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 purport 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.

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.

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.

[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.

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 intertemporal 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:

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

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

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

(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; $A\,F$ 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 for a graphical

[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 $G_E > b\,G_M$.

representation of the logistic contest function.[6]

The Decision of the Elite

The elite take the output as given, and maximise their intertemporal 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:

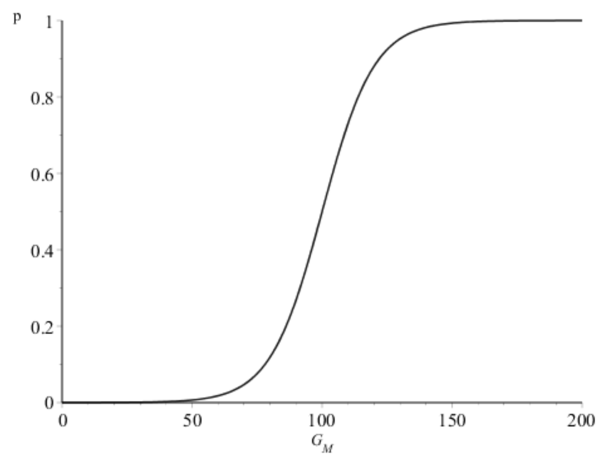
$$max_{G_E,C_E}\, ln(C_E) + ln((1 - p(G_M, G_E)) \cdot AF) \tag{5}$$

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: Logistic Contest Function



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

[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.

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:

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

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.

3.2 Solving the Problem

In this subsection 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 technology equals the decrease in the expected welfare from marginally reducing the investment in production. Any investment in the contest exceeding this level is not optimal, as the marginal loss from not investing in the production exceeds the benefit from investing in the contest. Similarly, any marginal benefit from additional investment in the production is offset by the marginal loss from the decrease in power.

The optimal level of consumption $\bar{C}_M$ is chosen to be equal to the optimal investment in production $\bar{F}$, as in this way the marginal utilities from consumption and production are equalised. This implies that the optimal production level can be expressed as $\bar{F} = \frac{1}{2}(R_M + (1-s)X - \bar{G}_M)$

The following assumption ensures that the contest technology is sufficiently effective, so that it is worth 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.

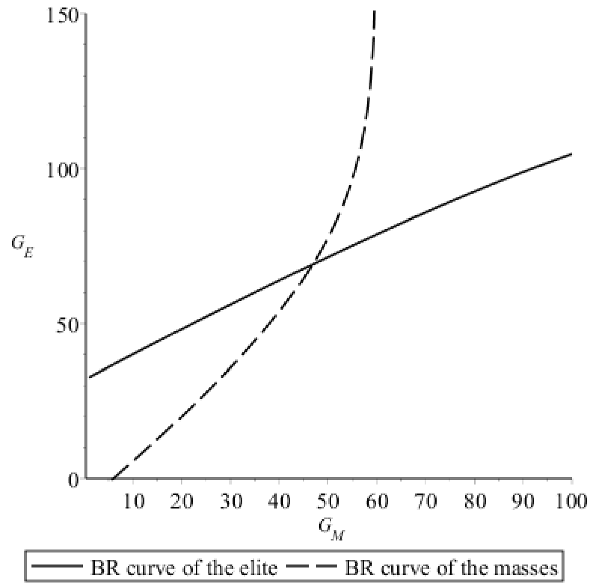
The Best Response Curve of the Elite:

(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).*

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 3 graphically represents the two best response curves and their crossing point, assuming specific parameter values.

Figure 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.

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.

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 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* $\frac{dC_M^*}{dX} > 0$,

[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.

$\frac{dp^*(.)}{dX} > 0$ 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 be 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^* is marginally increasing in the 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 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

[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.

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_E and R_M. This is discussed in the next subsection.

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

This subsection 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 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.

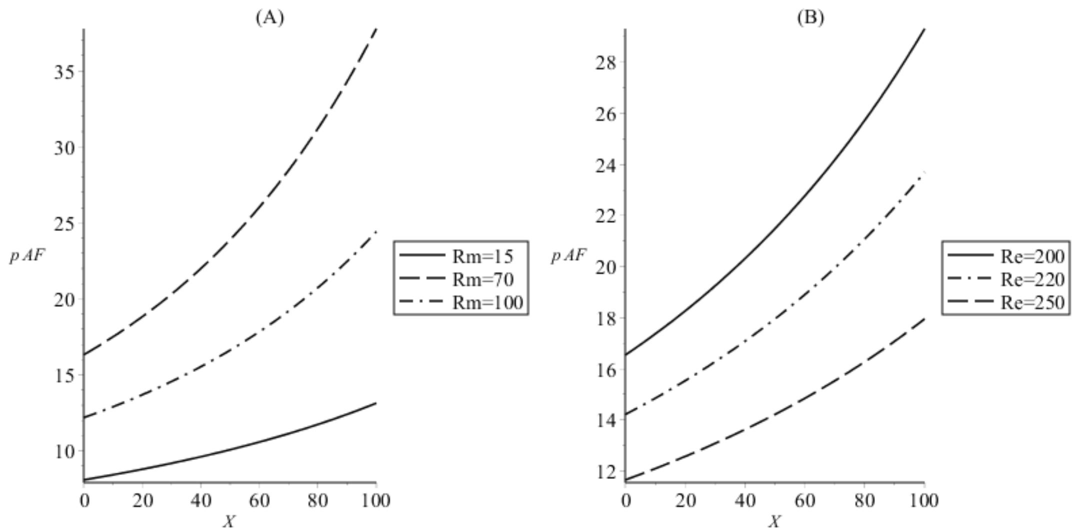
Proposition 4 (Aid Effectiveness and the Existing Levels of Funds of the Masses and Elite)**.** *Given that Assumption 1 and Assumption 5 hold and X^* is the solution to* (8)-(13)*:*

(a) when the share of aid that the elite extract 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 extract 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 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 4, where by varying the funds of the masses and elite we change the slope of the 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.

Proposition 5 (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.*

Proposition 5 provides with an empirically testable hypothesis. We test it in the next section.

4 Empirical Analysis

The aim is to test the hypothesis that aid is more effective in increasing the economic welfare of the masses in more equal countries. The empirical analysis follows the dynamic panel specifications in Rajan and Subramanian (2008) and Chong et al. (2009), but has the additional feature that it explores aid effectiveness conditional on economic inequality.

4.1 Data

We use a panel dataset of 67 countries over the time period 1960-2000, averaged over 5 year periods.

Data on inequality are the Gini coefficients from 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 (World Bank's Deininger & Squire data set) and other determinants.[10]

All the other variables are from Rajan and Subramanian (2008) and were made available by courtesy of the authors. A detailed description of the variables is found in section A.12 of the Appendix. See Table 1 for the summary statistics.

As a proxy for aid we use net Official Development Assistance (Net ODA), data on which is collected by the OECD Development Assistance Committee (OECD-DAC) and are available

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

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. 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).

Table 1: Summary Statistics

	No .of Obs.	Mean	St. Dev.	Min. Value	Max. Value
Change in GDP	192	1.16	2.79	-6.19	8.31
Equality	192	54.59	4.84	43.62	71.13
Change in equality	176	-1.21	4.05	-11.07	15.41
Aid/GDP	192	3.60	4.70	0.01	25.25
(Aid/GDP)^2	192	34.99	83.28	0.00	637.43
(Aid/GDP)×Equality	192	190.36	247.20	0.69	1280.71
Log initial GDP per.cap.	192	8.19	0.76	6.27	9.79
Initial level of life expectancy	192	62.84	8.80	40.18	77.35
Policy (Sachs-Warner)	192	0.42	0.49	0.00	1.00
Institutional quality	192	0.50	0.17	0.06	0.91
Log inflation	192	0.25	0.49	-0.00	3.89
M2/GDP	192	36.51	20.64	3.93	112.11
(Budget balance)/GDP	192	-2.61	4.18	-21.56	14.53
Revolutions	192	0.25	0.43	0.00	2.60
Ethnic frac.	192	0.42	0.29	0.00	0.90
Geography	192	-0.35	0.87	-1.04	1.78
(Aid/GDP)×Institutional quality	192	1.63	2.21	0.00	10.69

4.2 Testing the Hypotheses

The aim of the empirical tests is to investigate whether, as suggested by the model, aid is more effective in raising the economic welfare of the masses when the country is more equal. Two types of dependent variables are used to achieve this goal. Firstly, following Rajan and Subramanian (2008) regressions are run using the growth in real GDP per capita as dependent variable. These tests assume that GDP per capita is a good representation of the welfare of the masses. The growth regressions are followed by regressions using another proxy for the welfare of the masses, i.e. the change in the measure of economic equality over the 5-year period, where economic equality is defined as 100-Gini coefficient.

The equations that we base the tests on can be summarised as follows:[11]

$$\triangle g_{ct} = \beta_1 g_{ct-1} + \beta_2 a_{ct} + \beta_3 \left(a \times Equality\right)_{ct} + \beta_4 \left(Equality\right)_{ct} + \boldsymbol{x'_{ct}}\,\boldsymbol{\alpha} + \varepsilon_{ct}$$
$$\varepsilon_{ct} = \mu_c + v_{ct} \tag{26}$$

[11]We also test a specification where a squared aid term is included; following Rajan and Subramanian (2008) we use the income at the beginning of the 5-year period as a regressor, instead of its first lag as implied by $g_{c\,t-1}$.

and

$$\triangle(Equality)_{ct} = \delta_1 g_{c\,t-1} + \delta_2 a_{ct} + \delta_3 \, (a \times Equality)_{ct} + \delta_4 \, (Equality)_{ct} + \boldsymbol{x'_{ct}} \, \boldsymbol{\lambda} + \varepsilon_{ct}$$
$$\varepsilon_{ct} = \mu_c + v_{ct} \tag{27}$$

where c indexes recipient countries and t indexes time periods. The term ε_{ct} is a disturbance term consisting of fixed effects, μ_c, and idiosyncratic shocks, v_{ct}; g_{ct} denotes logarithm of GDP, a_{ct} denotes the aid/GDP ratio, $(Equality)_{ct}$ denotes 100 minus Gini coefficient, $(a \times Equality)_{ct}$ represents the aid-equality interaction, $\boldsymbol{x_{ct}}$ is a vector of controls and $\triangle$ denotes the change from time period $t-1$ to time period t, i.e. $\triangle g_{ct} = g_{ct} - g_{ct-1}$.

Following Rajan and Subramanian (2008) we include the following variables as endogenous controls: initial per capita GDP, initial level of life expectancy, proxies for policy and institutional quality, inflation, M2/GDP, budget balance/GDP and number of revolutions. We include a proxy for ethnic fractionalization, a geography variable and dummies for recipient countries in Sub-Saharan Africa and East Asia as exogenous controls. See more details on these variables in section A.12 of the Appendix.

The main coefficients of interest are β_2 and β_3 in equation (26) and δ_2 and δ_3 in equation (27). Their estimated magnitudes and significance demonstrate whether there is evidence that aid has an effect on the welfare proxy of interest and whether this effect depends on the existing level of economic equality.

Previous work on aid effectiveness in terms of growth (Rajan and Subramanian, 2008; Hansen and Tarp, 2001) and inequality (Chong et al., 2009) discusses the need to deal with potential endogeneity, omited variable bias and the persistence of time series. Literature has adressed these issues by using the difference GMM estimator by Arellano and Bond (1991) and system GMM estimator by Arellano and Bover (1995) and Blundell and Bond (1998) which deal with potential endogeneity and explicitly take into account fixed effects. In addition, these estimators are suitable for estimating a dynamic specification.

Difference GMM first-differences data, eliminating the fixed effects, and uses lags of the endogenous variables as instruments. 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. The identification is based on the notion that the lagged levels and/or differences are valid istruments for the endogenous variables, in this kind of setup. As the difference GMM estimator can suffer from weak instrument problems, the results presented here utilise the system GMM estimator. However, system GMM is particularly prone to instrument proliferation which can bias coefficient estimates and weaken the Hansen J test for joint validity of the instruments (see discussion in Roodman (2009b,a)). Therefore, we check the robustness of the result after implementing a strategy to reduce the number of instruments.

The Effectiveness of Foreign Aid in Raising Growth

To start answering the research question, regressions are run using the growth in real GDP per capita as dependent variable, following the specification by Rajan and Subramanian (2008).[12] Columns I-a and I-b of Table 2 present the replication of the results of these authors, but using a smaller sample size, to be able to compare the results in columns I-a and I-b to the results in columns II-a-III-b. Column I-a includes the aid variable (Aid/GDP) and its square as regressors to allow for the possibility of diminishing returns to aid; column I-b includes only the linear aid variable. The results in columns I-a and I-b show that the coefficient of aid enters with a negative sign and is insignificant at conventional significance levels. In column I-a the coefficient of the squared aid term enters with a positive sign, but is also insignificant. Finding no significant effect of aid in this kind of specification is consistent with the findings of Rajan and Subramanian (2008).

With respect to the other variables, results in columns I-a and I-b reveal that initial income and inflation have a negative significant effect in both the linear and quadratic specification. Institutional quality has a positive effect significant at 5% level but only in the linear specification (column I-b), suggesting that previous findings in literature of diminishing returns to aid may be actually driven by institutional quality.

[12]We include all available lags of endogenous variables, starting from the second lag onwards as instruments. Variables Ethnic fractionalisation, Geography, and dummies for time period, Sub-Saharan Africa and East Asia, constant are assumed to be exogenous and included as instruments.

Table 2: The Effect of Aid on Growth

	I-a	I-b	II-a	II-b	III-a	III-b
Aid/GDP	-0.210	-0.0181	-1.377**	-1.841**	-1.283**	-1.497*
	(0.288)	(0.819)	(0.012)	(0.042)	(0.021)	(0.073)
(Aid/GDP)ˆ2	0.00957		0.0117		0.0102*	
	(0.359)		(0.186)		(0.091)	
Equality	-0.00149	0.0292	-0.0648	-0.0878	-0.0850	-0.107
	(0.986)	(0.711)	(0.411)	(0.454)	(0.281)	(0.322)
Initial per.cap.GDP	-2.227**	-2.311***	-1.659*	-2.454***	-1.700	-2.452**
	(0.013)	(0.003)	(0.100)	(0.003)	(0.119)	(0.010)
Initial level of life expectancy	0.139	0.140	0.0930	0.119	0.131	0.155
	(0.194)	(0.101)	(0.379)	(0.333)	(0.218)	(0.174)
Policy (Sachs-Warner)	0.983	1.161	0.579	0.737	1.073**	1.007
	(0.180)	(0.199)	(0.361)	(0.421)	(0.037)	(0.135)
Institutional quality	2.629	4.758**	2.679	4.023	3.479	5.642**
	(0.271)	(0.040)	(0.171)	(0.187)	(0.152)	(0.049)
Log inflation	-1.323***	-1.298**	-1.683***	-1.551**	-1.448***	-1.281**
	(0.000)	(0.014)	(0.002)	(0.016)	(0.000)	(0.018)
M2/GDP	-0.00170	0.00192	-0.00853	-0.00605	-0.00181	-0.00176
	(0.930)	(0.921)	(0.725)	(0.815)	(0.924)	(0.930)
Budget balance/GDP	0.0580	0.0462	0.112	0.0701	0.102	0.0938
	(0.477)	(0.540)	(0.238)	(0.557)	(0.236)	(0.346)
Revolutions	-0.0293	-0.266	-0.357	-0.272	0.000906	0.109
	(0.951)	(0.662)	(0.453)	(0.588)	(0.999)	(0.872)
Ethnic frac.	0.364	1.170	0.800	1.450	1.431	2.830
	(0.815)	(0.569)	(0.619)	(0.543)	(0.386)	(0.179)
Geography	0.600	0.370	0.665	0.942	0.666	1.024
	(0.378)	(0.345)	(0.355)	(0.291)	(0.333)	(0.286)
(Aid/GDP)×Equality			0.0219**	0.0343**	0.0242***	0.0306*
			(0.023)	(0.042)	(0.010)	(0.062)
(Aid/GDP)×Inst.quality					-0.551	-0.439
					(0.179)	(0.224)
No. of instruments	170	162	177	170	179	172
Observations	192	192	192	192	192	192
Groups	65	65	65	65	65	65
Hansen test of overid. restr.	44.669	47.333	48.609	46.900	44.102	47.478
P-value (Hansen)	1.000	1.000	1.000	1.000	1.000	1.000
AR(2) (test for serial correlation)	0.127	0.112	0.086	0.090	0.091	0.109

p-values in parentheses

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

Dependent variable is annual % change in real economic growth (5-year average). Estimator used is the GMM system estimator by Arellano and Bover (1995) and Blundell and Bond (1998); standard errors are robust. Regression also includes constant and time period dummies. Endogenous variables used as instruments: Initial per.cap.GDP, Aid/GDP, (Aid/GDP)ˆ2, Equality, Policy, Inst. quality, M2/GDP, Budget balance/GDP, revolutions, Life expectancy, (Aid/GDP)×Equality, (Aid/GDP)×Inst.quality. Exogenous variables used as instruments: Ethnic fractionalization, Geography; time period dummies, dummies for countries in Sub-Saharan Africa, East Asia, and a constant. All lags starting from lag 2 onwards used to construct instruments from the endogenous variables. For more details on the variables, see section A.12 of the Appendix.

Table 3: Reducing the Number of Instrumental Variables

Panel A

	Dependent variable: % change in growth rate					
	I-a	I-b	II-a	II-b	III-a	III-b
Aid/GDP	-3.537	-4.286*	-3.905	-5.031**	-3.721	-4.083*
	(0.143)	(0.075)	(0.162)	(0.040)	(0.235)	(0.068)
(Aid/GDP)ˆ2	0.000921		0.00182		0.00307	
	(0.980)		(0.944)		(0.914)	
(Aid/GDP)×Equality	0.0651	0.0753*	0.0722	0.0957*	0.0718	0.0737*
	(0.212)	(0.094)	(0.207)	(0.057)	(0.254)	(0.093)
(Aid/GDP)×Inst.Quality	0.118	0.890	0.393	0.0389	-0.0416	0.370
	(0.923)	(0.348)	(0.651)	(0.968)	(0.974)	(0.740)
No. of instruments	43	43	48	47	45	45
Observations	192	192	192	192	192	192
Groups	65	65	65	65	65	65
Hansen test of overid. restr.	22.643	18.269	23.341	20.876	25.671	20.201
P-value (Hansen)	0.161	0.438	0.383	0.528	0.140	0.445
AR(2) (test for serial correlation)	0.167	0.070	0.077	0.062	0.078	0.057
Method to reduce instrument count	pca	pca	pca & lags	pca & lags	pca & lags	pca & lags
Lags used in instrumentation	2-7	2-7	2-6	2-6	2-5	2-5

Panel B

	Dependent variable: change in equality					
	I-a	I-b	II-a	II-b	III-a	III-b
Aid/GDP	-4.267***	-2.296	-3.438**	-2.135	-2.741*	-0.934
	(0.000)	(0.140)	(0.026)	(0.200)	(0.051)	(0.570)
(Aid/GDP)ˆ2	0.0330**		0.0247*		0.0204*	
	(0.030)		(0.085)		(0.082)	
(Aid/GDP)×Equality	0.0622***	0.0489*	0.0529**	0.0439	0.0397*	0.0158
	(0.002)	(0.093)	(0.038)	(0.155)	(0.095)	(0.600)
(Aid/GDP)×Inst.Quality	1.034	-0.862	0.578	-0.519	0.494	-0.153
	(0.187)	(0.435)	(0.440)	(0.711)	(0.480)	(0.915)
No. of instruments	43	43	46	43	43	41
Observations	181	181	181	181	181	181
Groups	65	65	65	65	65	65
Hansen test of overid. restr.	18.951	16.054	17.060	19.314	15.658	12.261
P-value (Hansen)	0.331	0.589	0.649	0.373	0.548	0.726
AR(2) (test for serial correlation)	0.767	0.764	0.784	0.896	0.946	0.858
Method to reduce instrument count	pca	pca	pca & lags	pca & lags	pca & lags	pca & lags
Lags used in instrumentation	3-7	3-7	3-6	3-6	3-5	3-5

p-values in parentheses

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

"pca" stands for principal component analysis; "lags" stands for restricting the number of lags used in generating instuments from the endogenous variables. Estimator used is the GMM system estimator by Arellano and Bover (1995) and Blundell and Bond (1998); standard errors are robust. Regressions also include the following variables for which we do not report the coefficient estimates: constant, time period dummies, Initial per.cap.GDP, Equality, Policy, Inst. quality, M2/GDP, Budget balance/GDP, revolutions, Life expectancy, Ethnic fractionalization, Geography, dummies for countries in Sub-Saharan Africa and East Asia. Endogenous variables used as instruments: Initial per.cap.GDP, Aid/GDP, (Aid/GDP)ˆ2, Equality, Policy, Inst. quality, M2/GDP, Budget balance/GDP, revolutions, Life expectancy, (Aid/GDP)×Equality, (Aid/GDP)×Inst.quality. Exogenous variables used as instruments: Ethnic fractionalization, Geography; time period dummies, dummies for countries in Sub-Saharan Africa, East Asia, and a constant. For more details on the variables, see section A.12 of the Appendix.

Columns II-a and II-b of Table 2 incorporate the interaction between aid and equality, as represented by (Aid/GDP)×Equality. The proxy for equality is 100 minus Gini coefficient. Including the interaction returns a significant negative coefficient estimate of aid. In addition, the estimated coefficient of the interaction term is positive and significant at 5% level. These findings are true in both columns (II-a and II-b). In column II-a the squared aid term remains insignificant. These results are consistent with the theoretical model that suggests that aid should be more effective in the more equal countries.

To quantify the findings in column II-b, an increase in the aid/GDP ratio by one standard deviation [13] boosts percentage growth rate by 0.25 points in an equal recipient country with a Gini coefficient of 37 and detracts it by 2.30 points in an unequal recipient country with a Gini of 54.

Because higher levels of economic equality can be correlated with better institutional quality, the above effect may be actually a consequence of better institutions, rather than the level of equality. To investigate this possibility, columns III-a and III-b test a specification that includes an interaction between aid and a proxy for institutional quality: the (Aid/GDP)×Inst.quality variable. As it can be seen, the estimated coefficient of this interaction is negative and insignificant, however, the coefficient of the aid-equality interaction remains significant and positive. In particular, in column III-a which depicts the quadratic specification, the coefficient of the aid-equality interaction is significant at 1% level.

A potential concern is raised by the seemingly ideal P-value of 1 for the Hansen test statistic, which as pointed out by Roodman (2009b,a) can be a sign of instrument proliferation. The authors recommend reducing the number of instruments, as a robustness check. Following this, in panel A of Table 3 we report the regression results after reducing the set of instruments by replacing them with their principal components.[14] This method minimises the arbitrariness of reducing the instrument count (Kapetanios and Marcellino, 2010; Mehrhoff, 2009; Bai and Ng, 2010). In columns II-a to III-b this strategy is combined with reducing the number of lags used to generate instrumental variables, as recommended by Roodman (2009b). Reducing the number of instrumental variables below the number of groups returns more realistic but still

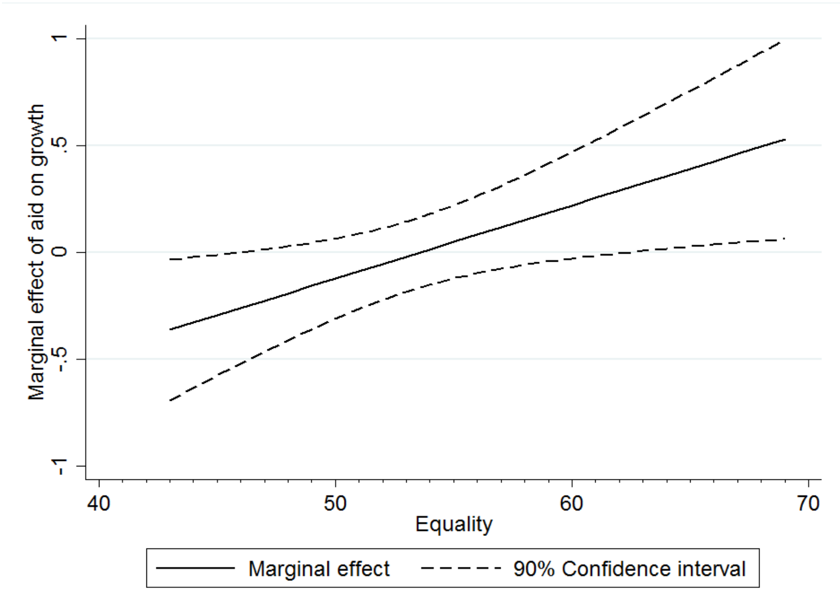
[13] We use the sample standard deviation in cross section which is 5.01.

[14] Mehrhoff (2009) finds that reducing the number of instruments using principal component analysis results in both lower bias and mean squared error than the standard techniques of limiting lag depth and "collapsing" the instrument matrix. The strategy is implemented using the option pca for the user-written Stata command xtabond2 (Roodman, 2009a).

acceptable P-values for the Hansen test statistic, so the null of instrument validity cannot be rejected. The signs of the coefficients of aid and aid-equality interaction remain the same as in Table 2. In addition, the coefficients remain significant in at least one of the specifications (quadratic or linear).

Following Brambor et al. (2006), Figure 5 depicts the marginal effect of the aid/GDP ratio on the change in growth rate conditional on economic equality.[15] The area between the dashed lines represent the 90% confidence interval; the marginal effect depicted by the continuous line is significant if both of the dashed lines are above (below) zero. As it can be seen, there is a positive relationship between equality in the recipient country and marginal effect on growth. However, this relationship is significant only at the tails of the inequality distribution, i.e. when the equality measure is approximately below 46 (i.e. Gini above 54) and when it is above 63 (Gini below 37).

Figure 5: The Marginal Effect of Aid on Growth Conditional on Equality



Note: equality is defined as 100 minus Gini coefficient.

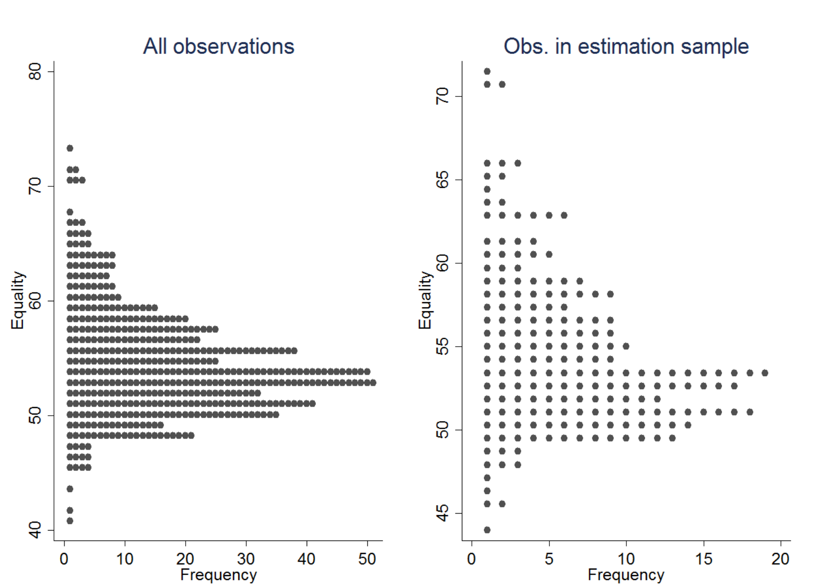
Figure 6 presents dot plots of two distributions of economic equality. The dot plot on the left hand side represents the equality distribution among all the aid recipient countries that are included in the OECD-DAC database; the dot plot on the right hand side depicts the equality distribution only among those recipient countries that have been included in the estimation sample of the regressions in Table 2. From the right hand side dot plot it can be deduced that the

[15]As implied by the specification in column II-b in Table 2.

recipient countries characterised by such equality levels for which the relationship is significant constitute approximately 8 % of the estimation sample, more specifically, approximately 2 % of all countries are characterised equality level of 46 and slightly more than 6% fall above the equality level of 63. The dot plot on the left hand side of Figure 6, shows that once the aid recipient countries excluded from the estimation sample are considered, the number of countries that have an equality level for which the effect can be expected to hold increase. However, the proportion of these observations relative to the whole sample remains similar.

To summarise, our results suggest a significant conditioning effect of income equality on the effectiveness of aid, that holds at both tails of the inequality distribution.

Figure 6: Dot Plot of Equality



Note: equality is defined as 100 minus Gini coefficient; dot plot on the left hand side includes data on all the aid recipient countries reported on by OECD DAC for which data on Gini coefficients is available; dot plot on the right hand side includes data for only those aid recipient countries that are included in the estimation sample.

Aid Effectiveness and Elite's Ability to Extract Aid

The framework developed in section 3 implies that the elite's ability to extract aid s influences aid effectiveness. More specifically, aid should be ineffective when this parameter exceeds a certain threshold. To investigate the possibility of distinct effects conditional on the elite's ability to extract aid, we choose the Control of corruption measure disseminated by the Worldwide Governance Indicators project as a proxy for the parameter s, and estimate separate regressions after splitting the sample according to the median of this measure.[16] Columns I-a and I-b of Table 4 present the regression results for the high-corruption sample and columns II-a and II-b present the results for the low-corruption sample. Regressions corresponding to columns I-a and II-a include both the linear and squared aid terms, columns I-b and II-b include just the linear term.

According to the model, aid effectiveness is expected to be higher in the low-corruption sample. The results reveal a significant negative coefficient of aid and a significant positive coefficient of the aid-equality interaction in both the high and low-corruption samples (columns I-a, I-b and II-b). The magnitudes of these coefficients are higher when using the low-corruption sample. These results do not provide evidence for the existence of completely opposite effects depending on whether the level of corruption is high or low, however, they are consistent with a lower elite's ability to extract aid being linked to higher aid effectiveness.

Figure 7 depicts the marginal effect of aid on growth conditional on economic equality in both the high-corruption and low-corruption samples.[17] The magnitude of the effect is higher in the low-corruption sample, as implied by the steeper slope of the continuous line.

Investigating the dashed lines marking the confidence interval implies that in the low-corruption countries this effect becomes significant when the level of equality rises above 63 (Gini below 37) and falls below 46 (Gini above 54). The values of equality in the low-corruption sample for which the effect is significant are similar to the ones in Figure 5. However, in the high-corruption sample, the effect is significant for a larger share of the equal countries. More specifically, it can be seen that the effect is significant for recipient countries with equality above 58 (Gini below 42), which constitute around 26 % of the recipient countries in the estimation sample.

[16]The institutional quality variable is omitted from these regressions, as it is correlated with the corruption measure, and omitting it allows utilising a larger sample size.

[17]The left hand side graph depicts the marginal effects when running the regression in column I-b of Table 4 and the right hand side graph depicts the marginal effects when running the regression in column II-b of Table 4.

Table 4: The Effect of Aid on Growth: Different Levels of Corruption

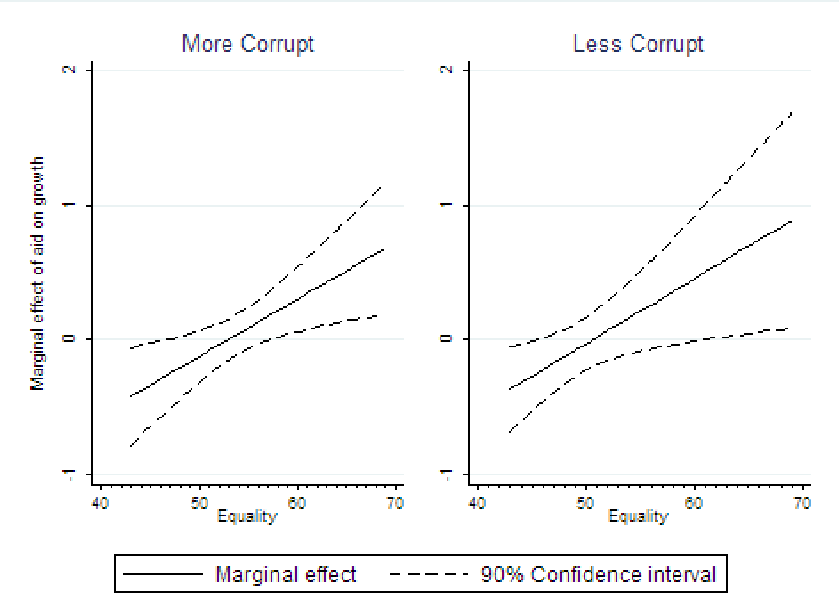
	I-a	I-b	II-a	II-b
Level of corruption	High	High	Low	Low
Aid/GDP	-1.922**	-2.238**	-1.792	-2.434**
	(0.036)	(0.025)	(0.735)	(0.040)
(Aid/GDP)ˆ2	0.00648		-0.0000206	
	(0.238)		(1.000)	
Equality	-0.100	-0.260	-0.360	-0.447
	(0.733)	(0.480)	(0.567)	(0.228)
(Aid/GDP)×Equality	0.0337**	0.0423**	0.0352	0.0481**
	(0.036)	(0.022)	(0.667)	(0.045)
Initial per.cap.GDP	-3.269**	-5.891	4.786	4.202
	(0.016)	(0.157)	(0.506)	(0.605)
Initial level of life expectancy	0.438	0.312*	-0.648***	-0.452
	(0.173)	(0.092)	(0.001)	(.)
Policy (Sachs-Warner)	-0.978	-0.428	-1.561	-3.358
	(0.497)	(0.647)	(0.504)	(0.129)
Log inflation	-3.114**	-3.698**	-2.058	-2.039
	(0.018)	(0.012)	(0.196)	(0.162)
M2/GDP	-0.0898	-0.0495	-0.128*	-0.112
	(0.354)	(0.603)	(0.096)	(0.147)
Budget balance/GDP	-0.0488	0.000555	0.631***	0.416
	(0.793)	(0.998)	(0.007)	(0.108)
Revolutions	-0.445	-0.210	-3.192	-2.454
	(0.659)	(0.782)	(0.334)	(0.269)
Ethnic frac.	0.532	1.176	61.73	47.00
	(0.770)	(0.500)	(0.537)	(0.622)
Geography	1.284	0.625	4.998	4.796
	(0.305)	(0.625)	(0.500)	(0.571)
Observations	151	151	147	147
Groups	40	40	33	33
Hansen test of overid. restr.	19	18	12	12
P-value (Hansen)	1.000	1.000	1.000	1.000
AR(2) (test for serial correlation)	0.620	0.551	0.374	0.604

p-values in parentheses

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

Dependent variable is annual % change in real economic growth (5-year average). Estimator used is the GMM system estimator by Arellano and Bover (1995) and Blundell and Bond (1998); standard errors are robust; regression also includes constant, time period dummies, variable on Ethnic fractionalization, Geography, dummies for countries in Sub-Saharan Africa and East Asia; endogenous variables used as instruments: Initial per.cap.GDP, (Aid/GDP, (Aid/GDP)ˆ2, Equality, Policy, M2/GDP, Budget balance/GDP, revolutions, Life expectancy, Aid/GDP)×Equality; exogenous variables used as instruments: Ethnic fractionalization, Geography; time period dummies, dummies for countries in Sub-Saharan Africa, East Asia, and a constant; all lags starting from lag 2 used to construct instruments from the endogenous variables. For more details on the variables, see section A.12 of the Appendix.

Figure 7: The Marginal Effect of Aid on Growth Conditional on Equality: Distinct Levels of Corruption



Note: indicator of Control of Corruption by Worldwide Governance Indicators.

The Effectiveness of Foreign Aid in Reducing Inequality

Table 5 explores aid effectiveness in terms of a different proxy for the welfare of the masses – economic equality. More specifically, the dependent variable is the change in the equality over the 5-year period.[18] As in Table 2, the regression in column I-a includes both the linear and squared aid term; column I-b includes only the linear term. Columns I-a and I-b do not include the aid-equality interaction. Same as in Table 2, before including the aid-equality interaction the estimated coefficients of aid and aid-squared are insignificant.

After including the aid-equality interaction, these results change. Results in column II-b show that the coefficient of aid is negative and has become significant at 1% level, the coefficient on the aid-equality interaction is positive and also significant at 1% level.

[18]We instrument equality and later aid-equality interaction with all available lags from lag 3 onwards. The other endogenous variables are instrumented with all available lags from lag 2 onwards. Variables Ethnic fractionalization, Geography, and dummies for time period, Sub-Saharan Africa and East Asia, constant are assumed to be exogenous and included as instruments.

Table 5: The Effect of Aid on Equality

	I-a	I-b	II-b	III-a	III-b
Aid/GDP	-0.289	0.0436	-1.671***	-2.568**	-1.877***
	(0.221)	(0.602)	(0.006)	(0.014)	(0.000)
(Aid/GDP)ˆ2	0.0132			0.0113	
	(0.291)			(0.285)	
Equality	-0.0396	0.00489	-0.0873	-0.142	-0.0469
	(0.603)	(0.957)	(0.354)	(0.337)	(0.652)
Initial per.cap.GDP	-1.117	-0.431	-0.733	-0.380	-0.679
	(0.123)	(0.591)	(0.229)	(0.464)	(0.325)
Initial level of life expectancy	0.169**	0.0816	0.117*	0.123	0.104
	(0.017)	(0.205)	(0.076)	(0.104)	(0.161)
Policy (Sachs-Warner)	0.810	0.502	0.518	0.535	0.524
	(0.217)	(0.324)	(0.178)	(0.374)	(0.290)
Institutional quality	-1.810	-1.209	-0.972	-2.501	-3.111
	(0.427)	(0.528)	(0.633)	(0.338)	(0.250)
Log inflation	-0.0605	0.0171	-0.128	-0.178	-0.185
	(0.909)	(0.972)	(0.755)	(0.701)	(0.689)
M2/GDP	0.0325**	0.0162	0.0170	0.0201	0.0194*
	(0.022)	(0.207)	(0.220)	(0.179)	(0.080)
Budget balance/GDP	-0.0135	0.0192	0.0346	0.0241	0.0204
	(0.782)	(0.694)	(0.538)	(0.634)	(0.726)
Revolutions	0.0374	-0.337	-0.521	-0.660	-0.387
	(0.943)	(0.555)	(0.373)	(0.355)	(0.544)
Ethnic frac.	3.433	1.180	1.884	1.445	1.536
	(0.192)	(0.492)	(0.141)	(0.381)	(0.259)
Geography	0.0620	-0.358	-0.117	-0.268	-0.0322
	(0.840)	(0.252)	(0.685)	(0.438)	(0.915)
(Aid/GDP)×Equality			0.0319***	0.0420**	0.0326***
			(0.005)	(0.024)	(0.000)
(Aid/GDP)×Inst.quality				0.394	0.461
				(0.368)	(0.235)
No. of instruments	163	155	162	169	164
Observations	181	181	181	181	181
Groups	65	65	65	65	65
Hansen test of overid. restr.	43.891	45.717	44.327	46.732	45.681
P-value (Hansen)	1.000	1.000	1.000	1.000	1.000
AR(2) (test for serial correlation)	0.973	0.937	0.988	0.980	0.959

p-values in parentheses

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

Dependent variable is change in 100-Gini coefficient over the 5 year period. Estimator used is the GMM system estimator by Arellano and Bover (1995) and Blundell and Bond (1998); standard errors are robust. Regression also includes a constant and time period dummies. Endogenous variables used as instruments: Initial per.cap.GDP, Aid/GDP, (Aid/GDP)ˆ2, Equality, Policy, Inst. quality, M2/GDP, Budget balance/GDP, revolutions, Life expectancy, (Aid/GDP)×Equality, (Aid/GDP)×Inst.quality. Exogenous variables used as instruments: Ethnic fractionalization, Geography; time period dummies, dummies for countries in Sub-Saharan Africa, East Asia, and a constant. We use all available lags from lag 3 onwards to construct instruments from Equality, (Aid/GDP)×Equality; all lags starting from lag 2 onwards used to construct instruments from the other endogenous variables. For more details on the variables, see section A.12 of the Appendix.

This is consistent with the capacity for aid to reduce inequality being strongly dependent on the existing level of inequality in the recipient country. To quantify the results in Column II-b, increasing the aid/GDP ratio by one standard deviation is estimated to decrease the Gini coefficient by 0.35 points in an equal recipient country with an existing Gini coefficient of 42; and increase the Gini coefficient by 1.45 points in an unequal recipient country with a Gini coefficient of 54.

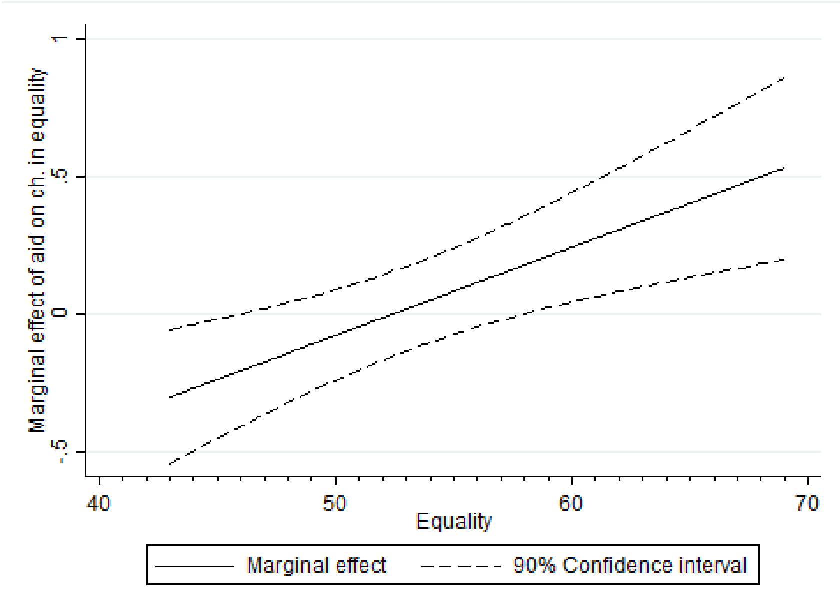
Regressions in columns III-a and III-b include an aid-institutional quality interaction, in order to investigate whether the result in column II-b is driven by more equal countries having better institutions. The fact that the coefficient of aid-institutional quality interaction is insignificant and the coefficient of aid-equality interaction remains significant implies that this effect does not occur because of better quality of institutions, but is indeed driven by equality.

As before, we check the robustness of the result after reducing the number of instruments. Panel B of Table 3 depicts the regression results after the number of instruments is reduced using principal component analysis.[19] In columns II-a-III-b we also restrict the number of lags used to generate moment conditions. Once again, after reducing the number of instrumental variables below the number of groups, the P-value for the Hansen statistic falls but still favours not rejecting the null of instrument validity. Also, the signs of the coefficients of aid and aid-equality interaction remain the same as in Table 5. Finally, both coefficients remain significant in all the specifications with the squared aid term.

Figure 8 graphically depicts the marginal effect of the aid/GDP ratio on the change in equality conditional on the existing level of economic equality within the recipient country. The effect is positive and, as implied by the dashed lines representing the 90% confidence interval, significant at equality levels below 46 (Gini above 54) and above 58 (Gini below 42). The recipient countries corresponding to the tails of the equality distribution where the effect is significant represent 2% and 20 % respectively of the estimation sample.

[19]See Kapetanios and Marcellino (2010); Mehrhoff (2009); Bai and Ng (2010). The strategy is implemented using the option pca for the user-written Stata command xtabond2 (Roodman, 2009a).

Figure 8: The Marginal Effect of Aid on Equality Conditional on Equality



Note: equality is defined as 100 minus Gini coefficient.

4.3 Summary of the Empirical Findings

The consistent finding is that aid effectiveness is conditioned by the level of income inequality within the recipient country. The results are quite striking: in particular in archetypally unequal countries (with Gini > 54) a one standard deviation increase in aid intensity is estimated to result in a lowering of the percentage growth rate by 2.30 points and an increase in the Gini coefficient by 1.45 points. However, we do not go so far as to recommend reducing aid to unequal countries. Instead aid in such circumstances might be particularly targeted or such that the intended recipient countries may actually benefit. But certainly caution should be exercised before making unconditional aid payments to countries which are characterised by significant inequality.

5 Conclusion

This work analyses aid effectiveness when a recipient country is characterized by a contest between a rent-seeking elite and economically active masses. Before the contest, a foreign aid donor decides the level of money to be given to the country in order to maximize the expected welfare of the masses. A share of the aid, however, can be extracted by the rent-seeking elite, which is a plausible scenario in developing countries where aid reaches the poor via governmental institutions, the transparency and accountability of which can be questioned.

The main theoretical finding is that aid is more effective at increasing the welfare of the masses when the level of economic inequality between the masses and the elite is lower. Also, when the elite is able to extract an excessive share of the aid transfers, aid is ineffective and will be counter-productive.

The findings on aid effectiveness are investigated empirically by running dynamic panel regressions using growth and inequality as proxies for the welfare of the masses. A significant positive effect of aid conditional on the level of inequality is found when using both of these proxies.

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 0.25 points among the most equal recipient countries and a detraction by 2.30 points among the least equal recipient countries. The recipient countries for which the effect is significant constitute approximately 8% of the estimation sample.

Similarly, an increase by one standard deviation in the aid/GDP ratio decreases the Gini coefficient by at least 0.35 points among the most equal recipient countries and increases it by at least 1.45 points among the most unequal recipient countries. Hence aid enhances equality in countries already relatively equal. It is associated with a deterioration in inequality when inequality is already high. The recipient countries for which the effect is significant constitute approximately 22% of the estimation sample.

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APPENDIX A

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:

$$p_g \cdot F - p = 0 \tag{28}$$

and

$$C_M = F \tag{29}$$

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 (28) and denote:

$$FOC_M \equiv p_g \cdot (\frac{1}{2} \cdot (R_M + (1-s)X - G_M)) - p = 0 \tag{30}$$

A.1.2 Second Order Condition

It is possible to show that G_M solving (28) 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 (30) 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 (30) 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 (30) (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 contradict $f(G'_M) = h(G'_M)$. 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 contradict $f(G''_M) = h(G''_M)$. 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 (28).

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:

$$FOC_E \equiv \frac{-p_G}{(1-p)} - \frac{1}{C_E} = 0 \quad ==> \quad pk = \frac{1}{C_E} \tag{31}$$

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 (31) 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) $\frac{dz(.)}{dG_E} > 0$

(e) $\frac{dl(.)}{dG_E} < 0$.

Suppose a value of $G_E \leq R_E + sX$ that satisfies (31) 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 (31) 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 (32) 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 $-\frac{k((s-1)b+s)^2(-1+p)^2A(p-2)p^3}{(2\,p^2-p+1)^3b} < q_{xx}$.

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 (31). 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:
$\frac{dFOC_E}{dX} = \frac{g_x\,(pp_{gG}-p_G\,p_g-p_{gG})C_E{}^2+s(-1+p)^2}{(-1+p)^2C_E{}^2} ==> \frac{dFOC_E}{dX} = \frac{g_x\,((-1+p)p_{gG}-p_G\,p_g)b^2+p_g{}^2s}{b^2(-1+p)^2}$
$==> \frac{dFOC_E}{dX} = -k^2p\,((bg_x-s)\,p-bg_x)$

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

$$\begin{cases} g_x = \frac{(1-s)b(1-p)+2\,pG_x}{b(1+p)} \\ G_x = (1-p)\,bg_x + sp \end{cases} \quad ==> \quad \begin{cases} g_x = \frac{(1-s)b(1-p)+2\,p^2s}{b(2\,p^2-p+1)} \\ G_x = \frac{((1-s)b+s)p^2+((2\,s-2)b+s)p+(1-s)b}{2\,p^2-p+1} \end{cases} \tag{32}$$

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 (28) 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 $\frac{du(.)}{dX} = \frac{k(-1+p)^2 p((s-1)b+s)}{2\,p^2-p+1}$.

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 $\frac{dpAF}{dXdR_E} = -\frac{k((s-1)b+s)(-1+p)^2A(p-2)p^3}{(2\,p^2-p+1)^3 b}$. 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 5

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 $\frac{dX^*}{d(R_E-R_M)} < 0$.

APPENDIX B

Table 6: Sources and Description of the Variables

Variable	Description	Source
Except for the Gini coefficients, all variables were made available by courtesy of Rajan and Subramanian (2008). The dataset was 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/GDP	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
Gini	Estimated 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
Initial per capita GDP	Log of per capita real GDP at the beginning of the 5-year period.	Penn World Table, version 6.1
Initial level of 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
Log 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/`
Financial depth	Ratio of M2/GDP averaged over 5 year periods.	Easterly, William [website]
Budget balance/GDP	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)
Policy (Sachs-Warner)	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)
Institutional quality	ICRG index by Bosworth and Collins (2003), averaged over 5-year periods.	Bosworth and Collins (2003)
Geography	Average number of frost days and tropical land area.	Bosworth and Collins (2003)
Ethnic fractionalization	Ethnic fractionalization based on Soviet Atlas, plus estimates for missing in 1964.	Easterly, William [website]

Data Sources

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