Altruism, Aid Instruments and Institution Building Incentives.*

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Abstract

An altruistic donor can give aid by combining a discretionary budget and infrastructure projects targeted to the rich or to the poor. Under imperfect information on the income available for redistribution, pooling contracts are often optimal, and provide the donor a higher expected payoff than the expectation of the full information equilibrium allocations. Aid has a detrimental effect on the recipient country's incentives to develop institutions only when institutional development mainly improves the income of the country. If institutional development mainly increases the redistribution motive of the rich, aid can enhance development.

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Even for an altruist giving away resources is a complicated matter. Resources are limited and giving resources to some individuals may hurt others; helping may create a culture of aid among individuals and hinder or crowd-out incentives; the resources that are given may not be used for their intended purpose. But not giving away resources is also costly for our altruist. These concerns are especially acute when motivated lenders extend aid to developing countries. Motivated lenders often look beyond the monetary return from aid and care about how aid will help the country develop, not only in producing goods and services but also in correcting inequality, favoring social mobility, in short whether there is adequate redistribution of resources, and whether the country will put in place better functioning institutions.

But how should an altruist donor give aid to make it effective? Should she tailor the aid package to the characteristics of the country, in particular its available income? Should she favor infrastructure building rather than discretionary budget? Should the donor be worried that aid destroys incentives for the recipient to invest in the development of "good" institutions? In this paper we provide a theoretical framework for thinking of these issues and offer some answers to these questions: Yes, a mix of modalities should be used, and often in a way that is non contingent on the private information of the recipient country; Yes, the donor should be worried about a Samaritan paradox, but only if institutional development does not modify the political balance of power within the country.

In our environment, the donor and the recipient differ in their desire to redistribute income to the poor and for this reason, a discretionary budget support will not be distributed optimally from the point of view of the donor. By contrast, infrastructure projects confer the donor a higher control over redistribution; building a school in a rural area benefits mainly the poor, while building a freeway through the same area facilitates the distribution of manufactured goods, which benefits mainly the rich.[1] When projects can be targeted (to the poor or to the rich), the donor can use a mix of these instruments to achieve a desired level of redistribution and development at least cost.

We first consider a situation of perfect information about the preferences of the recipient country and its ability to transfer income to the poor. There is a moral hazard aspect related to the non-contractibility of consumption flows in the recipient country which is responsible for implementing redistributive policies. We show that in the optimal contract the discretionary budget is a decreasing function of income while the infrastructure projects are (weakly) increasing functions of the ability to transfer income in the recipient country. Transfers can even be negative – which we interpret as a co-financing of infrastructure projects – for larger income countries. For low income countries, the infrastructure project is independent of income, but for higher income countries, the project will be increasingly targeted toward the rich when the shadow price of transfers is small but targeted toward the poor if the shadow price of transfers

[1] At least in a static framework; better schooling may eventually benefit the rich if it enables the adoption of more complex technologies; better roads may induce poor to migrate or to develop local enterprises.

is large.

The assumptions of perfect information on the ability to transfer and on the preference for redistribution are idealizations. In fact, an often voiced argument for using only infrastructure projects rather than giving a discretionary budget to the recipient country is that of incentive compatibility, for instance a rich country may pretend to have low ability to redistribute in order to benefit from aid.[2] A more salient assumption is that of asymmetry of information about the ability of the recipient to transfer income to the poor. Even if the donor may have a good knowledge of the preference of the recipient country for redistribution, or its GDP, the donor may not know the effective share of this GDP that could be transferred from the rich to the poor in the country.

Because the donor can use two instruments in contracting, budget and project characteristics, it is possible to use contracting to separate types; our main result for the case of imperfect information is that the donor often elects to use a pooling contract. In fact, pooling is the unique second-best contract when the recipient country cannot commit to co-finance a project, that is when transfers from the donor must be non-negative, but pooling may also be optimal even when co-financing is possible.

There are three reasons for this result. First, contrary to usual screening models where the principal benefits from reducing transfer payments while the agent suffers from this reduction, here both the donor and the recipient value transfers. Second, in our model the recipient country has the liberty to choose the level of redistribution of income between rich and poor and the autarky payoff is increasing in the initial income (type). Under the full information allocation, when contracting for aid happens under symmetric information about the ability to transfer to the poor, the recipient's payoff net of its autarky payoff is a *decreasing* function of its type, suggesting that in the second-best providing rents to higher types is not as costly for incentive compatibility as in standard screening contexts with uniform outside options. Finally, both the donor and the recipient are risk-averse in monetary transfers and in infrastructure projects. Contracting under imperfect information gives the donor the opportunity to commit to aid contracts that are independent of type, hence to provide insurance *for the two parties.* Such a commitment is not credible if contracting happens under perfect information since both parties know that they can benefit from renegotiation.

Our specification allows us to address the concern that aid may decrease a country's incentives to invest in institutions. We show, under perfect and imperfect information, that aid depresses incentives to invest in institutional development when institutional building has for main effect to increase income but has little effect on the redistribution motive of the rich. This observation is consistent with the perceived failures of conditionality for aid and the need to condition on the development of institutions that balance the political power of the rich and the poor. By contrast, if institutional building increases the redistribution motive, for instance because it gives more voice to the poor in the legislative system, then aid cannot depress investment and can often increase

[2]The argument parallels that made in the literature on welfare benefits, and the role of food stamps versus cash subsidies.

such investments. Hence, institutional development for economic reasons is prone to the Samaritan dilemma, but institution development for modifying the political balance between the poor and the rich is not. In the first case, aid and development are substitute, in the second, they complement each other.

Literature Review

Our paper borrows from different strands in the literature on aid that we review below. We discuss the more technical literature on screening under heterogeneous outside options or the relationship between our pooling result and the literature on "simple" contracts in section 3.

Altruism in aid. Our focus on altruism as a driver for aid is consistent with the finding in the literature (Feeny and McGillivray, 2008; Berthelemy, 2006; Hefeker, 2006; Alesina and Dollar, 2000) that aid allocation responds to the need of the recipient country, although the extent of altruism is different between donors and across time. There are obviously other factors beyond altruism of the donor that matter for aid. For instance, opportunism or the perceived "merit" of recipient countries, or aid serving as a quid-pro-quo for military presence of the donor (our model could encompass this aspect if military presence of a foreign country is interpreted as "infrastructure" which is likely to benefit only the rich.) But while the effects of these other factors are relatively well understood, the effects of altruism on aid, or on financial contracting in general, are not.

Aid modalities. The literature on aid effectiveness has traditionally focused on the role of different imperfections linked to the characteristics of donors and recipients of aid: lack of institutional capacities and corruption in the recipient country as well as the lack of coordination among donors and the inherent enforcement problems (Doucouliagos and Paldam, 2009; Bourguignon and Sundberg, 2007; Tarp, 2006; Bourguignon and Platteau, 2015). More recently, the focus has shifted from the recipient country's internal limitations to the optimal design of the aid contract, and the costs and benefits of different aid instruments have been debated in the literature. This change of focus seems deserved given the available evidence.

Indeed, OECD data suggest that for both bilateral and multilateral donors there is a mix of budget and infrastructure support to LDCs and LMICs. There is significant variation among donors in the share of budget support in total aid allocated but also in the evolution of this share. If we consider multilateral aid to LDCs, the share of budget assistance in total aid was 14.25% in 2013 while it had been 37.12% in 2004. The decrease is not uniform among donors however; for instance, International Development Association increased the share of budget support from 13% in 2001 to 43% in 2004 and to 50% in 2005; the European Commission and the UK's Department for International Development have provided almost 50% of their total aid in the form of budget support. For bilateral aid, the decrease in the share of budget may be significant; for instance, for

ODA provided by the U.K. to Tanzania, the ratio of budget support to project assistance was 794 in 2006, 25 in 2009 and 1.5 in 2012.

Theoretical arguments in favor of budget support include the absence of crowding effect, the low level of transaction and administrative costs and the freedom given to the recipient for allocating the money to the sectors that are most in need (Hefeker, 2006; Jelovac and Vandeninden, 2008; Leiderer, 2012). Budget support, however, suffers from being more vulnerable to fungibility and corruption (Leiderer, 2012; Dollar and Pritchett, 2013); budget can be diverted by the recipient to purposes others than the ones for which it was initially intended. Project assistance gives more control to the donor to monitor the use of aid but suffers from high transaction costs especially when aid is fragmented (many donors giving small amounts in the same recipient country), a feature characterizing aid giving in practice. It may also be undermined by the lack of coordination between donors yielding over investment or even duplicated investments. Our model captures transaction costs in a drastic way by assuming a cost ϕc for infrastructure, where c is the monetary cost and ϕ could incorporate the transaction costs alluded to before. We are silent on coordination problems among donors, but our results must be part of an analysis with multiple donors since in a non-cooperative equilibrium with multiple donors, each donor will take as given the aid package of other donors, and she will contract on the basis of the "residual needs" of the recipient country.

Surprisingly, the debate on the choice of aid instruments stayed long at the descriptive level until the pioneering work of Cordella and Dell'Ariccia (2007) who consider separately two modalities of aid: a budget aid that is conditional on (observable) capital investments made by the recipient country, and a project aid that directly imposes a capital expenditure. They find that budget support always dominates project assistance when the preferences of donors and recipients are aligned, and when the assistance is small relative to the recipients' own resources. They do not consider however the possibility of having both budget and project aid in the same package.

Another paper examining separately the use of aid modalities is Hefeker (2006) who asks which instrument is better suited to increase the economic situation of underprivileged groups in recipient countries. The finding is that budget support is a better instrument than project aid, if aid programs are small with respect to the government's resources and if the difference between the agents' preferences is large.

Closer to our model Jelovac and Vandeninden (2008) use a unified framework for the comparison between aid modalities. They show that all aid should be given via budget support, independently of whether conditionality can be used or not. This is because of the combination of two effects: the linearity of the donor's preferences, and her anticipation that projects may have a crowding-out effect on the resources of the recipient country (i.e., these resources would be otherwise allocated toward development in the absence of aid). As we show in our sections on endogenous institutional development, the crowd-out effect – the Samaritan dilemma facing the donor – is at play only when the recipient's investment in institutions affects the available income in the country but not when it affects the balance of power between poor and rich, that is the willingness of the rich to redistribute income to the poor. But even if there is a crowding out in our model, the two modalities are used in equilibrium because of the non-linearity of the agents' preferences.

Both Jelovac and Vandeninden (2008) and Hefeker (2006) consider that the donors and the recipients are perfectly informed about their environment and their mutual characteristics, and they do not address the role of asymmetric information for the design of aid contracts. Moreover, these theories are silent on the role that the mix of instruments may play for aid effectiveness. A corollary of our main result is that an aid policy that offers either only budgetary support or infrastructure support to countries is dominated by a policy that offers the same mix of budget and infrastructure to all countries.

On the empirical side Clist and Morrissey (2012) analyze whether the selectivity exercised by donors is implemented over aid modality rather than the level of aid. They find some evidence that multilateral donors are more likely to change the instrument through which aid is provided, even if they have not altered the total level of aid allocated.

All of the papers mentioned above do not investigate the issue of redistribution of wealth within the recipient country nor do they examine the effect of aid on institutional development (which, precisely, facilitates redistribution).

Redistribution and screening. Azam and Laffont (2003) analyze aid as a contract where the North gives a transfer to the South in return for poverty reduction. Conditionality is modeled as aid contingent on observed consumption of the poor, the contracting problem being set in the shadow of asymmetric information about the degree of altruism of the government of the South. In our model the consumption of the poor is not verifiable, making conditionality difficult to enforce. Rather than conditionality, we focus on the role of risk aversion and on the mix of aid modalities to generate information from the recipient country.

Samaritan dilemma. Our discussion on the incentives to invest in institutions has an obvious parallel with the literature showing how tied transfers (Buchanan, 1975) may be a solution to the Samaritan dilemma. This dilemma states that if an altruist insures an agent, helping him out in bad states of nature, this may result in under provision of effort by the agent. The explanation relies on the fact that the Samaritan's promise to help in bad times is known ex-ante by the agent. Hence the dilemma faced by the altruist. We show that the *nature of institutional development* is key for the emergence of a Samaritan dilemma: it appears when institutional investment is mainly to foster economic performance, but is not present when institutional development helps increase the redistribution motive, e.g., by increasing the political representation of the poor.

The remainder of the paper is organized as follows: the next section introduces the benchmark model. The optimal aid under full information is characterized in section 2. We extend the analysis to asymmetric information in section 3 and establish the pooling result and why other separating contracts like grant matching contracts not only yield a lower expected surplus for the donor but also exclude more recipients from aid.

1 A Model of Structural and Monetary Aid

A donor (international institutions, developed countries, private benefactors) provides foreign aid to a developing country, the recipient. In the recipient country, there is a measure 1 of rich and a measure $n > 1$ of poor. All individuals in the country derive utility $\log(c)$ from income c.

Rich have total income y and the consumption levels of the rich and the poor are denoted by r, p respectively. The rich can engage in income redistribution subject to the budget constraint $r + np = y$, in which case the welfare of the recipient country is $\log r + na \log p$. The donor country has the same objective function as above but with $a = 1$. Hence $a \leq 1$ indexes the degree of preference alignment between the recipient and the donor.

The way we model the two main modalities of aid, budget support and infrastructure projects, and the fact that the recipient has greater discretion with the budget than with infrastructure is consistent with OECD (2006).[3] Hence, aid may consist of a lump-sum transfer, a budget, T from the donor to the recipient, in which case total income in the country is $y + T$. T can be positive or negative, in the later case we interpret it as a co-financing of the project by the recipient country.[4] The lump-sum transfer benefits the low income agents only if the decision makers in the recipient country decide to channel this additional income to them. When $a < 1$, the recipient country will channel funds to the poor at a rate that is lower than the one the donor would like.

In addition, or instead of, lump sum transfers, the donor can help the recipient country build an infrastructure project like a road, a school, a bridge, a telephone network. Projects increase the benefits of consumption for different classes of individuals. For instance, electricity networks in rural areas may benefit industries but also low income agents, the same for road development. However, digging of water wells or building a school in a rural area tend to benefit mainly low income agents. We model this by assuming that projects create a multiplier effect on consumption for the poor and the rich. Projects are parametrized by (ρ, π), with $\rho \geq 1$ is the multiplier effect of the project for the rich and $\pi \geq 1$ is the multiplier effect for the poor. Because consumption

[3] Budget support is defined as aid channeled to the partner government using the country's own allocation, procurement and accounting system, and this support is not linked to specific project activities. Budget support is transferred to the recipient government's treasury, and is managed in accordance with the partner country's budgetary procedures. With project assistance, the donor directly participates in the design and the implementation of a developmental project, decides the inputs to be provided, and usually uses its own disbursement and accounting procedures, this is off-budget (Foster and Fozzard, 2000).

[4] The idea is that aid comes as a combination of budget support and infrastructure projects. As such, when the transfer is negative, it is interpreted as a contribution of the recipient to the infrastructure project.

levels are r, p, total welfare becomes[5]

$$\log(\rho r) + na \log(\pi p).$$

There is an opportunity cost of $\phi \geq 1$ of transferring income from the donor to the recipient country and a project (ρ, π) costs $c(\rho + \pi - 2)$, linear in the total multiplier effect, with a zero cost when $\rho = \pi = 1$.[6]

To simplify the exposition, we assume that the shadow price of transfers is low enough, in particular is bounded by the total population of poor.

Assumption 1. *$\phi c < n$.*

2 Full Information

2.1 Optimal Aid Package

Autarky

To simplify, we will assume that the recipient country does not have the capabilities to develop its own projects. This may be due to lack of technical expertise, or inability to channel funds efficiently because of corruption or other imperfections. In autarky, the recipient country chooses consumption levels r, p in order to solve the problem

$$\max_{r,p} \log r + na \log p$$
$$\text{s.t. } r + np \leq y$$

which solution is:

$$r = \frac{y}{1 + na}; p = \frac{ay}{1 + na}.$$

The welfare under autarky is therefore

$$\underline{U}(y, a) = (1 + na) \log y + A(a)$$

where

$$A(a) \equiv na \log a - (1 + na) \log(1 + na).$$

[5]This specification separates the effects of income and infrastructure projects. In the absence of separability, an uncommon assumption in screening models, the analysis becomes a lot more involved, see for instance Guesnerie and Laffont (1984); Ruiz del Portal (2012). The log specification itself is inconsequential for our qualitative results. For instance, if for an allocation where rich and poor have income m_R, m_P and targeted projects are ρ, π, the rich have utility $u_R(m_R) + v(\rho)$ and the poor have utility $u_P(m_P) + v(\pi)$, where $v(0) = 0$, and v, u_i are increasing and concave, while the cost of projects is $\phi c(\rho + \pi)$, the non-monotonicity of project targeting and the pooling result persist. We will return to this more general specification when these results are presented.

[6]The linearity of the cost of projects is assumed for convenience but does not affect the qualitative results of the model. In general, a convex cost function $c(\cdot)$ with support $[0, \infty]$ and satisfying $c(0) = 0$ and $c'(0) = c$ can be used; remember that $\rho = \pi = 1$ while 0 means now the status-quo, no infrastructure aid, hence $c(0) = 0$.

Aid

When offered an aid package (T, ρ, π), the recipient country solves

$$\max_{r,p} \log r + na \log p + \log \rho + na \log \pi$$
$$\text{s.t. } r + np \leq y + T$$

yielding optimal consumption levels

$$r = \frac{y+T}{1+na}; p = \frac{a(y+T)}{1+na}$$

and a total welfare

$$U(T, \rho, \pi | y, a) = (1 + na) \log(y + T) + \log \rho + na \log \pi + A(a)$$

regardless of the level of optimal transfer, the poor gets a share $\frac{a}{1+na}$ while the rich get a share of $\frac{1}{1+na}$. Even if the monetary aid is initially intended for the poor, a share of $\frac{1}{1+na}$ is captured by the rich.

For a given (T, ρ, π), the donor's payoff can be written as

$$\begin{aligned} V(T, \rho, \pi | y, a) = U(T, \rho, \pi | y, a) & \\ & + (n - na)[\log(y + T) + \log \pi] + (n - na)[\log a - \log(1 + na)] \\ & - \phi(T + c(\rho + \phi - 2)). \end{aligned} \tag{1}$$

Hence, even when the preferences on the donor and the elite in the recipient country have the same preference for redistribution (i.e., $a = 1$), there is still a non-trivial conflict of interest and contracting problem since the donor internalizes the cost of the aid package while the recipient does not. Having a different motive for redistribution will matter when we later allow the recipient to modify the value of a.

Full Information Optimal Aid

Anticipating the choices made by the recipient country, the donor will choose the aid (T, ρ, π) to solve:

$$\begin{aligned} Max_{T,\rho,\pi}(1 + n) \log(y + T) + \log \rho + n \log \pi + n \log a & \\ - (1 + n) \log(1 + na) - \phi(T + c(\rho + \pi - 2)) & \\ \text{s.t. } (1 + na)[\log(y + T) - \log y] + \log \rho + na \log \pi \geq 0 & \end{aligned} \tag{2}$$

where the inequality is the individual rational constraint of the recipient country.

If the constraint does not bind, the optimal lump-sum transfer is

$$T^*(y) = \frac{1+n}{\phi} - y,$$

and it is optimal to give a positive monetary transfer only if y is smaller than $(1+n)/\phi$. For richer developing countries, the optimal transfer is negative, suggesting that the recipient country has to *co-finance* the infrastructure project. We will also highlight the case where recipients cannot co-finance projects (say because the shadow cost of such transfers is large).

The optimal project solves

$$\pi^*(y) = \frac{n}{\phi c} \tag{3}$$
$$\rho^*(y) = \max\left(1, \frac{1}{\phi c}\right).$$

Within this regime, the infrastructure is always profitable to the poor. If $\phi c \geq 1$, only the poor benefit from it, but if $\phi c < 1$, the infrastructure may also benefit the rich, however by a factor $1/n$.

This yields a welfare for the recipient country that is independent of y:

$$u^*(a) = (1+na)\log\left(\frac{1+n}{\phi^2 c}\right) + na\log(\max[1,\phi c]) + na\log n + A(a). \tag{4}$$

The recipient accepts the aid when its participation constraint (2) holds, that is if $U^*(y,a) \geq \underline{U}(y,a)$, or when

$$y \leq y^*(a) \equiv \frac{1+n}{\phi^2 c} \cdot n^{\frac{na}{1+na}} (\max[1,\phi c])^{\frac{na}{1+na}}. \tag{5}$$

The cutoff $y^*(a)$ is increasing in n, and is therefore bounded below by $y^*(0) = \frac{1+n}{\phi^2 c}$. We can also show that $y^*(a) > \frac{1+n}{\phi}$.[7]

For $y \leq y^*(a)$, the aid for a poor country then takes the form of a project that is independent of the income of the recipient country, a positive monetary transfer to recipient countries with $y \leq \frac{1+n}{\phi}$, decreasing with the income of the recipient country, but a *negative transfer* for richer countries, those with income larger than $(1+n)/\phi$ but smaller than $y^*(a)$. Richer countries should co-finance the project.

If y is larger than $y^*(a)$, the donor's best aid contract will bind the individual rationality constraint of the recipient's country. In this case, there is a shadow price associated to the participation constraint, and if $\lambda(y)$ denotes this shadow price, the

[7] If $\phi c < 1$, $y^*(a) = \frac{1+n}{\phi}\frac{n^{\frac{na}{1+na}}}{\phi c} > \frac{1+n}{\phi}$ since $\phi c < 1 < n^{\frac{na}{1+na}}$. If $\phi c > 1$, $y^*(a) = \frac{1+n}{\phi}\left(\frac{n}{\phi c}\right)^{\frac{na}{1+na}}$ which is greater than $\frac{1+n}{\phi}$ by Assumption 1.

solution is $T^*(y), \rho^*(y), \pi^*(y), \lambda^*(y)$ such that:

$$y + T^*(y) = \frac{1 + n + \lambda^*(y)(1 + na)}{\phi} \tag{6}$$

$$\rho^*(y) = \max\left[1, \frac{1 + \lambda^*(y)}{\phi c}\right] \tag{7}$$

$$\pi^*(y) = \frac{n(1 + \lambda^*(y)a)}{\phi c} \tag{8}$$

A missing condition is the binding participation constraint:

$$(1 + na)\log(y + T^*(y)) + \log \rho^*(y) + na \log \pi^*(y) = (1 + na)\log y$$

Because $\log \rho^*(y) + na \log \pi^*(y)$ is positive, it must be the case that $T^*(y)$ is negative: rich countries *co-finance* the project in the first best. Moreover, since the difference $\log(y + T) - \log(y)$ is a decreasing function of y, as y increases the shadow price $\lambda^*(y)$ must increase.

It is immediate from (6) that $\lambda^*(y)$ has positive variation if, and only if, $1 + T^{*'}(y)$ has positive variation. Consumption being a normal good, it must be the case that the consumption of the rich and the poor are increasing in the total available income $y + T(y)$. The marginal consumptions of rich and poor are proportional to $y + T(y)$, and therefore the Lagrange coefficient $\lambda^*(y)$ is indeed increasing in y.

If $\phi c \leq 1 + \lambda^*(y)$, as y increases, the ratio $\frac{\pi^*(y)}{\rho^*(y)} = \frac{n(1+\lambda^*(y)a)}{1+\lambda^*(y)}$ has variation proportional to $(a - 1)\lambda^{*'}(y)$ and is a decreasing function of y since the shadow price is an increasing function of y. Note that while the ratio $\frac{\pi^*(y)}{\rho^*(y)}$ decreases with y, when $na > 1$, $\pi^*(y)$ increases faster than $\rho^*(y)$.

By contrast, if $\phi c > 1 + \lambda^*(y)$, $\rho^*(y) = 1$ and therefore $\pi^*(y)$ has variation proportional to $\lambda^{*'}(y)$, and is increasing in y.

Another consequence of the increasing shadow price is that the transfer $T^*(y)$ in (6) has slope greater than -1, which is the variation of the transfer when $y < y^*(a)$. Hence, while the recipient country will co-finance the project for $y > y^*(a)$, this will be done at a rate lower than the one chosen for poorer recipient countries.

Proposition 1. *The recipient's country is made strictly better off by aid only if its income is less than* $y^*(a)$.

(i) The payoff of recipient y *is*

$$U^*(y, a) = \begin{cases} u^*(a) & \text{if } y \leq y^*(a) \\ \underline{U}(y, a) & \text{if } y \geq y^*(a). \end{cases}$$

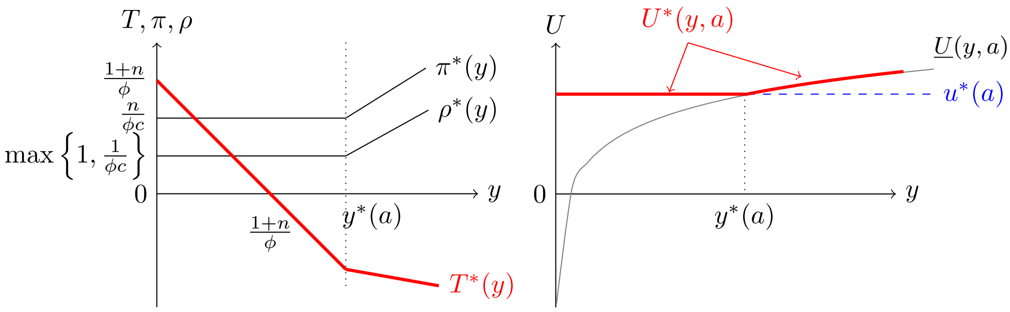
(ii) As y *increases in* $[0, y^*(a)]$*, the transfer to the recipient decreases but the project is independent of* y*.*

(iii) When $y < y^*(a)$*, the donor invests in projects that are independent of* y*. The*

transfer to the recipient is positive for all $y \leq \frac{1+n}{\phi}$*, but is negative (the recipient co-finances projects) when* $y \in \left[\frac{1+n}{\phi}, y^*(a)\right]$.

(iv) As $y > y^*(a)$*, the donor invests in larger projects. As* $\phi c \leq 1$*, projects are increasingly targeted towards the rich. When* $\phi c > 1$*, projects are first increasingly targeted toward the poor (i.e., for* $\phi c > 1 + \lambda^*(y)$*) and then towards the rich.*[8]

Figure 1 is a graphical representation of Proposition 1.[9]



(a) Transfers and Projects

(b) Payoffs

Figure 1: Full information ($\phi c < n$)

Monetary aid and projects are substitute in the full information case. Countries that are not able (or willing) to transfer wealth to the poor (low y) get high transfers and small (constant) projects, the reverse being true for countries with high y. Because $y^*(a)$ is increasing in a, the more preferences are aligned, the larger is the interval of incomes y over which aid strictly benefit the recipient country; therefore, the lower the region where IR binds. A larger value of a makes it more likely that the donor offers constant projects and asks for co-financing.

2.2 Does Aid Complement or Substitute for Institutional Development?

A common criticism to international aid is that it depresses the incentives of the recipient country to engage in redistribution or to develop institutions that will facilitate such redistribution. In other words, there may be a Samaritan dilemma at play. Institutional development can affect both the realized income y of the country, but also the motive a of elites for redistribution. We show that a Samaritan dilemma arises only if institutions do not influence the redistribution motive of elites significantly. In other words, when institutions enhance mainly productive capabilities, international aid will tend to depress incentives to invest in better institutions.

Let z be the level of institutional development, and assume that z is one-dimensional and that "better institutions" have a higher index z. Institution z affects a and y

[8] In the case of the more general specification in footnote 5, the non-monotonicity in targeting arises when $\frac{\phi c}{n} < v'(0) < \phi c$.

[9] The functions $\pi^*(y), \rho^*(y)$ are represented for convenience as linear.

stochastically, and there is a distribution $F(y, a; z)$ of (y, a). To simplify, we assume that a, y are independently distributed, that is $F(y, a; z) = G(a; z)H(y; z)$, where G, H are the marginals of a, y respectively. We also assume that "better institutions" (higher value of z) increase $G(a; z)$ and $H(y; z)$ in the first order stochastic sense. Because $A(a)$ is a convex function of a, both $u^*(a)$ an $\underline{U}(y, a)$ are convex functions of a.[10] To insure interior solutions in the choice of institutional development, we require that the cost of z is a function $\psi(z)$ that is (sufficiently) convex. (This assumption gives the best chances for a Samaritan dilemma to arise; a convex objective function will lead to corner solutions and inelastic response of the country to (small) levels of aid. Details upon request.)

Assumption 2. *The cost function $\psi(z)$ is sufficiently convex that the functions $\int_{(y,a)} U^*(y, a)dF(y, a; z) - \psi(z)$ and $\int_{(y,a)} \underline{U}(y, a)dF(y, a; z) - \psi(z)$ are globally concave in z.*

Assuming as we have done until now that the donor observes the realizations of y, a, the aid contracts detailed in the previous sections are still optimal *given that the donor cannot commit* to a choice of aid conditional on y, a. Under our assumptions, there exist unique optimal values z_{aut} under autarky and z_{aid} under aid. There is a Samaritan dilemma whenever $z_{aut} > z_{aid}$, and under Assumption 2 a necessary and sufficient condition is that the marginal expected payoff under autarky be larger than the marginal expected payoff under aid at z_{aut}.

The difference in recipient's payoff under aid and autarky when z is chosen is equal to

$$\begin{aligned}\Delta(z) &\equiv \int_{(y,a)} [U^*(y, a) - \underline{U}(y, a)]dF(y, a; z) \\ &= \int_a \left\{ \int_y [U^*(y, a) - \underline{U}(y, a)]dH(y; z) \right\} dG(a; z)\end{aligned}$$

and therefore the marginal effect of institutional development z is

$$\begin{aligned}\Delta'(z) = &\int_a \left\{ \int_y [U^*(y, a) - \underline{U}(y, a)]dH_z(y; z) \right\} dG(a; z) \\ &+ \int_a \left\{ \int_y [U^*(y, a) - \underline{U}(y, a)]dH(y; z) \right\} dG_z(a; z) \qquad (9)\end{aligned}$$

Proposition 2. *Suppose that $G_z(a; z) \equiv 0$, but that $H_z(y; z) < 0$. There is a Samaritan dilemma: aid depresses the incentives of the recipient to invest in z.*

Proof. We show that for any y, a, $U^*(y, a) - \underline{U}(y, a)$ is a decreasing function of y. For any $y < y^*(a)$, the payoff to the recipient under aid is independent of y, $U^*(y, a) = u^*(a)$ while their autarky payoff is a function of y. It follows that $\partial_y \underline{U}(y, a) = \frac{1+na}{y}$ is always

[10] Convexity of these functions is not specific to our logarithmic specification. For instance, if the payoff to the rich is $w(r) + nav(p)$, then the variation of the autarky payoff with respect to a is by the envelop theorem equal to $nv(p)$ and therefore the second derivative is equal to $np'(a)v'(p(a))$ which is positive since $p(a)$ is, by Topkis's theorem, an increasing function of a.

greater than $\partial_y U^*(y,a) = 0$. For $y > y^*(a)$, $U^*(y,a) - \underline{U}(y,a) \equiv 0$, and therefore the variation with respect to y is equal to zero.

Our assumption on G, H yields the result since the second term in (9) is equal to zero and the first term is negative. □

By contrast, if institutional development has mainly an effect on the redistribution motive of elites, e.g., by rebalancing political power between rich and poor, then aid provides additional incentives for institutional development with respect to those available under autarky.

Proposition 3. *Suppose that* $H_z(y;z) \equiv 0$ *but that* $G_z(a;z) < 0$. *Then aid will increase the incentives to invest in* z *with respect to autarky.*

Proof. We show that for any $a \in (0,1)$, the marginal return on a is greater with aid than in autarky. Direct computations imply that

$$\begin{aligned}\partial_a U^*(a) &= n\log(y^*(0)) + n\log(\max(1,\phi c)) + n\log n + A'(a) \\ &> n\log(y^*(a)) + A'(a).\end{aligned}$$

Now, in autarky,

$$\partial_a \underline{U}(y,a) = n\log y + A'(a).$$

If $y \leq y^*(a_{aut})$, it follows that $\partial_a \underline{U}(y, a_{aut}) < \partial_a U^*(a_{aut})$ since the recipient country is, by Proposition 1, strictly better off with aid. Hence $a^* > a_{aut}$. If $y > y^*(a_{aut})$, then for a in a neighborhood of a_{aut} we have $u^*(a) \equiv \underline{U}(y,a)$, and therefore $a^* = a_{aut}$. The rest of the proof follows that of Proposition 2, our assumption that $H_z(y;z) = 0$, $G_z(a;z) < 0$ and global concavity of the objective functions. □

Because the donor cannot commit not to renegotiate the aid contract, imperfect information may *help rather than hinder a donor*. As we will verify shortly, imperfect information indeed improves the donor's welfare but cannot solve the Samaritan dilemma when institutional development is mainly correlated with income increase.

3 Imperfect Information and Pooling

Even if there is a good estimate of the total GDP in the country, the share of GDP that could be transferred from rich to poor, y in our model, is likely to be private information.

Importantly, the screening problem faced by the donor has two characteristics that are known to make the derivation of the optimal second-best contract difficult: different outside options for different types and utility functions that are not quasi-linear in income. In the context of aid for development, these two assumptions seem hard to bypass.

First, countries with different incomes or institutions have different outside options, in particular in their ability to commit to redistributing to the poor. The literature (e.g., Jullien, 2000) has shown that *bunching* (giving the same allocation to different types) occurs naturally in this setting, at least for some intervals of types. A recent application of screening models with type dependent outside options to development is Attanasio and Pastorino (2015); the authors show that cash transfers may strengthen the incentives of a monopoly seller to price discriminate and therefore exacerbate the consumption distortions associated with nonlinear pricing. In our case, cash transfers make it optimal for the donor to offer a unique project to the recipient countries.

Second, the features that make it difficult for an economy to develop — lack of access to capital markets, difficulties to contract, corruption — suggest that allocations are subject to non-transferabilities and that aversion to risk cannot be easily insured against. Screening with risk averse agents introduces additional complications in the mechanism design problem since the insurance motive may complement or substitute for the usual rent extraction motive (the literature is scarce, see Laffont and Rochet, 1998 and more recently Arve and Martimort, 2016), especially when the screening problem is combined with a moral hazard problem like in our case (see Jullien, Salanie and Salanie, 2007); in our context the altruism of the principal makes the insurance motive more important and leads, for a large class of environments, to the pooling solution.[11]

Pooling contracts are "simple" contracts, and the literature has highlighted situations where simple contracts should be expected when there is a combination of adverse selection and moral hazard. Guesnerie and Laffont (1984) remark that a unique contract may be optimal if the first best allocation is decreasing in the agents types while incentive compatibility requires the opposite; they call this non-responsiveness. Non-responsiveness is not necessary however for the second-best mechanism to involve pooling (e.g., Ollier and Thomas, 2013 and more recently Gottlieb and Moreira, 2017). The fact that pooling emerges when an altruistic principal values insurance seems a novel rationale for the emergence of simple contracts.

In what follows, we first show that despite the difference in outside options, the standard result that incentive compatibility implies that individual rationality holds whenever it holds for the lowest type is true in our environment. We then show that there are conditions under which the second-best optimal contract is pooling.

3.1 Incentive Compatibility and Individual Rationality

Let us denote the aggregate value of the project to the recipient by

$$P(y) = \log(\rho(y)) + na\log(\pi(y)) \tag{10}$$

The donor has at its disposal two instruments to separate types: the transfer T and the overall value of projects P in order to control the payoff of the recipient country of $u(T, P, y) \equiv (1 + na)\log(y + T) + P + A(a)$.

[11] The lack of quasi-linearity makes it difficult to apply standard techniques, but as we will see shortly, the fact that the donor has preferences close to that of the recipients allow us to compute the second-best contract in some general environments.

We note that $\frac{\partial^2 u}{\partial T \partial y} = -\frac{(1+na)}{(y+T)^2} < 0$ while $\frac{\partial^2 u}{\partial P \partial y} = 0$. Hence, the ratio $\frac{\partial u}{\partial T} / \frac{\partial u}{\partial P}$ is a strictly decreasing function of y, implying that the Spence-Mirrlees condition holds as long as $T'(y) \leq 0$.

Incentive compatibility requires that $T(y)$ be non increasing in y and that $P(y)$ be non-decreasing in y. The proof is standard and is relegated to the Appendix. The full information allocation has this property, but is not incentive compatible; this is clear for types $y \leq y^*$ who get the same project benefit but receive a lower monetary transfer, hence would all like to claim to have a low value of y.

Lemma 1. *(i) Incentive compatibility requires that $T(y)$ be non increasing in y and $P(y) \equiv \log \rho(y) + na \log \pi(y)$ to be non-decreasing in y.*

(ii) For almost all y,

$$P'(y) = -(1+na)\frac{T'(y)}{y+T(y)}. \tag{11}$$

(iii) The full information allocation does not satisfy the incentive compatibility conditions.

We have, despite the fact that there are type-dependent autarky payoffs, the familiar result that incentive compatibility implies individual rationality as long as it is satisfied for the lowest type.

Lemma 2. *Consider an incentive compatible aid $T(y), P(y)$. Individual rationality is satisfied for all $y \geq \underline{y}$ whenever it is satisfied at $\underline{y}$.*

3.2 Pooling Contracts

The necessary and sufficient conditions for incentive compatibility are that $T'(y) \leq 0$ and that $T'(y), P'(y))$ are in the one-to-one relation (11). Hence, the donor chooses a menu of aid contracts $\{x = \langle T(y), \rho(y), \pi(y) \rangle\}$ in order to solve (the function V is defined in (1)):

$$\max_{(T(y),\rho(y),\pi(y))} \mathbb{E}_y[V(T(y), \rho(y), \pi(y)|y, a)]$$

$$\text{s.t. } T'(y) \leq 0 \tag{IC1}$$

$$P'(y) = -(1+na)\frac{T'(y)}{y+T(y)} \tag{IC2}$$

$$(1+na)[\log(\underline{y}+T(\underline{y})) - \log(\underline{y})] + P(\underline{y}) \geq 0 \tag{IR}$$

If there is separation of types on some intervals, the payoff from infrastructure projects $P(y)$ to the donor must be increasing in y over this interval. This implies that both $\pi(y)$ and $\rho(y)$ are increasing function of y but the ratio $\frac{\pi(y)}{\rho(y)}$ can be increasing in y or decreasing in y depending on whether $\rho(y)$ is equal or greater than 1.

Proposition 4. *Suppose that the second-best allocation involves separation on an interval of types and that $\rho(\underline{y}) = 1$ while $\rho(\overline{y}) > 1$. Then as y increases, projects are* *increasingly targeted towards the poor for low values of y and increasingly targeted towards the rich for higher values of y.*

Proof. We know that the infrastructure benefit $P(y) = \log \rho(y) + na \log \pi(y)$ is increasing in y. For a given value of $P(y)$, the donor will choose ρ and π to solve

$$\max_{\rho,\pi} \log \rho + n \log \pi - \phi c(\rho + \pi - 2) \qquad (12)$$
$$\text{s.t. } \log \rho + na \log \pi = P(y).$$

Let P^* be the value to the recipient country of the first-best projects $\rho^* = 1$, $\pi^* = \frac{n}{\phi c}$. If $P(\underline{y}) < P^*$, let us define a new menu of projects $\hat{P}(y)$ where $\hat{P}(\underline{y}) = P^*$ and $\hat{P}(y) = P^* + \int_{\underline{y}}^{y} P'(x)dx$. Because incentive compatibility depends only of the derivative of the project value, the new project $\hat{P}$ is incentive compatible but brings more benefit to the donor. Now, since $P(y) \geq P^*$, we can rewrite the problem of the donor by substituting the equality in the constraint by an inequality.

$$\max_{\rho,\pi} \log \rho + n \log \pi - \phi c(\rho + \pi - 2) \qquad (13)$$
$$\text{s.t. } \log \rho + na \log \pi \geq P(y).$$

Let $\mu(y)$ the Lagrange coefficient of the constraint. Because $P(y)$ is positive, either $\rho(y)$ or $\pi(y)$ must be greater than 1. The first order conditions lead to $\rho = \frac{1+\mu(y)}{\phi c}$ and $\pi(y) = \frac{n(1+\mu(y)a)}{\phi c}$, and $\pi(y)$ is greater than 1 since $n > \phi c$. Hence there can be two regimes when $\phi c > 1$. If $\mu(y)$ is small, then $\rho(y) = 1$, and $\frac{\pi(y)}{\rho(y)} = \pi(y)$ is an increasing function of $\mu(y)$, and since $\mu(y)$ increases when y increases, the projects are increasingly targeted toward the poor. By contrast, if $\rho(y) = \frac{1+\mu(y)}{\phi c} > 1$, the ratio $\frac{\pi(y)}{\rho(y)} = \frac{n(1+\mu(y)a)}{1+\mu(y)}$ is a decreasing function of $\mu(y)$ and since $\mu(y)$ is an increasing function of y, the ratio is decreasing in y as claimed. □

Let us now turn to the role of pooling contracts in our environment. Let $x = \langle T(y), \rho(y), \pi(y) \rangle$ be an aid package allocation. Construct from this allocation another allocation, a pooling allocation $\alpha(x) = (T^p, \rho^p, \pi^p)$ that does not depend on types as follows:

$$\log(\rho^p) = \mathbb{E}[\log(\rho(y))]; \ \log(\pi^p) = \mathbb{E}[\log(\pi(y))] \qquad (14)$$
$$(1+n)\mathbb{E} \log(y + T^p) - \phi T^p = (1+n)\mathbb{E}[\log(y + T(y)] - \phi \mathbb{E}[T(y)].$$

By concavity,

$$\rho^p + \pi^p < \mathbb{E}[\rho(y) + \pi(y)],$$

and it follows that the allocation $\alpha(x)$ is less expensive than the allocation x and therefore leads to a higher payoff for the donor than the initial allocation x. From this simple observation, we have the following result. (It should be clear that the same argument applies to more general specifications of the utility functions in footnote 5.)

Lemma 3. *Consider a second-best contract* $x = (T(y), \rho(y), \pi(y))$ *and suppose that for the pooling contract* $\alpha(x) = (T^p, \rho^p, \pi^p)$ *constructed in* (14), $U\left(\alpha(x)|\underline{y}\right) \geq \underline{U}(\underline{y})$, *then the second-best contract is a pooling contract.*

Proof. Under the condition $U(\alpha(x))|\underline{y}) \geq \underline{U}(\underline{y})$, the pooling contract is incentive compatible and individual rational, hence is feasible. Because $V(\alpha(x)) > V(x)$ whenever x is a non-trivial function of y, we have a contradiction if x is not a pooling contract. □

This lemma enables us to show optimality of the pooling contract in specific environments. Observe first that while the full information aid allocation $x^* = \langle T^*(y), \rho^*(y), \pi^*(y)\rangle$ in section 2.1 *is not incentive compatible*, the pooling contract $\alpha(x^*)$ is incentive compatible. If the lowest type has a non-negative expected payoff, the pooling contract is feasible in the second-best and the expected utility of the donor is strictly greater than under full information. This is because under incomplete information, the pooling contract generates income and project smoothing, and therefore (by risk-aversion) improves on the perfect-information allocation. Alternatively, as illustrated by Figure 1, under perfect information it is not incentive compatible *for the donor* to offer a contract that is the same for all recipient countries.

A sufficient condition for the expected allocation $(\mathbb{E}[T^*(y)], \mathbb{E}[\rho^*(y)], \mathbb{E}[\pi^*(y)])$, to be individually rational is that $\mathbb{E}[T^*(y)] \geq 0$. If $\mathbb{E}[T^*(y)] < 0$, a necessary and sufficient condition is that $(1+na)(\log(\underline{y}) - \log(\underline{y} + \mathbb{E}[T^*(y)])) \leq \log(\mathbb{E}[\rho^*(y)]) + na\log(\mathbb{E}[\pi^*(y)])$.

Proposition 5. *The pooling contract that coincides with the expected allocation under perfect information is second-best feasible if one of the following conditions holds:*

(i) $\mathbb{E}[T^*(y)] \geq 0$;

(ii) $\mathbb{E}[T^*(y)] < 0$ *and* $(1+na)(\log(\underline{y}) - \log(\underline{y}+\mathbb{E}[T^*(y)])) \leq \log(\mathbb{E}[\rho^*(y)]) + na\log(\mathbb{E}[\pi^*(y)])$

In these cases, the donor has a higher expected payoff than when the choice of aid is made under perfect information.

3.3 Examples

Co-Financing is Not Possible

A special case is when transfers are restricted to be non-negative, e.g., because the recipient country cannot commit to co-finance a project. Optimality of a pooling contract is a consequence of lemma 3: since any feasible contract that gives positive transfers is dominated by a pooling contract, the second-best is obtained at a pooling contract. The second-best contract solves $\max_{T\geq 0, \rho \geq 1, \pi \geq 1} \mathbb{E}[V(x|y,a)]$. The first order conditions with respect to ρ, π imply that the second-best infrastructure projects coincide with the full information projects when $y \leq y^*$; see (3).

The optimal transfer solves the condition $(1+n)\mathbb{E}\left[\frac{1}{y+T}\right] = \phi - \lambda$, where λ is the shadow price of the constraint $T \geq 0$. The constraint does not bind when $\lambda = 0$ and therefore $\mathbb{E}\left[\frac{1}{y+T}\right] = \frac{\phi}{1+n}$. By the intermediate value theorem, there exists a unique y_F

such that $\frac{1}{y_F} = \mathbb{E}\left[\frac{1}{y}\right]$. Because for any non-negative T, $\mathbb{E}\left[\frac{1}{y+T}\right] \leq \mathbb{E}\left[\frac{1}{y}\right]$, the constraint does not bind whenever $y_F \leq \frac{1+n}{\phi}$. If the constraint binds, then it is optimal to set $T^s = 0$, that is to give aid only through infrastructure projects. Note that contrary to the first best allocation, rich countries (those with $y \geq \frac{1+n}{\phi}$) do not co-finance projects in the second-best.

Corollary 1. *Suppose that transfers must be non-negative. The second-best contract is the pooling contract:*

$$\begin{aligned}
&\rho = \max\left\{1, \frac{1}{\phi c}\right\},\ \pi = \frac{n}{\phi c},\\
&T \text{ solves } \mathbb{E}\left[\frac{1}{y+T}\right] = \frac{1+n}{\phi} \text{ if } y_F \leq \frac{1+n}{\phi},\\
&T = 0 \text{ if } y_F \geq \frac{1+n}{\phi}.
\end{aligned}$$

Menus of Simple Contracts

The donor could offer a menu of simple contracts, each consisting of either a monetary transfer and no project or a project but no monetary transfer. Clearly, for incentive compatibility, neither the transfer T nor the project value $P = \log\rho + na\log\pi$ can be dependent on y, and there can be at most two simple contracts. Country y prefers the transfer when

$$(1+na)\log(y+T) \geq (1+na)\log y + P,$$

Because $\log(y+T) - \log y$ is a decreasing function of y, there exists a unique cutoff y^* such that countries with $y < y^*$ prefer the transfer while countries with $y > y^*$ prefer the project. However, since T is positive lemma 3 implies that the menu is dominated by the aid contract T^*, ρ^*, π^*, where $T^* = F(y^*)T$, $\rho^* = (1 - F(y^*))\rho$, and $\pi^* = (1 - F(y^*))\pi$.

Corollary 2. *A menu of simple contracts consisting of either a monetary transfer or a project is dominated by a contract offering both a transfer and a project.*

Matching Grants

When the recipient cannot commit to co-finance projects, the transfers must be non-negative and incentive compatibility prevents the donor from excluding countries from aid: as soon as there is a positive transfer or a project leading to a benefit $P > 0$, then independently of y, aid increases the recipient's payoff with respect to the autarky payoff. This is not the case when recipient countries can commit to co-finance projects, and in this case it may be optimal for the donor to exclude some recipient countries from aid. Poorer countries cannot co-finance (or will refuse such an aid package because they are better off in autarky) and if they obtain a positive transfer this will make it harder to satisfy the incentive compatibility condition of richer countries, hence will increase the cost of providing aid (since transfers must increase) or decrease the expected return from aid. There is, even for an altruistic donor, a tradeoff between providing aid to all countries and tightening the level of aid for countries which would most benefit from it.

A simple way to implement co-financing in an incentive compatible way is via a program of *matching grant*. The donor commits to match the contribution of the recipient towards an infrastructure project. Hence, if the recipient contributes t, the donor will contribute t and the project that is chosen must satisfy the budget condition

$$2t \geq \phi c(\rho + \pi - 2)$$

A recipient with income y chooses to contribute t in order to solve

$$\begin{aligned}\max_{t,r,p,\rho,\pi} \; & \log(r) + na\log(p) + \log(\rho) + na\log(\pi) \\ \text{s.t.} \; & r + np \leq y - t \\ & 2t = \phi c(\rho + \pi - 2) \\ & \rho \geq 1, \pi \geq 1.\end{aligned}$$

Because the marginal cost of investment is higher for poor countries, a minimum income is required for countries to accept matching grant programs. We show in the Appendix that this is indeed the case. Compared to other aid contracts, matching grants exclude some countries from aid and as y increases, the recipient country invests first exclusively in projects that benefit the poor, but then for larger values of y starts investing in projects that benefit the rich while keeping the ratio π/ρ constant and equal to na. Hence contrary to the perfect information case, it is not the case that aid for richer countries will target more the rich in their choice of infrastructure projects.[12]

Lemma 4. *In a matching grant equilibrium:*

(i) If $y \leq \frac{1+na}{na}\phi c$, $t(y) = 0$ *and* $\rho(y) = \pi(y) = 1$.

(ii) If $y \in \left[\frac{1+na}{na}\phi c, na\phi c\right]$, $t(y) = \frac{2nay-(1+na)\phi c}{2(1+2na)}$, $\rho(y) = 1, \pi(y) = \frac{2nay+na\phi c}{\phi c(1+2na)}$.

(iii) If $y \geq na\phi c$, $t(y) = \frac{y-\phi c}{2}$, *and* $\rho(y) = \frac{y+\phi c}{\phi c(1+na)}, \pi(y) = na\rho(y)$.

From the perspective of our altruistic donor, matching grants have two drawbacks: they exclude some countries from aid and, among the countries which benefit from aid, the infrastructure development comes at a redistributive cost. Our donor could instead choose to finance all the infrastructure in order to reduce the burden on redistribution, that is, he could decide to offer the project $\rho(y), \pi(y)$ and pay the full cost $2t(y)$. The resulting aid *will not be incentive compatible* however since all countries would prefer to

[12] By revealed preferences, matching grants are incentive compatible, hence must satisfy the incentive compatibility condition (11), which is indeed easy to verify. For instance, in the third regime, $T'(y) = -\frac{1}{2}$ while $P(y) = (1+na)\log\left(\frac{y+\phi c}{\phi c(1+na)}\right) + na\log(na)$. Hence, $P'(y) = \frac{1+na}{y+\phi c}$ is equal to $-(1+na)\frac{T'(y)}{y+T(y)}$.

benefit from the best infrastructure. However, this thought experiment will enable our donor to realize that he could offer a single infrastructure project to all countries, solving the incentive problem while also increasing his own payoff. Hence a pooling contract consisting of only an infrastructure grant may dominate a matching grant policy for our donor.

A sufficient condition for this is that $\overline{y} \leq \frac{1+n}{\phi}$: indeed, for a given y, the donor who decides to finance the full project without transfers from the recipient bears an additional cost of $\phi t(y)$ but gains on redistribution by $(1+n)(\log(y)-\log(t(y))$. Because $\frac{\log(y)-\log(t(y))}{t(y)}$ is bounded below by $\frac{1+n}{y}$, the result follows. We derive a weaker condition in the Appendix.

Proposition 6. *Let $t(y)$ be the investment of the country in the matching grant equilibrium of Lemma 4. Let $\overline{y}$ be the maximum value of y for a recipient. Then, if $\overline{y} < \frac{1+n}{\phi}$, an altruistic donor always prefers to offer a pooling contract to a matching grant. If $\overline{y} > \frac{1+n}{\phi}$, the donor prefers to offer a pooling grant whenever*

$$(1+n)\frac{\mathbb{E}[\log(y)-\log(y-t(y))]}{\mathbb{E}[t(y)]} \geq \phi.$$

Remark 1. A (stronger) sufficient condition can be obtained by observing that because $\log(y) - \log(y - t(y))$ is bounded below by $\frac{t(y)}{y}$,

$$\mathbb{E}\left[\frac{1}{y} \cdot \frac{t(y)}{\mathbb{E}[t(y)]}\right] \geq \frac{\phi}{1+n} \tag{15}$$

which can also be written as

$$\frac{1}{y_F} + \text{Cov}\left[\frac{1}{y}, \frac{t(y)}{\mathbb{E}[t(y)]}\right] \geq \frac{\phi}{1+n},$$

where y_F is such that $\frac{1}{y_F} = \mathbb{E}[1/y]$ (y_F has been defined in the text before Corollary 1). Because the covariance is negative, it is necessary that $y_F < \frac{1+n}{\phi}$.

3.4 Institutional Development and Samaritan Dilemma

Let us revisit the role of aid in inducing the recipient country to invest in institutional development, and assume to simplify that transfers must be non-negative. As in the section on complete information about a, y, let z be the level of institutional development, which comes at cost $\psi(z)$ and consider the two extreme cases where z affects only the realization of y, and where z affects only the realization of a.

The following proposition is the equivalent to Propositions 2 and 3: the anticipation of aid induces the recipient country to invest more in institutional development than under autarky only if aid affects the balance of power between rich and poor, hence the redistribution motive a. The added complication with respect to the case of perfect information is that the donor must form beliefs about the level of institutional development, and this belief must be consistent with the choice of z by the recipient.

Proposition 7. *(i) Assume that aid changes the distribution of y but does not change a. Then there is a Samaritan dilemma: aid cannot lead to an increase in z with respect to autarky, and sometimes leads to a decrease.*

(ii) Assume that aid changes the realization of a but does not change the distribution of y. Then aid cannot lead to a decrease in z with respect to autarky, and can sometimes lead to an increase.

4 Conclusion

The mix of aid modalities is a crucial element of the effectiveness of aid, perhaps as important as the aid level itself. In order to limit distortions, common wisdom calls for rewarding well-governed countries with monetary transfers and providing low-performing countries with structural aid only. From a full information perspective, our results suggest that promoting aid effectiveness goes in the opposite direction. Indeed, interpreting y as the willingness of the recipient to transfer a share of the revenue to the poor, we show that a country with a low y (often correlated with autocracies, corrupt regimes or countries with poor institutions and non-transparent administrative rules) should receive more monetary aid along with smaller projects. The level of aid should in fact be *decreasing* in the ability of the recipient country to transfer income to the poor. For richer countries it should even involve a co-payment by the recipient towards the financing of a (larger) project. Such an aid schedule is however not incentive compatible and the main result of this paper is that, when y is not observed by the donor, the second-best optimum may take the form of a pooling aid contract.

An appealing feature of the pooling contract is that it is immune to information leakages in a dynamic context. By contrast, other contracts, including matching grant policies, may lead to ratchet like effects. The evidence from OECD data in the introduction suggests that both the intensity of aid and the relative proportion of budget aid change over time. If it is possible to partially observe how transfers are made between the rich and the poor, our framework suggests that the mix of budget and infrastructure aid may play an important role in a dynamic context. Once information about y is sufficiently precise, as y increases, the aid package should shift from a combination of positive monetary transfer and project to negative transfer and larger projects. However, the full analysis of a dynamic setting is beyond the scope of this paper.

The paper provides insights into the effect that the anticipation of aid will have on the desire of the recipient to improve its institutions. The main observation from our analysis is that investments in institutions that mainly improve the ability of the recipient country to generate income will lead to a Samaritan dilemma: aid will depress the incentives to invest. It is only when institutions modify the redistribution motive of the elites, e.g., by balancing political power between the poor and the rich, that aid will improve investment in these institutions.

While there is now a large body of empirical evidence supporting the view that aid is more effective in countries with sound policy environments (Collier and Dollar (2002), Burnside and Dollar (2000), Alesina and Dollar (2000)), there is a lack of theoretical work. Our model suggests that one should be careful in making inferences from these observed regularities. Indeed, when institutions are given, the empirical results in the literature may be interpreted as a supermodularity property of the effectiveness measure (for instance the growth rate of the economy) that is a function of the institution z and the aid package $x \equiv (T, \rho, \pi)$: the increase in effectiveness following an increase in x is greater when z is greater. However, this result has nothing to say about the effect of aid on institutional development, that is on the dynamic effects of aid. If the supermodularity property is also true for the payoff function of the recipient country, then, when aid increases, the country will increase its investment and there is a virtuous cycle: more (anticipated) aid induces the country to invest more, which induces the donor to give more aid. In our model, this happens when the institutional investment changes the desire for redistribution. If z affects only the distribution of y — if development is purely economic — the recipient's payoff is in fact submodular in the level of aid and institutional investment; hence while "better institutions" may be correlated with greater aid effectiveness, the recipient country may choose "worse institutions" than in the absence of aid.

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5 Mathematica Appendix For Online Publication

Proof of Lemma 1

(i) Consider $y > \hat{y}$ and two aid packages $(T, \rho, \pi), (\hat{T}, \hat{\rho}, \hat{\pi})$ designed for countries of types $y, \hat{y}$ respectively. Let $U(y)$ be the utility of the recipient with the contract (x). Then, if y chooses the contract $\hat{T}, \hat{\rho}, \hat{\pi}$ that is intended for $\hat{y}$, his utility is

$$U(y, \hat{y}) = U(\hat{y}) + (1 + na)[\log(y + \hat{T}) - \log(\hat{y} + \hat{T})]$$

and the incentive compatibility condition is $U(y) \geq U(y, \hat{y})$. There is a similar condition $U(\hat{y}) \geq U(y, \hat{y})$ for $\hat{y}$, and therefore the incentive compatibility conditions for these two types can be written as

$$\begin{aligned} (1 + na)[\log(y + T) - \log(\hat{y} + T)] \geq & \qquad \text{(A.1)} \\ & U(y) - U(\hat{y}) \\ & \geq (1 + na)[\log(y + \hat{T}) - \log(\hat{y} + \hat{T})] \qquad \text{(A.2)} \end{aligned}$$

where (A.2) is the condition for y and (A.1) is the condition for $\hat{y}$. Concavity of log and $y > \hat{y}$ imply that

$$\hat{T} \geq T. \tag{A.3}$$

Therefore, $U(y) \geq U(\hat{y})$ and we must have:

$$\log \rho + na \log \pi \geq \log \hat{\rho} + na \log \hat{\pi}.$$

Hence, if the transfers are different, it must be the case that they are decreasing in income, while the "aggregate" project must be increasing in income. This establishes the proof of part (i) of Lemma 1.

(ii) Incentive compatibility requires that for any $y, \hat{y}$,

$$\begin{aligned} (1 + na)(\log(\hat{y} + T(\hat{y})) - \log(\hat{y} + T(y))) &\geq P(y) - P(\hat{y}) \\ &\geq (1 + na)(\log(y + T(\hat{y})) - \log(y + T(y))) \end{aligned}$$

Because $T(y)$ is non-increasing and $P(y)$ is non-decreasing, the two functions are differentiable almost everywhere. Considering a common point of continuity, we have

$$\begin{aligned} (1 + na) \lim_{\hat{y} \to y} & \frac{T(\hat{y}) - T(y)}{y - \hat{y}} \frac{\log(\hat{y} + T(\hat{y})) - \log(\hat{y} + T(y))}{T(\hat{y}) - T(y)} \\ & \geq \lim_{\hat{y} \to y} \frac{P(y) - P(\hat{y})}{y - \hat{y}} \\ & \geq (1 + na) \lim_{\hat{y} \to y} \frac{T(\hat{y}) - T(y)}{y - \hat{y}} \frac{\log(y + T(\hat{y})) - \log(y + T(y)))}{T(\hat{y}) - T(y)}. \end{aligned}$$

Because the left and right bounds have a common limit, we have for almost every y:

$$P'(y) = -(1+na)\frac{T'(y)}{y+T(y)}, \tag{A.4}$$

which illustrates the negative co-variation of $T(y)$ and $P(y)$ Furthermore, since $U(y) = (1+na)\log(y+T(y)) + P(y)$,

$$U'(y) = \frac{1+na}{y+T(y)} \text{ and } U(y) = U(\underline{y}) + \int_{\underline{y}}^{y} \frac{1+na}{x+T(x)}dx. \tag{A.5}$$

For any $y \geq \hat{y}$, we have

$$U(y) - U(\hat{y}) = \int_{\hat{y}}^{y} \frac{1+na}{x+T(x)}dx,$$

which is positive since $x+T(x)$ must be greater than 0 (otherwise individual rationality would fail).

(iii) We consider different cases. If both $y, \hat{y}$ are smaller than y^*, $y + T^*(y) = \hat{y} + T^*(\hat{y})$, and since the aggregate project is the same, $U(y) = U(\hat{y})$, but then (A.2) is violated since $y > \hat{y}$.

If both y and $\hat{y}$ are larger than y^*, the participation constraints bind and therefore $U(y) - U(\hat{y}) = \underline{U}(y,a) - \underline{U}(\hat{y})$, implying that the incentive conditions reduce to

$$\begin{aligned}\log(y+T^*(y)) - \log(\hat{y}+T^*(y))] &\geq \log(y) - \log(\hat{y}) \\ &\geq \log(y+T^*(\hat{y})) - \log(\hat{y}+T^*(\hat{y}))\end{aligned}$$

implying that $T^*(y) < 0 < T^*(\hat{y})$, but $T^*(\hat{y}) > 0$ is not consistent with the first best transfer of recipient countries when $\hat{y} > y^*$ (Proposition 1).

If $\hat{y} \leq y^* < y$, $U(y) = \underline{U}(y,a)$ and therefore $U(y) - U(\hat{y}) \leq \underline{U}(y,a) - \underline{U}(\hat{y})$, and (A.2) requires that $\log(y) - \log(\hat{y}) \geq \log(y+T^*(\hat{y})) - \log(\hat{y}+T^*(\hat{y}))$, which is possible only if $T^*(\hat{y})$ us positive, that is if $\hat{y} \leq \frac{1+n}{\phi}$. In this case, $T^*(\hat{y}) = \frac{1+n}{\phi} - \hat{y} \geq 0$, and we have:

$$\begin{aligned}U(y) - U(\hat{y}) &= (1+na)\left(\log y - \log\left(\frac{1+n}{\phi}\right)\right) - (\log\rho^*(\hat{y}) + na\log\pi^*(\hat{y})) \\ &< (1+na)(\log(y+T^*(\hat{y})) - \log(\hat{y}+T^*(\hat{y})))\end{aligned}$$

violating (A.2).

Proof of Lemma 2

As already noted in the text, if $T(y)$ is positive for all values of y, recipient countries cannot be worse-off since $P(y)$ is non-negative, and therefore all types will benefit from aid. If $T(\underline{y}) \leq 0$, then for any y,

$$\begin{aligned} U(y) &= U(\underline{y}) + \int_{\underline{y}}^{y} \frac{1+na}{x+T(x)} dx \\ &\geq U(\underline{y}) + \int_{\underline{y}}^{y} \frac{1+na}{x} dx \\ &\geq U(\underline{y}) + \int_{\underline{y}}^{y} \underline{U}'(x) dx. \end{aligned}$$

Therefore, if $U(\underline{y}) \geq \underline{U}(\underline{y})$, individual rationality is satisfied for all y. Note that this case allows for contracts in which $T(y) = P(y) = 0$ for all types $t < t^*$, and $T(y^*) < 0$: that is only types higher than y^* benefit from aid. The last case is when $T(\underline{y}) > 0$ and there exists y^* such that $T(y^*) = 0$. In this case, $T(y) \leq 0$ for all $y > y^*$, and we have:

$$\begin{aligned} U(y) &= U(y^*) + \int_{y^*}^{y} U'(y) dy \\ &\geq \underline{U}(y^*) + \int_{y*}^{y} \frac{1+na}{x+T(x)} dx \\ &\geq \underline{U}(y^*) + \int_{y*}^{y} \frac{1+na}{x} dx \\ &\geq \underline{U}(y, a). \end{aligned}$$

Matching Grants: Proof of Lemma 4

$$\begin{aligned} \max_{t,r,p,\rho,\pi} \; & \log(r) + na\log(p) + \log(\rho) + na\log(\pi) \\ \text{s.t. } & r + np \leq y - t \\ & 2t = \phi c(\rho + \pi - 2) \\ & \rho \geq 1, \pi \geq 1. \end{aligned}$$

Once t is chosen, the infrastructure project solves

$$\begin{aligned} \max_{\rho,\pi} \; & \log(\rho) + na\log(\pi) \\ \text{s.t. } & 2t \geq \phi c(\rho + \pi - 2) \\ & \rho \geq 1, \pi \geq 1. \end{aligned}$$

Ignoring the constraints $\rho \geq 1, \pi \geq 1$, and denoting by λ the coefficient of the budgetary constraint (which must bind), we have

$$\mathcal{L}_\pi = \frac{na}{\pi} - \lambda\phi c; \; \mathcal{L}_\rho = \frac{1}{\rho} - \lambda\phi c.$$

If $\rho > 1$, we must have $\pi > 1$ and if $t > 0$, necessarily $\pi > 1$.

Suppose that $\rho = 1$. Using the binding budget constraint, we have $2t = \phi c(\pi - 1)$, and $\pi = \frac{2t}{\phi c} + 1$ which is greater than 1. If $\rho = 1$, then $\mathcal{L}_\rho \leq 0$, and $\lambda > \frac{1}{\phi c}$. Now, since $\mathcal{L}_\pi = 0$, we have $\lambda = \frac{na}{\pi \phi c}$, and therefore, $\lambda = \frac{na}{2t+\phi c}$, which is consistent with $\mathcal{L}_\rho \leq 0$ only if $\frac{na}{2t+\phi c} > \frac{1}{\phi c}$, or

$$t < \frac{\phi c(na - 1)}{2}, \tag{A.6}$$

which is possible only if $na > 1$. It follows that the donor chooses t to maximize

$$(1 + na)\log(y - t) + na \log(2t + \phi c),$$

and the solution $t = \frac{2nay-(1+na)\phi c}{2(1+2na)}$, is positive when $y \geq \frac{1+na}{na}\phi c$ and satisfies (A.6) if, and only if, $y < na\phi c$.

Note that for this value of t, $\pi = \frac{2nay+na\phi c}{\phi c(1+2na)}$, and is equal to na when $y = na\phi c$, which is the equation of the frontier between the regimes $\rho = 1$ and $\rho > 1$.

Suppose $\rho > 1$. In this case, $\mathcal{L}_\rho = \mathcal{L}_\pi = 0$ and $\pi = na\rho = \frac{na}{\lambda \phi c}$. The budget constraint implies that $2t = \frac{1+na}{\lambda} - 2\phi c$, which is consistent with $t > 0$ when $\lambda < \frac{1+na}{2\phi c}$. Because $\rho = \frac{2(t+\phi c)}{\phi c(1+na)}$, the recipient's optimization problem reduces to $\max_t \log(y-t)+\log(t+\phi c)$ which implies that $t = \frac{y-\phi c}{2}$. Clearly $t < y$ and $t > 0$ only if $y > \phi c$. Hence, $\lambda = \frac{1+na}{2(y+\phi c)}$, which is consistent with our previous condition $\lambda < \frac{1+na}{2\phi c}$ for any y.

Hence, $\rho = \frac{y+\phi c}{\phi c(1+na)}$ which is consistent with $\rho > 1$ only if $y > na\phi c$ and $\pi = na\rho$, implying that the recipient's payoff under the matching grant is

$$U(y) \equiv 2(1 + na)\log(y + \phi c) + A(a) + na \log(na) - (1 + na)[\log(\phi c) + \log(1 + na)],$$

proving the lemma.

Matching Grants: Proof of Proposition 6

Let $t(y), \rho(y), \pi(y)$ the matching grant equilibrium allocation described in Lemma 4. In this case, the donor's payoff if the recipient has income y is equal to

$$V_0(y) = (1+n)\log(y-t(y))+n\log(a)-(1+n)\log(1+na)+\log(\rho(y))+n\log(\pi(y))-\phi t(y),$$

since the donor contributes $t(y)$ towards the financing of the infrastructure. Suppose that the donor decides instead to offer an aid contract where the recipient does not pay nor receive anything and the donor invests $2t(y)$ to finance the same infrastructure projects $\rho(y), \pi(y)$; in this case, the donor's payoff is

$$V_1(y) = (1+n)\log(y))+n\log(a)-(1+n)\log(1+na)+\log(\rho(y))+n\log(\pi(y))-2\phi t(y),$$

and $V_1(y) > V_2(y)$ whenever

$$(1 + n)\frac{\log(y) - \log(y - t(y))}{t(y)} > \phi. \tag{A.7}$$

The left hand side is bounded below by $\frac{1+n}{y}$, and therefore the condition holds if $y < \frac{1+n}{\phi}$. Note that this bound corresponds to the bound on y under perfect information for which the donor gives a positive transfer to the recipient country. The dominance of a pooling contract follows Proposition 5.

The condition $y < \frac{1+n}{\phi}$ is consistent with recipient countries accepting the matching grant when $\frac{1+n}{\phi} > \frac{1+na}{na}\phi c$, that is when $a > \frac{\phi^2 c}{n(\phi^2 c+n+1)}$.

If the maximum value of y is $\overline{y} > \frac{1+n}{\phi}$, consider the expected payoff to the donor in the matching equilibrium:

$$\mathbb{E}V_0(y) = (1+n)\mathbb{E}[\log(y - t(y))] + \mathbb{E}[\log(\rho(y))] + n\mathbb{E}[\log \pi(y)] \\ - \phi\mathbb{E}[t(y)] + n\log(a) - (1+n)\log(1+na).$$

Let ρ^*, π^* be such that $\log(\rho^*) = \mathbb{E}[\log(\rho(y))]$ and $\log(\pi^*) = \mathbb{E}[\log \pi(y)]$; then $\rho^* < \mathbb{E}[\rho(y)]$ and $\pi^* < \mathbb{E}[\pi(y)]$, and therefore $2t(y) > \phi c(\rho + \phi - 2)$, and the cost of financing fully ρ^*, π^* is less than in the matching grant. Therefore the payoff obtained by the donor when financing fully ρ^*, π^* is greater than

$$\mathbb{E}V_1(y) = (1+n)\mathbb{E}[\log(y)] + \mathbb{E}[\log(\rho(y))] + n\mathbb{E}[\log \pi(y)] - 2\phi\mathbb{E}[t(y)] + n\log(a) - (1+n)\log(1+na)$$

and therefore a sufficient condition for $\mathbb{E}V_1(y) - \mathbb{E}V_0(y)$ to be positive is that

$$(1+n)\frac{\mathbb{E}[\log(y) - \log(y - t(y))]}{\mathbb{E}[t(y)]} \geq \phi.$$

Proof of Proposition 7

Case: $y \sim H(y; z)$, a is known. Suppose that the donor does not observe y and let z^* be the donor's belief about the quality of institutions chosen by the recipient when he anticipates an aid package. Because aid is decided after the recipient country has chosen z, it is optimal for the donor to offer a pooling aid contract, and the best pooling aid contract implies first-best projects as given by (3) while the transfer solves

$$(1+n)\int_y \frac{1}{y+T} dF(y; z^*) = \phi$$

Let y_z be the "certainty equivalent"

$$\frac{1}{y_z} = \int_y \frac{1}{y} dF(y; z),$$

From our previous derivations, the optimal T is

$$T(z^*) = \begin{cases} y_z & \text{if } y_{z^*} \leq \frac{1+n}{\phi} \\ 0 & \text{if } y_{z^*} \geq \frac{1+n}{\phi}. \end{cases} \tag{A.8}$$

We define an order on institutions following the first order stochastic order on $H(y;z)$. Hence, as z increases, y_z increases, and therefore it is less likely that the recipient receives a positive transfer from the donor.

Consider now the incentives of the recipient country to invest in z when anticipating a transfer T. The relevant maximization problem is (z^* is the belief of the donor, which is sunk when the recipient country chooses z)

$$\max_z (1+na)\int_y \log(y+T(z^*))dF(y;z) - \psi(z),$$

and the first order condition is (using integration by parts)

$$(1+na)\int_y \frac{1}{y+T(z^*)}(-F_z(y;z))dy = \psi'(z).$$

Because T is non-negative and $F_z < 0$, the left hand side is inferior to the marginal return under autarky (when $T(z^*) = 0$), and therefore for any $T(z^*) > 0$ there is a Samaritan paradox at play.

Hence, while imperfect information about y can improve the donor's welfare, it cannot solve for the Samaritan dilemma when institutional improvements affect mainly the distribution of y. Note that signals about z are not likely to help either as long as the donor cannot commit to punish the recipient when receiving "bad" signals; indeed, by punishing the recipient, the donor will also punish himself.

Let z_{aut} be the institutional choice under autarky,

$$z_{aut} = \arg\max_z (1+na)\int \log(y)dF(y;z) - \psi(z).$$

If $T(z^*) = 0$, that is if $y_{z^*} \geq \frac{1+n}{\phi}$, then the recipient country will behave as in autarky and $z^* = z_{aut}$, which is consistent with $T(z_{aut}) = 0$ when $y_{z_{aut}} \geq \frac{1+n}{\phi}$. If this is not the case, then from our previous observation there is a Samaritan paradox at play and the donor must have belief $z^* < z_{aut}$ solving

$$(1+na)\int_y \frac{1}{y+T(z^*)}(-F_z(y;z^*))dy = \psi'(z^*) \tag{A.9}$$

Aid has no effect on institutional development for high income countries, but has a depressing on institutional development for low income countries, proving (i).

Case $y \sim F(y)$ and $a \sim G(a;z)$. Consider next the situation where institutional development affects only a, but where, as in our basic framework, the income is a random variable with (known) distribution $F(y)$. Because we restrict attention to a situation where there is no co-financing, the optimal aid contract is pooling. In this case the projects are first-best and are given by (3) while the optimal transfer is independent of a and solves (using the same notations as above)

$$\int_y \frac{1}{y+T} dF(y) = \frac{\phi}{1+n} \text{ if } y_F \leq \frac{\phi}{1+n}$$

and is equal to 0 when $y_F \geq \frac{\phi}{1+n}$.

Clearly, if $T = 0$ there is no difference between autarky and aid, and therefore no effect on z. Suppose now that $y_F < \frac{\phi}{1+n}$. In this case, when z varies, the expected payoff to the recipient under autarky varies by $\left[\int (1+na) dG_z(a; z)\right] \log(y) - \phi'(z)$ while the expected payoff to the recipient under aid varies by

$$\left[\int (1+na) dG_z(a; z)\right] \log(y+T) - \phi'(z).$$

Hence, if z^{aut} is the optimal choice under autarky, $\left[\int (1+na) dG_z(a; z^{aut})\right] \log(y+T) - \phi'(z^{aut})$ is positive, implying that aid will increase the incentives to invest in z, proving (ii).