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The political economy of multilateral aid funds

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Abstract

The political economy of multilateral aid funds[*]

In 2014 over $60 billion was mobilized to help developing nations mitigate climate change, an amount equivalent to the GDP of Kenya. Interestingly, breaking from the traditional model of bilateral aid, donor countries distributed nearly fifty percent of their aid through multilateral aid funds (OECD, 2015). In this paper, we show that by delegating aid spending to an international fund, donor countries mitigate a "hold-up" problem that occurs when donor countries are tempted to allocate aid based on, say, a regional preference. That is, under bilateral aid, donor-country bias decreases the incentive of recipient countries to invest in measures such as good governance that increase the effectiveness of aid. By delegating allocation decisions to a fund, however, donor countries commit to allocating aid via centralized bargaining, which provides recipient countries with an increased incentive to invest. Additionally, we show that allocating funding by majority rule further increases recipient-country investment, since higher investment increases the probability that a recipient's project will be selected by the endogenous majority coalition, and detail conditions under which majority is the optimal voting rule.

Keywords: Aid policy, Climate change, International organizations

JEL: F35, O19, H87

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The 2015 Paris Agreement set a goal of mobilizing $100 billion per year by 2020 to help developing nations mitigate climate change. Already, donor countries distributed over $60 billion in climate change aid in 2014 – roughly equivalent to the total amount of development assistance provided by the World Bank for the same year (OECD, 2015, World Bank, 2015). Rather than being centralized under one institution, climate change aid is administered by a variety of different funds with different institutional rules: currently, at least nine multilateral funds have been established, such as the Green Climate Fund (pledged budget: $10.2 billion) and the Least Developed Countries Fund ($964 million), as well as several bilateral aid funds, such as the UK's International Climate Fund ($6 billion; Nakhooda et al., 2015).

In this paper, we analyze the optimal design of international aid spending, while taking into consideration the autarchic environment of foreign aid. In particular, we focus on the link between the institutional setup governing the distribution of aid to developing countries, and the incentives of the recipient countries to invest in reforms that increase the effectiveness of aid spending. As emphasized by UN Secretary-General Ban Ki-Moon, "corruption has disastrous impacts on development when funds that should be devoted to schools, health clinics and other vital public services are instead diverted into the hands of criminals or dishonest officials" (2015). That is, a successful development aid program requires more than just transfers from donor to recipient countries – it also requires reducing corruption and promoting good governance in the recipient countries.

Unfortunately, in practice, implementing such change is not always high up on recipient governments' agendas. In fact, the very nature of corruption suggests that recipient governments may not find it in their best interest to invest in reforming their local political and economic systems to ensure maximal impact of the aid money they receive. To incentivize needed investments and reforms, a new wave of aid conditionality - political conditionality - has emerged (see Molenaers et al. (2015)).

However, ex ante conditional aid suffers from a problem of non-contractibility – measures of good governance are partially subjective, and donor countries often face an ex post incentive to circumvent conditionality (for example, Stone, 2004 documents that countries with strong ties to the US are less likely to face sanctions for violating IMF conditionality). This results in a "hold-up" problem, know as the Samaritan's dilemma, faced by donor nations: if the donor country cannot commit to giving aid only conditional on reform investment efforts, the recipient country, knowing it will receive assistance in any case, has no incentive to implement costly reforms (see Mosley et al., 1995 and Pedersen, 1996 for a discussion of problems of time-inconsistency in aid spending).

While traditional (ex ante) aid conditionality is largely deemed to have failed (see Collier, 1997 and Dreher, 2009; in fact, Alesina and Weder, 2002 find no evidence that higher aid has resulted in lower corruption), experts have expressed more hope for rewarding countries for successful reform ex post (see, for example, Svensson, 2003). However, as shown by Öhler et al. (2012) in the case of a US aid program, instituting ex post conditionality is difficult in a bilateral setting, since it faces the same problems of credibility as ex ante conditionality. Here, we argue that the institutional setup of aid funds can help mitigate the Samaritan's problem. Specifically, the incentive structure faced by recipient countries depends on whether donor countries choose to disseminate aid through bilateral collaborations between donor and recipients, or to participate in multi-lateral aid funds.

We argue that it is precisely the process of preference aggregation that enables multilateral organizations to better implement aid conditionality. How funds are allocated is determined in a bargaining process between representatives of the different donating nations, whose preferences over aid allocation might differ; the bargaining outcome thus has to reflect a compromise between them.

The bargaining position of each donor will depend in part on the weight they place on allocating funding to their favored countries, but importantly, it also depends on the reform investments of the potential recipient nations. Intuitively, the more a recipient country invests in reforms, the better the bargaining position of donor countries lobbying on its behalf. This constitutes a new strategic reason for pooling resources in large aid funds rather than implementing aid bilaterally: when resources are pooled, competition among recipient countries over aid intensifies since, despite the heterogeneity of donor country preferences, bargaining results in an allocation that favors spending on efficient projects. That is, allocating funding via an international fund functions as a commitment to reward recipient countries for higher investments, thus overcoming the holdup problem.

Despite this strategic advantage of multinational aid funds over bilateral aid, our model shows that a donor's decision whether to join the fund rather than to give aid bilaterally is still not always straight-forward. After all, donors surrender control over their aid budget to a bargaining outcome, which may reduce the relative utility they receive from aid spending. How this trade-off resolves depends crucially on the composition of donor countries in the fund. Generally speaking, the more asymmetric they are in terms of the weight they place on allocating aid to their favored recipients, the less valuable a potential partnership becomes for one of the parties.

In addition to characterizing how international aid funds mitigate the Samaritan's problem, we demonstrate that the recipient countries' incentive to invest in reform is also a function of the decision rule used within the fund. Specifically, we explore the optimal voting rule and show that majority rule further increases the incentive for the recipient countries to invest, since higher investment increases the probability that a recipient's project is selected by the endogenous majority coalition. However, the higher incentive to invest comes at a cost of limiting the total number of projects that are funded, which implies that a majority rule will only outperform unanimity when the utility benefit of investment to the donor countries is relatively low.

Our paper's main contribution is to the literature on aid conditionality (see Dreher, 2009 and Molenaers et al., 2015 for an overview). We are not the first to suggest that transferring the responsibility for allocating aid to international organizations or funds may alleviate the Samaritan's dilemma. Most notably, Svensson (2000) has put forward the idea that if donor countries are lacking a commitment technology for implementing aid sanctions, "delegation of part of the aid budget to an (international) agency with less aversion to poverty [will] improve [the] welfare of the poor" (p.61). However, the argument we present here is quite different – instead of assuming the international organizations have preferences that are more conducive to aid conditionality, we show how the incentive for recipient countries to invest in reform arises endogenously from the bargaining process over the allocation of the fund's budget.

Our work also contributes to the literature on optimal decision rules in international organizations (see Harstad (2005), Maggi and Morelli (2006), and Barbera and Jackson (2006)). In particular, our results regarding the optimal voting rule in international funds are closely related to Harstad (2005), who shows how a majority rule can mitigate a holdup problem in a setting where investments by members of a club (or countries in a union) are expropriated ex post. A key difference in our findings, however, is that majority rule is not always optimal for donor countries, even though the costs of investments are fully borne by the recipient countries. Instead of simply choosing the decision rule that maximizes investments, unanimity rule may be optimal in our setting because it ensures that all recipient countries projects receive some level of funding, whereas majority rule increases investment precisely by limiting funding to a strict subset of projects.

Our paper proceeds as follows: Section 1 presents the baseline model, and the analysis is contained in section 2. Section 3 goes on to characterize the optimal voting rule within the international aid fund, and section 4 concludes. Formal proofs for all results are presented in the appendix.

1 Model

There are two donor countries and two recipient countries, denoted as $i = 1, 2$ and $j = 1, 2$ respectively.[1] Each donor country has an individual budget for international aid $x_i = x$ to allocate across a set of recipient country aid projects, $\{g_1, g_2\}$.

[1] For simplicity, we consider a baseline model of only two countries – while the main insights of the model remain unchanged with more countries, the comparative statics are difficult to characterize with $n > 2$.

Preferences and Actions

Donor countries initially choose whether to commit their budget to an international aid fund ($f_i = 1$) or to retain control over the allocation of their budget ($f_i = 0$). If one of the donor countries chooses bilateral aid ($f_i = 0$) then, in the last stage of the game, each country simultaneously chooses how to allocate x over $\{g_1, g_2\}$. However, if both donor countries choose $f_i = 1$, then the international aid fund allocates the full budget, $2x$, over $\{g_1, g_2\}$ via Nash Bargaining (NB) between the donor countries. In the bargaining process, each country has an equal bargaining weight, and the fund has access to utility transfers.[2]

Each donor country assigns different utility-weights on aid spending across the recipient countries, represented by the vector $\{\beta^i_j\}$. These weights could for example reflect preferences due to geographical proximity, trade relations or historical ties. In addition to the donor country weights, each recipient country has a "quality-weight," of $\alpha_j = 1 + \delta_j$. One may for example think about governance structures that impact the effectiveness of aid. Each recipient country can influence its own quality weight by investing in $\delta_j \geq 0$ according to the cost function $c(\delta_j) = (\delta_j + 1)^2 - 1$ or, equivalently, $c(\alpha_j) = (\alpha_j)^2 - 1$. This structure can be interpreted as each project having a minimum quality level of $\alpha_j = 1$, above which active investment by the recipient countries is required to improve project quality. Investment, however, is observable but non-contractible, which implies only a limited scope for donor countries to condition allocations on investments.

Donor countries have preferences over the set $\{g_j\}$ that are increasing and concave. Specifically, we assume

$$u_i(\{g_j, \alpha_j, \beta^j_i\}) = \sum_j \alpha_j \beta^j_i \sqrt{g_j} + \lambda^j_i \delta_j.$$

Note that while donor countries do not directly take into account the utility recipient countries receive from their aid spending, we do allow for the possibility that donor countries may value δ_j independently from its impact on the quality of the project, reflected in the term $\lambda^j_i \delta_j$ (we refer to this as the indirect benefit of investment). The main insights of our model do not rely upon this feature and, unless explicitly stated, all results go through with $\lambda^j_i = 0 \; \forall \; i, j$. However, given that good governance in recipient countries is a common policy goal of donor countries (as discussed in the introduction), and since recipient country investments may have spillover effects to other policy areas, we find it relevant to account for donor countries' preferences for, say, decreased corruption.

[2] Utility transfers ensure that donor countries split the utility surplus equally – without utility transfers, the NB results in an outcome that balances efficiency (aggregate utility) and equity (see Simon and Valasek, 2016 for more detail). Therefore, our main results remain qualitatively similar even without utility transfers.

Recipient countries have linear preferences over aid spending g_j:

$$u_j(g_j, \delta_j) = g_j - ((\delta_j + 1)^2 - 1) \equiv g_j - ((\alpha_j)^2 - 1).$$

Note that recipient countries only value the direct spending in their own country whereas donor countries may also value spillovers from projects they do not fund themselves. For this analysis, however, we assume that $\beta_i^j = 0$ for $i \neq j$ and $\beta_i^i = \beta_i > 1$, and that $\lambda_i^j = 0$ for $i \neq j$ and $\lambda_i^i = \lambda$. This introduces stark heterogeneity between donor countries in terms of their preferences across recipient countries (each donor country cares only about one specific recipient country) and allows for differences in valuations of aid in general (if $\beta_i \neq \beta_k$). These restrictions allows us to clearly illustrate the main points of the model. With the simplifying assumptions, each donor nation's utility function becomes:

$$u_i(\alpha_i, g_i) = \alpha_i \beta_i \sqrt{g_i} + \lambda \delta_i. \tag{1}$$

Timing and Equilibrium:

The timing of the game is as follows:

1. Donor countries choose whether to allocate aid bilaterally or join their resources in an aid fund (f_i).
2. Recipient countries choose investment levels, δ_j (α_j).
3. Aid is allocated either bilaterally - i.e. each donor country chooses $g_i \leq x_i$ - or centrally - i.e. donor countries bargain á la Nash over $\{g_i\}$ with $\sum g_i \leq \sum x_i$.

The equilibrium we utilize is analogous to sub-game perfect Nash equilibrium, with the exception that, if the donor countries choose to join their resources in an aid fund, the allocation decision is determined via NB.

Throughout the analysis, we consider the objective of the donor countries, rather than, say, an objective of maximizing aggregate utility. We argue that this is a natural objective to consider when analyzing the political economy of international aid funds. However, this does not imply that investments carried out by the recipient countries' should be considered as non-productive for the *population* of these countries: while we assume that investment in good governance is costly for the *regime* of the recipient country, it is possible that these reforms provide utility benefits to the recipient countries' population by increasing the effectiveness of the public sector.

2 Analysis

We solve the model by backward induction, and thus begin with the allocation decisions.

2.1 Allocation of aid

In the last step, donor countries decide how to allocate the aid budget to the set of projects $\{g_1, g_2\}$. They may decide not to spend (all of) the budget, but cannot at this point reverse their decision on whether to allocate bilaterally or jointly through a fund.

Bilateral allocation

If countries have chosen to bilaterally allocate their aid budget, each donor country i solves

$$\max_{\{g_1,g_2\}} \quad \alpha_i \beta_i \sqrt{g_i} \tag{2}$$

$$\text{s.t.} \quad g_1 + g_2 \leq x \tag{3}$$

Lemma 1
Irrespective of the level of α_i, each donor country i will spend all of its budget in recipient country i, i.e. $g_i = x$.

This result already eludes to the samaritan's dilemma donor countries face when allocating their aid budget bilaterally: Donors will always spend all their aid money, *irrespective* of the level of reform effort their target nation decides to implement. Even though they are free to reduce aid spending, their preferences make it impossible to effectively commit to such conditionality.

Joint fund

If donors have decided to allocate their aid budgets through a joint fund, at this stage they bargain over the allocation of the aggregate budget to the set of recipient country projects. Since utility transfers are possible, the Nash bargaining outcome maximizes the sum of utilities of the bargaining parties:[3]

$$\max_{\{g_i\}_{i=1}^n} \quad \sum_i \alpha_i \beta_i \sqrt{g_i} \tag{4}$$

$$\text{s.t.} \quad g_1 + g_2 \leq 2x \tag{5}$$

Note that the indirect utility benefit of recipient-country investment is not factored into the NB outcome, since $\lambda\delta_i$ is independent of the allocation decision (i.e. the indirect utility benefit of investment is part of each donor country's outside option).

The NB outcome implies the following lemma:

[3] A complete description of the NB outcome would include utility transfers; however, since there is no need to refer to them directly, we simplify the notation by not explicitly introducing the utility transfers.

Lemma 2

The fund will also spend the complete budget irrespective of the levels of α_j, i.e. $g_1 + g_2 = 2x$. The division of funds, however, does depend on the levels of reform investments:

$$g_i = \frac{(\alpha_i \beta_i)^2}{(\alpha_1 \beta_1)^2 + (\alpha_2 \beta_2)^2} 2x \tag{6}$$

Unlike with bilateral aid allocation, the share of the total aid budget that each target nation receives is sensitive to its investment in α_j.

Since utility transfers are possible, donor countries share the created surplus equally, i.e. they each receive:

$$u_i = \frac{1}{2} \sum_i \alpha_i \beta_i \sqrt{g_i}. \tag{7}$$

2.2 Investment decisions

Recipient countries move simultaneously when deciding their investment levels α_j (for convenience, we refer to recipient countries setting α_j, rather than δ_j, subject to the constraint that $\alpha_j \geq 1$). They also know the mechanism by which aid will be allocated (bilaterally or through a fund) and thus take into account how their share of aid will change with the investment they make.

Each recipient country chooses α_j to solve:

$$\max_{\alpha_j} \left\{ g_j(\{\alpha_k\}_{k=1}^n) - (\alpha_j^2 - 1) \right\}. \tag{8}$$

Bilateral aid

When aid is allocated bilaterally, recipient countries know that the donor who prefers to allocate aid to their project will do so irrespective of investments in α. That is, recipient countries solve problem 8 with $g_j = x$.

Lemma 3

When aid is allocated bilaterally, recipient countries do not invest in reforms beyond the minimum level, i.e. $\alpha_j = 1$ for all j.

This is a classic hold-up problem (aid allocation does not increase to reflect the increased investment). A minimum level of α is guaranteed to be implemented. Beyond that, donor countries face significant difficulties to actually implement aid conditionality when allocating aid bilaterally.

Aid fund

Here the recipient countries internalize the effect their reform efforts have on the final allocation of the fund's budget. That is, each recipient country choses α_j to maximize their utility, taking as given the allocation rule (6) of the donor countries and the investment decisions of the other recipient countries. This optimization problem yields

$$\alpha_j = \max\{1; \sqrt{2x}\frac{\beta_j\beta_i}{\beta_1^2+\beta_2^2}\} \quad \forall j \tag{9}$$

Proposition 1
Reform investment is always (weakly) greater when aid is allocated through a fund.

Proposition 1 details the main insight of the analysis: When aid is allocated through a joint fund, the bargaining process induces competition between the recipient countries. They thus have an incentive to invest in reforms in order to secure a larger share of the budget. Such competition cannot be induced through bilateral aid when donor countries are biased over the allocation of aid.

It is interesting to consider some comparative statics of the reform effort of recipient countries.

Corollary 1
Reform effort is increasing in the fund's budget.

This result is straightforward: The larger the pie recipient countries are now directly competing over, the higher the incentive to invest in reforms that will secure a larger part of the total aid budget.

Corollary 2
Reform effort is (weakly) decreasing in asymmetry between the donor countries' valuations β_i.

To see this, it helps to rewrite expression 9 in terms of the ratio $B = \frac{\beta_1}{\beta_2}$:

$$\alpha_j = \sqrt{2x}\frac{B}{1+B^2} \tag{10}$$

α_j is maximized when $B = 1$ and decreases as one moves away from $\beta_1 = \beta_2$ in either direction. Thus, a recipient country's incentives to invest in order to increase its aid share are higher the more equal the exogenously given donor valuations β are. Once donor countries are asymmetric in their own valuations, recipient country 1's investment incentives decrease - either because it is expensive to "catch up" with the other country's higher ex-ante valuation (in case $\beta_1 < \beta_2$), or because it is unnecessary to invest more, since country 2 finds it too expensive to catch up (in case $\beta_1 > \beta_2$).

2.3 Equilibrium Decision: Which donor prefers the fund?

Lastly, we consider the choice of donor countries of whether join an aid fund or to allocate its aid budget bilaterally: The optimal decision comes from comparing payoffs under each scenario, based on the anticipation of the donor countries regarding how the fund will influence the investment decisions of the recipient countries. Donor country i will find it optimal to join the fund ($f_i = 1$) when:

$$F_i = \frac{1}{2}[\alpha_i\beta_i\sqrt{g_i} + \alpha_j\beta_j\sqrt{g_j}] + \lambda\delta_i - \beta_i\sqrt{x} \tag{11}$$

$$= \frac{1}{2}\alpha\sqrt{2x}\frac{\beta_i^2 + \beta_j^2}{\sqrt{\beta_i^2 + \beta_j^2}} + \lambda\delta - \beta_i\sqrt{x} \geq 0. \tag{12}$$

This comparison involves the following trade-off: Through joining the fund, the donor country increases the level of investment, δ_i, chosen by the recipient country, but at the same time commits to equally share the utility surplus from aid spending among the donors. Both of these considerations depend on the level of asymmetry in βs as well as the size of the overall budget.

Proposition 2
When donor countries are symmetric ($\beta_1 = \beta_2$), it is optimal for both donor countries to commit their aid budgets to an international aid fund ($f_i = 1$ for $i = 1, 2$).

With symmetric βs, the equilibrium allocation of funds is exactly equal to the allocation under bilateral aid (i.e. each project receives x). Thus, there is only the upside of increased investments in α, which makes the fund always (weakly) more attractive than bilateral aid.

Proposition 3
When donor countries are not symmetric, holding β_j constant, there exists a cut-off level of β_i, β', such that for $\beta_i > \beta'$, donor country i sets $f_i = 0$ (i prefers bilateral aid over joining the fund).

Proposition 3 illustrates that when the donor countries biases are asymmetric, then the decision to commit to allocate aid via the fund is costly to the donor country with the greater bias. If this asymmetry is high enough, then the country with the higher bias will prefer to allocate aid bilaterally. Note, however, that this result only depends on the *relative* size, rather than the absolute size, of the β's.

3 Optimal Voting Rule

In the previous section, we assume the fund uses a decision rule of unanimity to determine the allocation of the budget. However, since the decision rule used by the donor countries may impact the investment decisions of the recipient countries, it need not be the case that unanimity is ex ante Pareto optimal (see for example Harstad, 2005, and Maggi and Morreli, 2006). In this section, we explore the optimal voting rule by characterizing the effect of a majority decision rule on the investment decisions of the recipient countries.

3.1 Model

Here we extend the model to incorporate majority decision making in the spirit of Harstad (2005), where an endogenously chosen majority coalition determines the allocation of the fund. For reasons of tractability and to highlight the effect of majority rule on competition, we consider the case of three donor countries and three partner counties and assume symmetry in spillovers ($\beta_i = \beta_j$).[4]

We model the majority decision rule as follows: After recipient countries choose investment levels and $\{\alpha_j\}$ is revealed, a donor country is randomly chosen as formateur, f (each country has an equal probability of being chosen). The formateur then selects a majority coalition, which bargains over project funding and utility transfers in a manner analogous to our baseline model. Since the majority coalition is chosen endogenously, the formateur will select the majority coalition that maximizes her expected utility; if the formateur is indifferent regarding which countries to include in the majority coalition, she chooses each country with equal probability. We also assume that utility transfers are restricted to the majority coalition, which implies that countries outside the majority coalition are not fully expropriated. Therefore, the bargaining outcome within the majority coalition is equivalent to the two-country bargaining outcome, given a budget of $3x$.

Additionally, to make the analysis tractable, we consider a stochastic investment technology. Specifically, we restrict each recipient countries' project to be either high quality, $\alpha_j = \alpha^h$, or low quality, $\alpha_j = \alpha^l < \alpha^h$. For ease of exposition, we set $\alpha^l = 1$. The quality of the project is in turn a stochastic function of the level investment chosen by country i, $\delta_j \in [0, 1]$. Specifically:

$$p(\alpha_j = \alpha^h | \delta_j) = \delta_j.$$

Each recipient country faces the same cost function, $c(\delta_j) = \delta_j^2$.

We assume that the indirect benefit of investment continues to be proportional to the

[4] This analysis characterizes the optimal q-rule, since in the sub-majority case recipient countries will have no incentive to invest.

level of investment, δ_j. Conceptually, this is consistent with our example of investment in good governance: in the stochastic case, decreasing corruption increases the probability that a recipient country's project realizes as high quality; the decrease in corruption, however, is enjoyed whether or not α_j is equal to α^h or α^l.

Formally, the stochastic model is analogous in expectation to the deterministic model, given that a marginal increase in the recipient country's investment increases the *expected* quality linearly. However, in contrast to the deterministic case, the stochastic model allows for pure strategy equilibria under majority rule, since it avoids an "open set problem" in which recipient countries have an incentive to set marginally higher levels of investments than their peers to ensure that they are chosen to the majority coalition (only mixed-strategy investment strategies exist in equilibrium under majority rule in the deterministic case).

To summarize, the timing of the model is as follows:

1. recipient countries choose investment levels, δ_j.
2. $\{\alpha_j\}$ realizes.
3. A donor country is randomly chosen as formateur, f.
4. The formateur selects a majority coalition, $\mathcal{M}$.
5. The majority coalition bargains over the allocation of project funding and utility transfers.

We restrict the analysis to symmetric equilibria, where all target nations choose the same level of investment, and all donor nations use a symmetric decision rule conditional upon being selected as the formateur.

An equilibrium is defined as follows:

Definition 1
An equilibrium under Majority Rule consists of an investment level, $\delta_j = \delta^m$, and a decision rule, ν, that maps $\{\alpha_j\}$ into a majority coalition $\mathcal{M}$, where:

1. *Given ν and $\delta_{k \neq j} = \delta^m$, $\delta_j = \delta^m$ maximizes $E[g_j - c(\delta_j)|\delta]$ for each $j \in P$.*
2. *Given $\{\alpha_j\}$, ν maximizes $u_i(g_j, \{\alpha_j\}, \beta_j\})$ for each $i \in D$ given that $\{g_i\}$ is set by NB within the majority coalition.*

That is, for this section, we consider the objective of donor countries to maximize their *expected* utility.

3.2 Analysis

We begin by characterizing the expected allocation to g_j under unanimity in the stochastic investment model:

$$\begin{aligned} E[g_j|\delta_j,\{\delta\}]^u =& p(A^h=0|\delta^u)\left[\delta_j g^{h,l,l}+(1-\delta_j)g^{l,l,l}\right] \\ &+p(A^h=1|\delta^u)\left[\delta_j g^{h,h,l}+(1-\delta_j)g^{l,l,h}\right] \\ &+p(A^h=2|\delta^u)\left[\delta_j g^{h,h,h}+(1-\delta_j)g^{l,h,h}\right], \end{aligned}$$

where $g^{z,y,w}=(\alpha^z)^2/((\alpha^z)^2+(\alpha^y)^2+(\alpha^w)^2)3x$ is the three-country allocation that results from NB.

Next, we consider the expected allocation to g_j under majority. Following backward induction, we first specify the equilibrium decision-rule ν.

Lemma 4
The equilibrium decision-rule, ν, specifies that the formateur selects a majority coalition, $\mathcal{M}$, equal to $\{f,i\}$, where α_i is the maximum element of the set $\{\alpha_i\}\backslash\alpha_f$. If the maximum is not unique, i is chosen randomly.

Since bargaining entails that the majority coalition's surplus is split equally, the formateur maximizes her utility by selecting a majority coalition consisting of herself and the country with highest α_j, since this maximizes the size of the majority coalition's surplus.

Lemma 4 implies that, from country j's perspective, the fund's allocation rule under majority is a function of the number of recipient countries, other than j, that have a high-quality project. We denote this value as $A^h=\sum^{k\in P\backslash j}\mathbb{1}(\alpha_k=\alpha^h)$. This allows us to characterize the expected allocation to g_j as a function of δ_j, given the investment decision of the other two countries (δ^m):

$$\begin{aligned} E[g_j|\delta_j,\{\delta\}]^m =& p(A^h=0|\delta^m)\left(\frac{1}{3}\left[\delta_j g^{h,l}+(1-\delta_j)g^{l,l}\right]+\frac{2}{3}\left[\delta_j g^{h,l}+(1-\delta_j)\frac{1}{2}g^{l,l}\right]\right) \\ &+p(A^h=1|\delta^m)\left(\frac{1}{3}\left[\delta_j g^{h,h}+(1-\delta_j)g^{l,h}\right]+\frac{2}{3}\left[\frac{1}{2}(\delta_j g^{h,h}+\frac{1}{2}(1-\delta_j)g^{l,h})+\frac{1}{2}\delta_j g^{h,h}\right]\right) \\ &+p(A^h=2|\delta^m)\left(\frac{1}{3}\left[\delta_j g^{h,h}+(1-\delta_j)g^{l,h}\right]+\frac{2}{3}\left[\frac{1}{2}\delta_j g^{h,h}\right]\right), \end{aligned}$$

where $g^{z,y}=(\alpha^z)^2/((\alpha^z)^2+(\alpha^y)^2)3x$ is the bargaining solution from the majority coalition, which is equal to the two-country bargaining solution with $\{\alpha^z,\alpha^y\}$.

For each realization of A^h, the above expression divides $E[g_j]$ into the case where $i=j$ is chosen to be the formateur (the first term in brackets on each line) and the case where $i=j$ is not the formateur (the second term in brackets). Note that when $i=j$ is chosen as the formateur, the expression for $E[g_j|\delta_j, \{\delta\}]$ is analogous to the case of unanimity – therefore, the difference between the incentive to invest under the two decision rules stems from the case in which $i = j$ is *not* chosen as the formateur. In this case, the probability that $i = j$ is selected into the majority coalition, and hence receives a positive level of g_j is increasing in δ_j, since Lemma 4 specifies that the formateur will always select the country with a higher level of project quality. This gives j two incentives to invest under majority rule: (1) to increase expected g_j, conditional upon $i = j$ being selected to the majority coalition, and (2) to increase the probability of $i = j$ being selected to the majority coalition.

The addition of incentive (2) under majority rule leads to the following proposition:

Proposition 4
The equilibrium level of investment under majority rule, δ^m, is weakly greater than the level of investment under unanimity rule, δ^u.

Proposition 4 follows from the first-order conditions of $E[g_j|\delta_j, \{\delta\}]$ and is formally proved in the appendix. The result is also illustrated visually in figure 1 for a fixed x ($x = 2$).

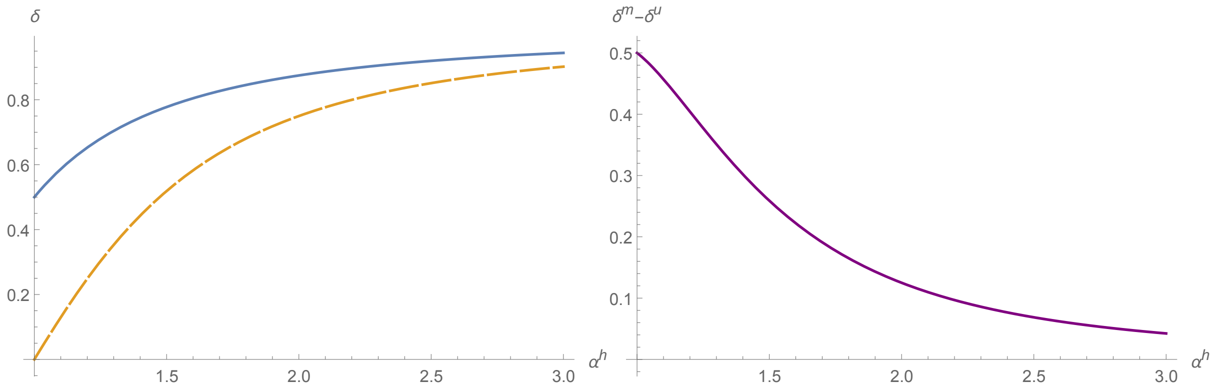
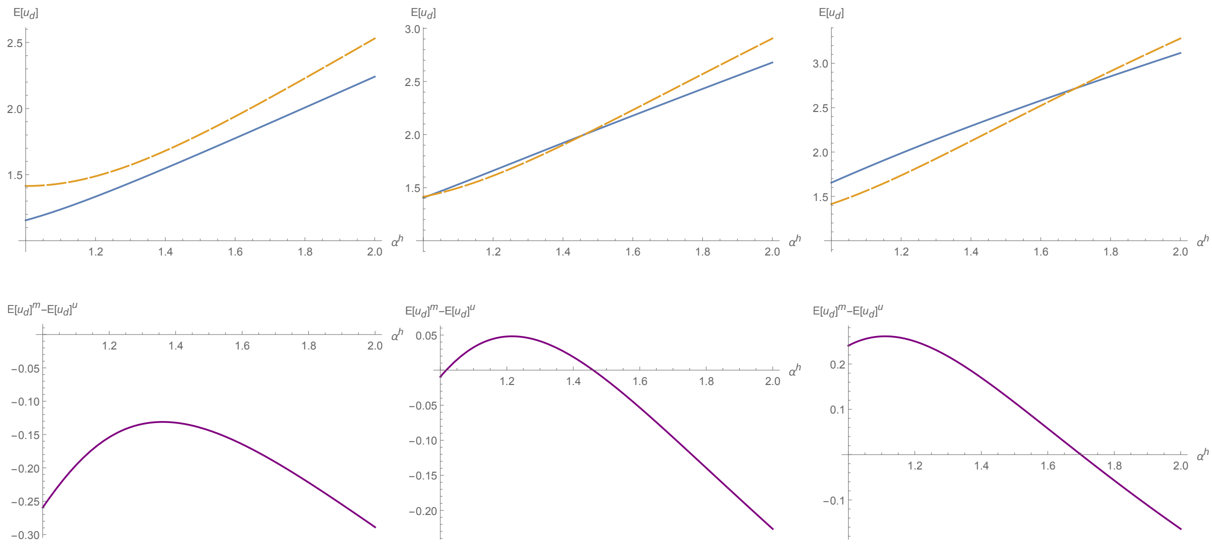


Figure 1: δ^m and δ^u (dashed line) for $x = 2$.

While Proposition 4 implies that investment levels are higher under majority rule for low levels of α^h, it does not imply that majority rule always outperforms unanimity rule. Instead, under majority rule, there is a tradeoff between higher investment and a utility loss that stems from the fact that majority rule limits funding to the two recipient countries in the majority coalition, and from the concavity of utility over g. This tradeoff is formalized in the following proposition, which considers the utility difference between the two decision rules holding x fixed and varying α^h:

Proposition 5
There exists λ^*, such that iff $\lambda > \lambda^*$, there exist an interval $(\alpha^l, \alpha']$ for some $\alpha' > \alpha^l$ such that the expected utility of the donor countries is higher under majority than unanimity for $\alpha^h \in (\alpha^l, \alpha']$.

The intuition for this result lies in the fact that under unanimity rule, as $\alpha^h \to \alpha^l$, the incentive to invest approaches zero for the recipient countries, since g^j approaches x for any α^j. Under majority rule, however, the incentive to invest stays strictly positive, since any country with $\alpha^j = \alpha^l$ is more likely to be left out of the majority coalition and receive $g^j = 0$. Therefore, as $\alpha^h \to \alpha^l$, $\delta^u \to 0$ while $\delta^m \to 1/4x > 0$. However, as $\alpha^h \to \alpha^l$, the direct benefit of investment (to the donor countries) also approaches zero, while the utility cost of restricting the budget allocation to two countries stays strictly positive. Therefore, for majority rule to dominate unanimity at low α^h, it must be the case that the indirect benefit of investment outweighs this utility cost.



$\lambda = 0$. $\lambda = 0.5$. $\lambda = 1$.

Figure 2: $E[u_d]^m$ and $E[u_d]^u$ (dashed line) for $x = 2$.

This result is also illustrated by figure 2, which shows the utility difference under the two voting rules for different values of λ. Note that utility difference between majority rule and unanimity rule is the highest at an interior value of α^h. The utility difference is increasing initially since, as α^h increases, the direct benefit of higher investment increases. However, as α^h increases, the difference in the investment levels under majority and unanimity also decreases.[5] Therefore, for high enough levels of α^h, the utility difference between the two decision rules is decreasing, resulting in an interior maximum.[6]

Lastly, we interpret these results in more general context: In the stochastic model,

[5] At high enough levels of α^h; by L'Hôpital's Rule, both δ^m and δ^u approach $\min\{1, 2x/(2+x)\}$ as $\alpha^h \to \infty$.

[6] Also, note that figure 2 demonstrates that a range of α^h where majority outperforms unanimity need not exist. In fact, simulations show that if $\lambda = 0$, then unanimity is preferable to majority for all x, α^h. With a higher budget, the benefit of higher partner-county investment increases; however, the incentive to invest also increases, decreasing the difference in investment levels between majority and unanimity – with symmetric β_js and $\lambda = 0$, the later effect dominates and unanimity is optimal for the donor countries.

decreasing α_h corresponds to decreasing the benefit of higher investment. Therefore, the result that majority rule can dominated unanimity rule for low levels of α^h corresponds to the statement that majority rule is the optimal voting rule when the direct benefit of partner-country investment is low. The intuition behind this result is straightforward: when the direct benefit of higher investment to the donor countries is relatively low, then the incentive to invest that is generated by collective allocation is relatively weak. Therefore, a majority rule is preferable in these cases, since it provides an additional incentive for recipient countries to invest to ensure that their donor country is selected to the majority coalition.

4 Conclusion

In this paper, we consider a formal model of the allocation of aid spending in an environment where donor countries face a bias over which recipient countries receive funding. Our analysis provides several important insights regarding the optimal design of international aid organizations. As highlighted by Svensson (2000, 2003), international aid organizations must focus on distributing aid in a manner that provides an incentive for developing nations to invest in reform. However, given competing national and special party interests, the question is how to enforce this objective. Here, we show that competition in the area of reform can arise endogenously when donor countries directly bargain over the allocation of aid funds, and that this competition is intensified under majority rule, as recipient countries invest in reform to increases the probability that their project will be selected by the endogenous majority coalition.

We emphasize that the predictions of our model only apply to international aid funds that allocate aid spending via an unstructured bargaining process. In recent years, "earmarked" donations (aka multi-bi aid) have become increasingly common as donor countries seek to take advantage of the benefits of scale of international organizations, while ensuring that aid is distributed according to national priorities. However, as our paper shows, earmarking diminishes the incentive of recipient countries to invest in reforms, since it circumvents multilateral bargaining. Therefore, in this case, less structure can result in greater efficiency.

Lastly, in future research we hope to consider the role of competition between multilateral organizations. Given the proliferation of climate change aid funds, competition has arguably arisen over funding the best projects. While the effect of such competition may be beneficial when the quality of the set of projects is exogenous, the effect of competition on endogenous quality is unclear. More research is needed to clarify the effect of the "market structure" of multilateral organizations on recipient countries' incentives to invest in reform.

References

Alesina, Alberto and Beatrice Weder (2002), "Do Corrupt Governments Receive Less Foreign Aid?" *American Economic Review*, 92, 1126–1137.

Ban Ki Moon (2015), "Secretary-General's Message for 2015." http://www.un.org/en/events/anticorruptionday/messages.shtml.

Barbera, Salvador and Matthew O Jackson (2006), "On the Weights of Nations: Assigning Voting Weights in a Heterogeneous Union." *Journal of Political Economy*, 114, 317–339.

Collier, Paul (1997), "The Failure of Conditionality." In *Perspectives on aid and development* (Catherine Gwin and Joan Nelson, eds.), Overseas Development Institute, Washington DC.

Dreher, Axel (2009), "IMF conditionality: theory and evidence." *Public Choice*, 141, 233–267.

Harstad, Bård (2005), "Majority Rules and Incentives." *The Quarterly Journal of Economics*, 120, 1535–1568.

Maggi, Giovanni and Massimo Morelli (2006), "Self-enforcing voting in international organizations." *American Economic Review*, 96, 1137–1157.

Molenaers, Nadia, Sebastian Dellepiane, and Jorg Faust (2015), "Political Conditionality and Foreign Aid." *World Development*, 75, 2–12.

Mosley, Paul, J Harrigan, and J.F.J. Toye (1995), *Aid and Power*, 2nd edition, volume 1 of *The World Bank and Policy-Based Lending*. Routledge, London.

Nakhooda, Smita, Charlene Watson, and Liane Schalatek (2015), "The Global Climate Finance Architecture." Overseas Development Institute.

OECD (2015), "Climate Finance in 2013-14 and the USD 100 billion Goal." OECD Publishing.

Öhler, Hannes, Peter Nunnenkamp, and Axel Dreher (2012), "Does conditionality work? A test for an innovative US aid scheme." *European Economic Review*, 56, 138–153.

Pedersen, Karl (1996), "Aid, Investment and Incentives." *The Scandinavian Journal of Economics*, 98, 423.

Simon, Jenny and Justin Valasek (2016), "Centralized Fiscal Spending by Supranational Unions." *Economica, Forthcoming.*

Stone, Randall (2004), "The Political Economy of IMF Lending in Africa." *American Political Science Review*, 98, 577–591.

Svensson, Jakob (2000), "When is foreign aid policy credible? Aid dependence and conditionality." *Journal of Development Economics*, 61, 61–84.

Svensson, Jakob (2003), "Why conditional aid does not work and what can be done about it?" *Journal of Development Economics*, 70, 381–402.

World Bank (2015), *The World Bank Annual Report 2015.* The World Bank.

Appendix

A Proofs

A.1 Proofs for Section 2

Proof of Lemma 1: Since country i does not value spending on g_j, it has no incentive to spend there. There is also no alternative productive use for the aid budget, so all x_i is spent on g_i. ■

Proof of Lemma 2: The first order conditions for problem 4 are:

$$\frac{\alpha_i \beta_i}{\sqrt{g_i}} = \nu \quad \forall i \tag{13}$$

$$g_1 + g_2 = x \tag{14}$$

where ν is the Lagrange multiplier on the budget constraint. They yield the optimal allocation rule in the fund:

$$g_i = \frac{(\alpha_i \beta_i)^2}{(\alpha_1 \beta_1)^2 + (\alpha_2 \beta_2)^2} 2x \tag{15}$$

$$g_1 + g_2 = 2x. \tag{16}$$

■

Proof of Lemma 3: Since reforms are costly and do not change the allocation of aid, target countries choose the minimum level $\alpha_j = 1$. ■

Proof of Proposition 1: Target countries move simultaneously, so we are looking for Nash equilibria. Each target country solves the stated problem, taking as given the other's reform investment level. This gives us two best response functions:

$$1 = 2x\alpha_i^2 \frac{(\beta_1\beta_2)^2}{((\alpha_1\beta_1)^2 + (\alpha_2\beta_2)^2)^2} \quad \forall i, \tag{17}$$

Setting these two best response functions, for $j = i, k$, equal to each other and simplifying gives the result that $\alpha_1 = \alpha_2 = \alpha$, and thus

$$\alpha = \sqrt{2x}\frac{\beta_1\beta_2}{\beta_1^2 + \beta_2^2} \tag{18}$$

There exist parameter combinations for which $\alpha < 1$, in which case target countries must choose the minimum investment level $\alpha_i = 1$. This particularly concerns small budgets of $x < 2$. There clearly also exist parameter combinations where $\alpha > 1$, so that it can be concluded that investment is always weakly larger than under bilateral allocation. ■

Proof of Corollary 1: The partial derivative of α with respect to x is positive. Since the true implemented α cannot fall below the minimum required investment of 1, α is not increasing in x until $x > 2$. ■

Proof of Corollary 2: Rewrite α in terms of the ratio $B = \frac{\beta_1}{\beta_2}$:

$$\alpha = \sqrt{2x}\frac{B}{1 + B^2} \tag{19}$$

α is maximized when $B = 1$. The necessary and sufficient conditions, respectively, are:

$$\frac{\partial\alpha}{\partial B} = \sqrt{2x}\frac{1 - B^2}{(1 + B^2)^2} = 0 \tag{20}$$

$$\rightarrow B = 1 \tag{21}$$

and

$$\frac{\partial^2}{\partial^2 B} = \sqrt{2x}\frac{-2B(1 + B^2)^2 - (1 - B^2)2(1 + B^2)2B}{(1 + B^2)^4} \tag{22}$$

$$\rightarrow \text{at } B = 1 \quad \frac{\partial^2}{\partial^2 B} < 0 \tag{23}$$

For $B < 1$, an increase in B corresponds to a decrease in asymmetry, for $B > 1$ an increase in B corresponds to an increase in asymmetry. ■

Proof of Proposition 2: Replacing $\beta_1 = \beta_2 = \beta$ in equation (12) yields the surplus for each donor nation from joining the fund:

$$F = \frac{1}{2}\alpha\sqrt{2x}\frac{2\beta^2}{\sqrt{2\beta^2}} + \lambda(\alpha - 1) - \beta\sqrt{x} \tag{24}$$

$$= (\sqrt{x}\beta + \lambda)(\alpha - 1) \geq 0, \tag{25}$$

since $\alpha \geq 1$. ■

Proof of Proposition 3: First, we consider the case where $\alpha = 1$ ($\delta = 0$). In this case, there is no advantage from the fund in terms of increased investment incentives. Without loss of generality, assume $\beta_i \geq \beta_j$. At $\beta_i = \beta_j$, the allocation of funds will be exactly the same as under bilateral aid:

$$g_i = 2x\frac{\beta_i^2}{\beta_i^2 + \beta_j^2} \tag{26}$$

$$\beta_1 = \beta_2 \to g_i = x, \tag{27}$$

so that both countries should be indifferent between the two forms of aid allocation. Indeed, for $\alpha = 1$ and $\beta_1 = \beta_2$

$$F_i = \frac{1}{2}\alpha[\beta_1\sqrt{g_1} + \beta_2\sqrt{g_2}] - \beta_i\sqrt{x} \tag{28}$$

$$= \frac{1}{2}2\beta\sqrt{x} - \beta\sqrt{x} = 0. \tag{29}$$

It then remains to be shown that the surplus from joining a fund, F, is larger than zero for country i whenever $\beta_i < \beta_j$ and smaller than zero otherwise. To see that, it suffices to show that the derivative of F with respect to β_i is less than zero everywhere:

$$\frac{\partial F_i}{\partial \beta_i} = \frac{1}{2}\sqrt{2x}\frac{2\beta_i\sqrt{\beta_i^2 + \beta_j^2} - \frac{\beta_i(\beta_i^2+\beta_j^2)}{\sqrt{\beta_i^2+\beta_j^2}}}{\sqrt{\beta_i^2 + \beta_j^2}^2} - \sqrt{x} \tag{30}$$

$$= \sqrt{x}\left[\frac{\sqrt{2}}{2}\frac{\beta_i}{\sqrt{\beta_i^2 + \beta_j^2}} - 1\right] < 0 \tag{31}$$

$$\tag{32}$$

Thus, when $\alpha = 1$ ($\delta = 0$), the donor country with the higher bias (i) will prefer to allocate aid bilaterally, and set $f_i = 0$.

Next, note that since $\alpha = \max\{1, \sqrt{2x}\frac{\beta_i\beta_j}{\beta_i^2+\beta_j^2}\}$, and since:

$$\lim_{\beta_i \to \infty} \sqrt{2x}\frac{\beta_i\beta_j}{\beta_i^2+\beta_j^2} = 0,$$

by L'Hôpital's Rule, there exists β' such that $\beta_i \geq \beta'$ implies $\alpha = 1$, which proves the result. ■

A.2 Proofs for Section 3

Proof Lemma 4: First note that the formateur will always select herself to the majority coalition, since the payoff of belonging to the majority coalition is strictly positive and utility transfers are restricted to the majority coalition. Since NB prescribes an equal split of the utility surplus, the utility of the formateur is equal to $1/2S$, where $S = \sum_{i\in M}\alpha_i g_i^{NB}$. And since NB results in the set of $\{g_j\}$ that maximizes S, $S(\{\alpha_f, \alpha^h\}) > S(\{\alpha_f, \alpha^l\})$. This implies that f has a strictly dominant strategy of selecting $M = \{f, i\}$ with $\alpha_i = \alpha_h$ over $M = \{f, i'\}$ with $\alpha_{i'} = \alpha_l$. Lastly, by assumption, f randomizes $i \in M, i \neq f$ if the maximal element of $\{\alpha_i\}\backslash\alpha_f$ is not unique. ■

Proof Proposition 4: Each partner country sets δ_j to maximize its expected utility, equal to:

$$E[u(\delta_j, \{\delta\})]^q = E[g_j|\delta_j, \{\delta\}]^q - \delta_j^2,$$

where q corresponds to the decision rule. The expected allocations are repeated here for convenience.

$$\begin{aligned} E[g_j|\delta_j, \{\delta\}]^u = & p(A^h = 0|\delta^u)\Big[\delta_j g^{h,l,l} + (1-\delta_j)g^{l,l,l}\Big] \\ & + p(A^h = 1|\delta^u)\Big[\delta_j g^{h,h,l} + (1-\delta_j)g^{l,l,h}\Big] \\ & + p(A^h = 2|\delta^u)\Big[\delta_j g^{h,h,h} + (1-\delta_j)g^{l,h,h}\Big], \end{aligned}$$

$$\begin{aligned} E[g_j|\delta_j, \{\delta\}]^m = & p(A^h = 0|\delta^m)\left(\frac{1}{3}\Big[\delta_j g^{h,l} + (1-\delta_j)g^{l,l}\Big] + \frac{2}{3}\Big[\delta_j g^{h,l} + (1-\delta_j)\frac{1}{2}g^{l,l}\Big]\right) \\ & + p(A^h = 1|\delta^m)\left(\frac{1}{3}\Big[\delta_j g^{h,h} + (1-\delta_j)g^{l,h}\Big] + \frac{2}{3}\Big[\frac{1}{2}(\delta_j g^{h,h} + \frac{1}{2}(1-\delta_j)g^{l,h}) + \frac{1}{2}\delta_j g^{h,h}\Big]\right) \\ & + p(A^h = 2|\delta^m)\left(\frac{1}{3}\Big[\delta_j g^{h,h} + (1-\delta_j)g^{l,h}\Big] + \frac{2}{3}\Big[\frac{1}{2}\delta_j g^{h,h}\Big]\right), \end{aligned}$$

After taking the first-order conditions of $E[u(\delta_j, \{\delta\})]^q$, imposing symmetry in the investment decisions, and simplifying, we get the following equation, which implicitly characterizes an interior solution for δ^u:

$$2\delta = (1-\delta^u)^2\big(g^{hll} - x\big) + 2(1-\delta^u)\delta^u\big(g^{hhl} - g^{llh}\big) + (\delta^u)^2\big(x - g^{lhh}\big). \tag{33}$$

And for δ^m:

$$2\delta = (1-\delta^m)^2\left(g^{hl} - x\right) + 2(1-\delta^m)\delta^m\left(\frac{1}{6}g^{hl} + x - \frac{1}{2}g^{lh}\right) + (\delta^m)^2\left(x - \frac{1}{3}g^{lh}\right). \tag{34}$$

Equation 33 implies that δ^u is characterized by:

$$\delta^u = \min\left\{1, \frac{((\alpha^h)^2-1)(2(\alpha^h)^2+1)x}{2+5(\alpha^h)^2+2(\alpha^h)^4+((\alpha^h)^2-1)^2x}\right\}, \tag{35}$$

while equation 34 implies that δ^m is characterized by:

$$\delta^m = \min\left\{1, \frac{(2(\alpha^h)^2-1)x}{2+2(\alpha^h)^2+((\alpha^h)^2-1)x}\right\}. \tag{36}$$

Deriving an analytical proof that $\delta^m > \delta^u$ is cumbersome, however, equations 35 and 36 can easily be used to verify the result numerically (code available on request). ■

Proof Proposition 5: Define $\delta^d(\alpha^h)$ as:

$$\delta^d(\alpha^h) = \delta^m(\alpha^h) - \delta^u(\alpha^h).$$

Since both equation 35 and equation 36 are continuous at $\alpha^h = 1$, it follows that $\lim_{\alpha^h\to\alpha^l}\delta^d(\alpha^h) = \delta^d(1)$, which simplifies to $\delta^d(1) = x/4$. Moreover, as $\alpha^h \to \alpha^l$, the NB allocations, $g^{z,y,w}$ and $g^{z,y}$, approach x and $3/2x$, respectively, regardless of $\{\alpha_j\}$.

Together, these two results imply that the difference in the donor country's expected utility under majority and unanimity, as $\alpha^h \to \alpha^l$ is equal to:

$$E[u^d]^m - E[u^d]^u = -\alpha^l\left[x^{\frac{1}{2}} - \frac{2}{3}\left(\frac{3}{2}x\right)^{\frac{1}{2}}\right] + \lambda\left(\frac{x}{4}\right),$$

where the first term reflects the utility loss from allocating X over two projects only, and the second term reflects the indirect utility benefit of the higher investment under majority rule (the direct benefit approaches zero as $\alpha^h \to \alpha^l$). Clearly, donors' expected utility is greater under majority rule in a neighborhood of $\alpha^h = \alpha^l$ if, and only if:

$$\lambda > \frac{4\alpha^l\left[1 - \frac{2}{3}\left(\frac{3}{2}\right)^{\frac{1}{2}}\right]}{x^{\frac{1}{2}}}.$$

■

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