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When is Foreign Aid Policy Credible?

Aid Dependence and Conditionality

Jakob Svensson

Disbursements of foreign aid are guided (in part) by the needs of the poor. Anticipating this, recipients have little incentive to improve the welfare of the poor. The welfare of all parties might be improved by tied project aid and by delegating part of the aid budget to an (international) agency with less aversion to poverty.

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Summary findings

Svensson studies foreign aid policy within a principal-agent framework. He shows that one reason for foreign aid's poor overall record may be a moral hazard problem that shapes the aid recipient's incentive to undertake structural reform. The model's basic prediction is a two-way relationship: Disbursements of foreign aid are guided (in part) by the needs of the poor. Anticipating this, recipients have little incentive to improve the welfare of the poor.

Preliminary econometric work shows that the data support this hypothesis.

In principle, conditionality could partly solve this problem, but only if the donor can make a binding commitment to increase disbursements in good relative to bad states. Without such a commitment technology, aid disbursements remain guided by the needs of the poor and recipient countries maintain a low effort to reduce poverty.

Contrary to the conventional wisdom found in the aid literature, Svensson shows that the welfare of all parties might be improved by using tied project aid or by delegating part of the aid budget to an (international) agency with less aversion to poverty.

This paper — a product of the Macroeconomics and Growth Division, Policy Research Department — is part of a larger effort in the department to study the effectiveness of foreign aid. Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Rebecca Martin, room N11-059, telephone 202-473-9026, fax 202-522-3518, Internet address rmartin1@worldbank.org. March 1997. (32 pages)

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When is Foreign Aid Policy Credible? Aid Dependence and Conditionality*

Jakob Svensson†

*Institute for International Economic Studies, Stockholm University and Policy Research Department, The World Bank. Not for citation without permission from the author.

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1. Introduction

> *Over the past few years Kenya has performed a curious mating ritual with its aid donors. The steps are: one, Kenya wins its yearly pledges of foreign aid. Two, the government begins to misbehave, backtracking on economic reform and behaving in an authoritarian manner. Three, a new meeting of donor countries looms with exasperated foreign governments preparing their sharp rebukes. Four, Kenya pulls a placatory rabbit out of the hat. Five, the donors are mollified and the aid is pledged. The whole dance then starts again* [THE ECONOMIST (August 19th, 1995)].

When is foreign aid policy credible? The quotation above on the relationship between the Kenyan government and the donor community seems to confirm that it is indeed a relevant question. Despite this, the voluminous literature on foreign aid and development has only to a limited extent dealt with incentive problems in the donor-recipient relationship. In particular, the issues of credibility and institutional design to mitigate time-consistency problems in foreign aid policy have not been addressed at all.

In many developing countries foreign assistance is an important source of revenue. For example, for the 40 most aid-dependent countries the mean value of aid as share of government revenue for the period 1970-89 was 56 percent.[1]

What has this vast amount of foreign aid achieved? The sizable literature on the effects of aid can roughly be divided into two main areas: microeconomic evaluations of projects and assessments of the macroeconomic impact of aid. White (1992) summarizes the results of this literature with the so called macro-micro paradox, concluding that, whilst micro-level evaluations have been, by and large, positive, those of the macro evidence have, at best, been ambiguous.

The macro-micro paradox raises questions of the efficiency of foreign aid and aid policy. Even though the state of the art is somewhat unclear, some general conclusions have emerged in the literature. First, it is argued that the weak macro performance of aid in many developing countries is largely due to unsound domestic policies in the recipient countries. Second, conditionality is a way to deal with such macroeconomic mismanagement. Third, the most efficient way to give aid is through untied program support [see e.g. Cassen (1986) and Krueger et al. (1989)]. Hence, tying aid to a specific source within the donor country is bad for the poor in the recipient country, and is viewed only as a method to increase the commercial impact of the aid program. Finally, there exists a vast literature criticizing the policies of the World Bank and the IMF. One of the arguments put

[1] Data compiled from the OECD and the IFS data base.

forward is that a donor with stronger emphasis on poverty alleviation will strike a better balance between efficiency and flexibility [see e.g. Havnevik (1987) and the discussion in Summers et al. (1993)].

In this paper we show that once we start looking at incentive effects of aid these statements need to be rethought. Our model suggests that one reason for the poor aggregate record of past aid disbursements may be a moral hazard problem adversely affecting the aid recipients' incentive to undertake structural reforms. In principle, conditionality could partly solve the problem, but this requires a strong commitment ability by the donor. Without such a commitment technology, aid disbursements are guided by the needs of the poor, resulting in low effort on the part of the recipient governments to alleviate poverty. Hence, we will end up in an aid policy cycle similar to what is described in the quotation from the *Economist.* Contrary to conventional wisdom in the aid literature, we show that tied project aid as well as delegation of part of the aid budget to an (international) agency with less aversion to poverty may improve welfare for all parties.

This paper is related to the literature on Samaritan's dilemma and soft-budget constraints.[2] By studying the problem within a simple principal-agent model, our analysis should be regarded as complementing this work. However, the key contribution of the paper is not in basic theory, but in integrating these conceptual frameworks with the policy discussion on foreign aid. This provides a framework to formalize the idea of conditionality and is the first contribution of the paper. Moreover, by analyzing a setup with several recipients, a coordination problem in foreign aid policy is identified: strategic manipulations by each recipient in order to increase the share of the aid disbursed lead to inefficiently low levels of investment (or effort exerted). The second contribution is normative. We describe two institutional arrangements that mitigate the time-consistency problem in foreign aid policy, namely delegation of part of the aid budget to a donor with less aversion to poverty, and tied project aid. Finally, we provide evidence that neatly fits the model's basic prediction of a two-way relation: foreign aid is (partly) disbursed according to the needs of the poor, and the anticipation of this adversely affects the recipients' incentives to carry out policies that would improve the poor's welfare. In particular, while there is no evidence that the poor benefit from aid, an *exogenous* increase in income (due to variations in the terms of trade) has a positive impact on social development. This finding indicates that the aid relationship may create adverse incentive constraints that undermine the overall purpose of assisting the poor. By estimating a simultaneous system, we blend together two strands of empirical literature on aid: on the one hand the

[2]See Kornai (1980a,b) for discussions and Dewatripont & Maskin (1991) and Qian & Roland (1994) for models of the soft budget constraint. The Samaritan's dilemma is formalized by, among others, Lindbeck & Weibull (1988). See for example Coate (1995) for references.

literature on the determinants of aid allocations, on the other hand the literature on the effects of these aid flows.[3]

The remainder of this paper is organized as follows. In section 2 the model is presented and the contract solutions are briefly described. In section 3 we study the equilibrium outcome under discretion. Alternative aid institutions are presented in section 4, and finally, in section 5 some empirical evidence is provided. Throughout the paper, the most important results are summarized in propositions.

2. A Model of Strategic Aid Dependence and Conditionality

Conditionality, and particularly macroeconomic conditionality, has emerged as an important component in foreign aid in the 1980s and 1990s. Even though conditionality may reflect bureaucratic requirements within the donor country, or simply represent a convenient method of packing and coordinating foreign assistance, the most important motive is to address incentive problems in the donor-recipient relationship.

The major aim of stabilization and structural reform assistance is to facilitate a move towards a sustainable fiscal situation, where the recipient can finance its own social objectives. Since aid resources are limited, an altruistic donor would like to allocate resources to those in most need. At the same time, fiscal imbalances are due partly to the state of the world, partly to the adjustment effort exerted by the recipient. Given that the donor cannot perfectly monitor or verify the recipients' adjustment efforts, the donor faces a standard moral hazard problem. Moreover, this problem is reinforced by an adverse competition for aid across recipients: each lowering effort in order to receive a larger share of the total aid budget. Of course, the problem of moral hazard is not limited to structural adjustment assistance, but prevalent in many aid programs in which the donor and recipient interact.

To concentrate on the time consistency issue in foreign aid policy and related normative issues, we will throughout the analysis treat the donor and the recipient

[3]See Maizels & Nissanke (1984), Frey et al. (1985), Frey & Schneider (1986) and Gang & Lehman (1990) for studies involving simple correlations and multiple regressions on cross-sectional data. See Dudley & Montmarquette (1976), Mosley (1985) and Trumbull & Wall (1994) for formal models of aid allocations. Assessments of the macroeconomic impact of aid date back at least to the study by Griffin (1970). Griffin (1970) found a negative correlation between aid and savings, generating a series of responses. In the papers that followed, substantial econometric problems were often recognized but was not dealt with in a satisfactory manner. Boone (1994,1995) and to some extent Mosley et al. (1987) are exceptions.

governments as single decision units. Hence, problems in aid policy steaming from divided governments in the recipient countries are assumed away. This is not to say that these issues are not important.[4] Moreover, to simplify the exposition, we consider only two types of informational settings: (i) the case where adjustment effort is perfectly observable, (ii) the case in which only aggregate outcome is observable. These two setups are not considered to be the best characterization of reality, but to provide a simple but yet rigorous structure in which to analyze normative issues in foreign aid policy.

2.1. The Model

Consider the following two-period model consisting of one bilateral donor and two recipients. In each period t the recipient government i determines the allocation of public funds (y_{it}) between government consumption, i.e. non-development spending (g_{it}), and development spending (d_{it}), where development spending is interpreted as spending benefiting the poor in the recipient country. In the first period, the recipients also make an investment choice (or exert effort), denoted by k_i. We assume that the public funds in period 1 are exogenously given, equal to y, while government income in period 2 depends on the adjustment effort (or investment) exerted in period 1 and the state of the world. The budget constraints are $g_{i1} + d_{i1} + k_i \leq y$ and $g_{i2} + d_{i2} \leq y(k_i)$.

The relation between government spending, adjustment effort and the state of the world is captured in the simplest possible way. Hence:

$$y(k_i) = \begin{cases} \gamma & \text{with probability} \quad q \\ \beta & \text{with probability} \quad (1-q) \end{cases}$$

where $\gamma > \beta > 0$. Investing more resources makes the good state more likely. Hence, we postulate that $0 \leq k_i \leq y$, and that the probability q is an increasing and concave function $q(k_i)$, such that $q(0) \geq 0$, $q(y) < 1$.

The donor has altruistic motives for giving foreign aid. More specifically, we assume that aid is used to produce a good or service, denoted by h_{it}, benefiting the poor. We assume that h is an increasing and concave function $h(a_{it})$, where a_{it} represents the (non-contingent) amount of aid disbursed to country i.[5] The

[4] See Svensson (1996) and Casella & Eichengreen (1994) for models of decentralized decision making and the effects of foreign assistance and Boycko et al. (1996) for a discussion of divided governments and aid.

[5] The consideration of aid as a factor of production has a long tradition, dating back at least to the study by Chenery & Strout (1966). In this setup, a_i can be interpreted either as project aid, or as program aid such as import-support. An alternative interpretation is to think of aid as pure cash transfers, but that due to bureaucratic or institutional factors the recipient has

poor derives utility from consuming the good, which is either produced by the donor's resources according to $h(\cdot)$, or provided by the recipient government, d. Alternatively one could think of the government producing the good with a linear technology. Thus, total (public) consumption of the poor in recipient country i is $c_{it} = d_{it} + h(a_{it})$

The i^{th} recipient's time-separable quasi-linear utility function is:

$$w_i = v(c_{i1}) + \varphi g_{i1} + u(c_{i2}) + u(g_{i2}) \tag{2.1}$$

where φ denotes the constant marginal utility of government consumption in period 1. We assume that u and v are differentiable, increasing and concave functions.[6]

The donor-agency is risk averse with preferences for consumption of the poor in the recipient countries. Hence, the donor-agency's preference function, w_D, is simply the sum of the utility of the poor in the two periods:

$$w_D = \sum_{t=1}^{2} \sum_{i=1}^{2} u\left(c_{it}\right) \tag{2.2}$$

The donor is endowed with a fixed aid budget in each period, A. The amount of resources earmarked for development aid by donor countries is often determined internally in the budget process. Therefore it is in this context reasonable to assume it to be exogenous. Note, however, that the total amount of aid disbursed to each individual country will be endogenous in the model. The budget constraint for the donor is simply:

$$A = \sum_{i=1}^{2} a_{it}(s), \quad s \in S \tag{2.3}$$

where $a_{it}(s)$ represents the state contingent amount of aid disbursed to country i in aggregate state s. S is the set of all possible aggregate states in period 2. We assume that the shocks in the two countries are independently distributed. Thus, there are four possible aggregate states in the model:

$$s = \begin{cases} (\beta, \beta) & \text{with probability} \quad (1 - q(e_1))\,(1 - q(e_2)) \\ (\beta, \gamma) & \text{with probability} \quad (1 - q(e_1))\,q(e_2) \\ (\gamma, \beta) & \text{with probability} \quad q(e_1)\,(1 - q(e_2)) \\ (\gamma, \gamma) & \text{with probability} \quad q(e_1)q(e_2) \end{cases}$$

where (γ, β) denotes the aggregate state when recipient 1 is in a good state and recipient 2 is in a bad state, and symmetrically for the other three aggregate states.

limited absorption capacity. Thus, aid will have a falling marginal product [cf. Cassen et al. (1986) and Karlström (1991)].

[6]For technical reason we also assume that $u''' > 0$.

It is convenient to define the subset of symmetric states, S_s, and the subset of asymmetric states, S_a, given by: $S_s = \{(\gamma,\gamma),(\beta,\beta)\}$, and $S_a = \{(\gamma,\beta),(\beta,\gamma)\}$.

To focus on the trade off between optimal incentives and optimal budget support, the following implicit assumption about the parameters of the model is made:

Assumption 1. *It is never optimal for the donor to write a contract such that the country in a good state receives more aid than the country in a bad state.*

This two-period model defines a game among the recipients and the donor. At the beginning of the game the three actors play a noncooperative game with respect to the allocation of aid and public funds. In the first stage, the recipients also make investment choices that in a stochastic way determine the outcome in period 2. In the last stage of the game, the donor and the two recipients again play a noncooperative game with respect to the allocation of aid and public funds between development spending and government consumption. We will consider three different settings. In the first case, the effort choices (investment) are observed by the donor. Moreover, the donor can commit to a policy rule *ex ante*. In the second scenario, we relax the assumption of full observability by assuming that the donor can only verify the outcomes in period 2. Finally, and more realistically, we relax the assumption of commitment, and consider the case where it is impossible to commit aid policy in advance. Within this latter setup, we analyze the impact of different institutional changes.

2.2. Optimal Contract when Adjustment Effort is Observable and the Donor Can Commit: First Best

Suppose that the donor can commit to a policy rule *ex ante* and, as a benchmark, that effort is fully observable. The optimal contract specifies adjustment effort (or investment) for each recipient and the allocation of aid across the two countries.

Two remarks about this setup is in order. First, even though the total aid budget is fixed, the level of aid disbursed to each individual country is endogenous. Second, aid is totally fungible in the model, implying that in each period, given the disbursement of aid, the recipient will allocate public funds so as to equalize the marginal utility of consumption between g and c. Consequently, the Nash equilibrium in the final stage of the game results in spending functions $C_i(s)$ and $G_i(s)$, where $C_i(s)$ $[G_i(s)]$ denotes total consumption of the poor [government consumption] in country i in aggregate state s, given the aid inflow $a_i(s)$. Solving for the equilibrium configuration of c and g in the last stage of the game yields: $C_i(s) = G_i(s) = \frac{1}{2}\left[y(k_i) + h\left(a_i(s)\right)\right]$. The solution to the aid disbursement problem in period 1 is trivial. Since both recipients are equal *ex ante*, $a_{i1} = A/2$, and

$d_{i1}^{*} = v_c^{-1}(\varphi) - h(A/2)$.[7]

The optimal contract is found by solving the program of maximizing the donor's expected utility subject to the recipients' individual rationality constraints (IR) and the budget constraint (2.3). Hence, for a given level of adjustment effort (investment), $k_i = k$, the optimal composition of aid across countries and states in period 2 is defined by the following maximization program:

$$\max_{\{\mathbf{a}_1(s),\mathbf{a}_2(s)\}} \sum_{i=1}^{2} \sum_{s \in S} Q(s) u\left(C_i(s)\right) \tag{2.4}$$

subject to:

$$\sum_{i=1}^{2} a_i(s) \leq A, \quad \forall s \in S \tag{2.5}$$

and:

$$v(\bar{c}) + \varphi(y - d_{i1}^{*} - k) + 2\sum_{s \in S} Q(s) u\left(C_i(s)\right) \geq Ew_i^0, \quad i = 1, 2 \tag{2.6}$$

where we have explored the properties of the symmetric Nash equilibrium in the last stage of the game, and where $Q(s)$ denotes the probability of aggregate state $s \in S$, $\mathbf{a}_i(s)$ is a vector of state-contingent aid disbursements to country i for all $s \in S$, $\bar{c} \equiv v_c^{-1}(\varphi)$, and Ew_i^0 is recipient i:s expected utility without aid. For convenience, time subscripts have been dropped. Let superscript 1 denotes the first-best equilibrium. The important properties of this subgame perfect equilibrium are summarized below.

Proposition 2.1. *The optimal contract when k is contractible (first-best) is characterized by four conditions: (i) the first-best equilibrium entails full consumption smoothing across countries, (ii) the equilibrium aid flows are independent of the probability function q and the cost of adjustment φ, (iii) the optimal amount of effort is higher than in the equilibrium without aid, (iv) the IR-constraints bind.*

Proof. See appendix 1. ■

Hence, since effort is contractible it is always optimal to give aid to those in most need, resulting in an equalization of the marginal utilities of aid across countries in equilibrium. Moreover, since the donor does not derive any utility from government consumption, the IR-constraints must bind. That is the donor (and the poor group) skims off the entire surplus from the recipient government, and the recipient government is no better off with aid than without. In other words, by giving conditional aid in an environment where the donor can commit, the donor in practise buys a certain amount of effort in exchange for the aid it disburses.

[7] We assume that A and y are sufficiently large to guarantee an interior solution.

2.3. Optimal Contract when Adjustment Effort is Not Verifiable and the Donor Can Commit: Second Best

In reality adjustment effort is seldom observable in all of its dimension. Typically certain elements are verifiable while others are less tangible. Without loss of generality, we consider below the case where the recipients' policies are not verifiable at all. In such a setting, the optimal contract can only be made conditional on the observable state of the world.

The optimal contract is derived as in previous subsection, except that there are now two additional conditions that constrain the maximization program, namely the two IC-constraints, given by:[8]

$$q'(k_1)\left[\Omega_1 - \Lambda_1\right] = \varphi \tag{2.7}$$

where:

$$\Omega_1 \equiv 2q(k_2)u\left(C_1(\gamma,\gamma)\right) + 2\left(1-q(k_2)\right)u\left(C_1(\gamma,\beta)\right) \tag{2.8}$$

$$\Lambda_1 \equiv 2q(k_2)u\left(C_1(\beta,\gamma)\right) + 2\left(1-q(k_2)\right)u\left(C_1(\beta,\beta)\right) \tag{2.9}$$

and corresponding constraint for recipient 2. The IC-constraint (2.7) has an intuitive interpretation. The left hand side of (2.7) captures the expected gain of higher adjustment effort, treating the other recipient's choice of k as given, while the right hand side is the marginal cost, φ. The cost takes the form of reduced government consumption in period 1, while the expected benefit is the product of the marginal increase in the probability of a good state times the relative change in utility of such an increase in q.

We denote the second-best equilibrium with superscripts 2. Solving the maximization program yields:

Proposition 2.2. *The optimal contract when k is not contractible (second-best) is characterized by four conditions; (i) there is less than full consumption smoothing across countries, $a_i^2(s) = A/2$ for all $s \in S_s$, and $a_1^2(\beta,\gamma) = a_2^2(\gamma,\beta) < a_1^1(\beta,\gamma)$, and $a_1^2(\gamma,\beta) = a_2^2(\beta,\gamma) > a_1^1(\gamma,\beta)$, (ii) the optimal amount of effort is lower than in the first best, $k^2 < k^1$, (iii) the equilibrium aid flows depend on the exogenous parameters of the model, (iv) the IR-constraints do not bind.*

Proof. See appendix 2. ■

Again this result is intuitive. The second best contract is a compromise between giving aid to those in most need and providing optimal incentives. In order

[8] We have replaced the infinite set of relative incentive constraints with a single "first-order constraint" (see appendix A.2).

to induce the recipient to exert higher effort, aid flows in bad states must be lowered and aid flows in good states raised. Note, that there are two forces that drive the equilibrium away from the first-best. First, there is a "moral hazard" in that full consumption smoothing lowers the incentive to invest or exert effort *ex ante.* This distortion is reinforced by an adverse competition for aid across recipients. Since the two recipients act non-cooperatively they do not take into account the effects of domestic policy choices on the other country. Given that the donor's resources are limited, the choice of adjustment effort in country i will affect the expected welfare of country j. This is so because the higher effort exerted by recipient i, the less likely it ends up in the bad state and the less likely it is that the country will receive as much foreign assistance. This in turn implies that expected aid to country j rises. Hence, there exists a positive externality between expected aid disbursement to country j and adjustment effort in country i. The recipients will not internalize this externality when choosing k, resulting in underinvestment in both recipient countries.

3. Discretion: Third Best

Contracts of the form described in section 2.3 and 2.4 have been suggested to solve the moral hazard problem present in many donor-recipient relations. However, enforcing such contracts are difficult. *Ex post,* once the recipients' choices of adjustment effort are determined and the shock realized, the donor-agency has incentives to increase disbursements to the country in most need. The anticipation that this will happen will in turn affect the incentive to carry out politically costly adjustment policies *ex ante.*

To analyze the game it is convenient to define expected utility of the i^{th} recipient as function of investment levels and aid disbursements:

$$W_i(k_1, k_2, \mathbf{a}_1(s), \mathbf{a}_2(s)) \equiv v(\bar{c}) + \varphi(y - d_{i1}^* - k_i) + q(k_i)\Omega_i + (1 - q(k_i))\Lambda_i \quad (3.1)$$

and symmetrically for country 2.

Definition 3.1. *The discretionary equilibrium is a vector of feasible policies* $(k_1, k_2, \mathbf{a}_1, \mathbf{a}_2)$ *such that: (i)* $a_i = \arg\max \sum_{i=1}^{2} u(c_i)\ \forall s \in S$, *s.t. the donor's budget constraint, (ii)* $k_1 = \arg\max W_1(\cdot)$, *given* k_2, *(iii)* $k_2 = \arg\max W_2(\cdot)$, *given* k_1.

We denote the equilibrium adjustment levels in the discretionary equilibrium by k^3. The important properties of this subgame-perfect equilibrium are stated in the following Proposition.

Proposition 3.2. *The discretionary equilibrium entails full consumption smoothing $a^3(s) = a^1(s)$, but too low adjustment effort, $k^3 < k^2$.*

Proof. The discretionary equilibrium is found by backward induction. In the last stage of the game, the donor determines the allocation of aid across the two countries, taking the composition of public funds in the second period as given. The first-order condition can be stated as follows:

$$u'\left(C_1(s)\right)h'(a_1(s)) - u'\left(C_2(s)\right)h'(a_2(s)) = 0, \qquad \forall s \in S \tag{3.2}$$

where c_i is replaced with the equilibrium composition of public funds $C_i(s)$. This condition imply aid-flows identical to the benchmark equilibrium. That is, *ex post,* aid will be allocated to the country in most need. At an optimum, the marginal utility of aid across the two countries is equalized.

In the first stage of the game the two recipients simultaneously and non-cooperatively choose adjustment effort. The equilibrium aid flows, implicitly defined by equation (3.2), will then act as incentive constraints on the recipients' maximization programs. Inserting these aid flows into the welfare function (2.1), and taking the first-order condition with respect to k_i yields:

$$q'(k_i)\left[\Omega_i^1 - \Lambda_i^1\right] = \varphi, \quad i = 1, 2 \tag{3.3}$$

It is now straightforward to show that $k_i < k_i^2$. Suppose that $k_i = k_i^2$, then $[\Omega_i^1 - \Lambda_i^1] < [\Omega_i^2 - \Lambda_i^2]$, implying that $k_i \neq k_i^2$. Suppose instead that $k_1 > k_1^2$. As the left-hand side of (3.3) is decreasing in k_i, this cannot be true either. Hence, e_i^3 is unambiguously lower than k_i^2. Because of symmetry, $k_1^3 = k_2^3 = k^3$. ■

In other words, the donor's incentive to push the outcome towards the first-best, will drive the equilibrium towards the third-best. Note that each recipient will choose a strictly positive effort level even though lower effort will be (partly) compensated by increased aid flows. The reason for this is that due to a fixed aid budget, only $A/2$ is disbursed to each individual recipient in the worse state of nature (β, β).

The welfare implications could be summarized as follows. The donor and the poor groups are strictly better off in the contract equilibrium than in the discretionary environment, while the welfare effects of the recipient governments are ambiguous. The reason for this is that in the discretionary equilibrium the individual government does not internalize the positive externality between expected aid disbursement to country j and adjustment effort in country i. Hence, the effort choice of the recipient government may be too low. To see this we can solve for the cooperative outcome under discretion.

Definition 3.3. *The discretionary cooperation equilibrium is a vector of feasible policies* $(k_1, k_2, \mathbf{a}_1, \mathbf{a}_2)$ *such that: (i)* $a_i = \arg\max \sum_{i=1}^{2} u(c_i)$ $\forall s \in S$, *s.t. the donor's budget constraint, (ii)* $\mathbf{k} = \arg\max \sum_{i=1}^{2} W_i(\cdot)$.

The following Lemma states the main result of this equilibrium.

Lemma 3.4. *A time-consistent cooperation equilibrium has higher levels of adjustment effort than in the third-best,* $k_i > k_i^3$.

Proof. See appendix A.3. ■

If the gain of increased aid flows in bad relative good states is outweighed by the loss of too low levels of adjustment effort, welfare of the recipient governments is higher in the contract equilibrium than in the discretionary environment.

In summary, conditionality could partly solve the incentive problem (inevitably) present in many situations in which the donor and recipients interact, but this requires a strong commitment ability by the donor. Without such a commitment technology aid will be allocated according to the needs of the recipients, resulting in underinvestment, or too low adjustment effort by the recipient governments. In the following section we describe two arrangements under which the incentives for *ex post* recontracting are eliminated, and which are able to sustain second-best outcomes.

4. Alternative Aid Institutions

The question we ask in this section is whether it is possible to design institutions so as to push the discretionary equilibrium closer to the second-best equilibrium. Two different scenarios are considered. In the first case, the set of policy instruments available for the donor is expanded by allowing for tied project aid. In the second case, an additional donor with different preferences over the allocation of foreign aid is introduced.

4.1. Tied aid

In this subsection we describe an alternative method to deal with the incentive problems in foreign assistance, namely tied project aid. We define tied aid as contracted by source to private firms in the donor country, non-financial project transfer of resources.

Project aid in general, and tied project aid in particular, have received a great deal of attention and criticism in the aid literature. A general conclusion that has emerged from this research is that if aid is highly fungible, targeting assistance to specific projects is essentially a futile exercise.[9] Furthermore, tying aid resources by source and end use to firms within the donor country is seen only as a way to increase the commercial impact of the aid program. However, these conclusions may in fact be reversed once we take into account how tied aid affect the time-consistency problem in foreign assistance.

The main reason for this result is that tied aid is contractible. That is, contrary to many international agreements where there are no third party or institution that can enforce contracts, tied project aid is contractible within the donor country. Furthermore, such a contract is credible not only because of the use of legal institutions within the donor country, but because the third party involved, i.e. the private firms within the donor country, is likely to enforce the contract for profit-maximizing reasons. Hence, by exploiting domestic institutions the donor achieves some commitment power in the international policy game.

To make the analysis more realistic, we consider both the case when tied aid is as efficient as non-tied aid and the case when tied aid is not. Since tied aid is likely to involve transaction costs within the donor country, the second scenario is more realistic. In other words, contractibility acts as a constraint that reduces efficiency. However, it turns out that tied aid can serve a useful role even though it is only an imperfect substitute for non-tied aid.

4.1.1. A modified model

Let tied project aid be denoted by t_i. We assume that the level of tied aid is determined before the outcome is realized. This seems like a reasonable timing assumption, since tied aid is an aid form which captures better commitment possibilities through the use of domestic institutions. More precisely, we postulate that a project realized through tied aid takes one period to implement.

Tied aid is less efficient than non-tied aid. Hence, a fraction μ of resources used for tied project aid will be wasted, where $\mu \geq 0$.

Assume initially that $\mu = 0$, so that tied aid is as efficient as non-tied aid. Then, *ex post*, once the shock is realized and the level of tied aid determined, the donor solves:

$$\max_{\{a_i\}} \sum_{i=1}^{2} u\left(y_i + h(a_i + t_i)\right) \quad y_i = \gamma, \beta, \;\; i = 1, 2 \tag{4.1}$$

subject to:

$$A = \sum_{i=1}^{2} a_i + t_i \tag{4.2}$$

[9] Whether or not aid is fungible is an empirical question. Boone (1994,1995) present evidence supporting the notation of fungibility.

It is now straightforward to prove the following Proposition.

Proposition 4.1. *The donor can implement the second-best equilibrium by using a combination of tied and non-tied aid.*

Proof. If $t_1 = t_2 = a_1^2(\gamma, \beta) = a_2^2(\beta, \gamma)$, the first-order condition with respect to a_1 of the maximization program (4.1), in aggregate state (γ, β) can be written as:

$$u'\left(\gamma + d\left(a_1 + a_1^2(\gamma, \beta)\right)\right) h_1' - u'\left(\beta + h\left(a_2 + a_1^2(\gamma, \beta)\right)\right) h_2' < 0 \qquad (4.3)$$

which is strictly negative. Hence, it is optimal, *ex post*, to allocate all available aid to country 2. By construction, then, the total level of aid disbursed to country 2 is $a_2^2(\gamma, \beta)$. By symmetry, the opposite result holds in state (β, γ). Given these aid-flows it follows from proposition 2.4 that it is optimal for the recipients in period 1 to choose $k_1 = k_2 = k^2$. ■

Hence, by tying up part of the available funds in tied project aid the second-best outcome can be implemented. Note that it is not optimal to tie up all aid resources, $t < A/2$. Thus, there exists a trade-off between flexibility and credibility. Due to the uncertain environment, it is optimal to provide more aid to countries in bad states. These resources would not be available if all aid was tied.

The intuition for this result is straightforward. *Ex post* it is optimal for the donor to equalize the marginal utilities of aid across the two countries. The recipients realize this, and will therefore choose too low effort *ex ante*. By credibly tying up part of the aid budget, the donor ties its own hands. As a result, it is no longer possible to equalize the marginal utilities of aid across countries *ex post*. Hence, the necessary incentives to induce the recipients to choose k^2 are created.

When $\mu > 0$ the second-best outcome can never be implemented. In this case, the donor faces a trade-off between waste of aid resources and creating incentives to induce the recipients to choose higher effort. Intuitively, under discretion effort is too low whereas the allocation of aid is set optimally. At the margin it is therefore optimal to accept some waste of aid resources in exchange for higher effort *ex ante*. This intuitive argument is formalized in proposition 4.3.

Let the indirect utility function of the donor be $W_D(\mu, \mathbf{m})$, where $\mathbf{m}$ is a vector of exogenous parameters, and denote the donor's expected welfare under discretion as EW_D^3. Then we have the following proposition:

Proposition 4.2. *There exists a threshold value $\hat{\mu} > 0$ such that for any $\mu \in [0, \hat{\mu})$ the donor is strictly better off in the tied aid case than in the third best.*

Proof. Both the budget constraint and the donor's utility function are continuous. Hence, by Berge's Maximum Theorem the value function W is continuous in all arguments. From proposition 2.4 it follows that $W_D(0, \mathbf{m}) > EW_D^3$. Proposition 4.3 is then immediate from the continuous property of W. ■

Corollary 4.3. *If the gain of increased aid flows in bad relative good states is outweighed by the loss, due to the coordination failure, of too low adjustment effort, there also exists a* $\mu > 0$ *such that the recipient governments are better off in the tied aid case than in the discretionary equilibrium.*

Proof. Immediate from proposition 4.3.

The optimal composition between non-tied and tied aid can be found in two steps.[10] First, define the vectors of net-aid flows (i.e. net of waste) that implement a given effort level as a function of the efficiency parameter μ, to be $[\mathbf{a}_1(s, \mu), \mathbf{a}_2(s, \mu)]$. Then, since tied aid is chosen *ex ante*, the equilibrium vector of net-aid flows must be identical to the vectors of aid flows that solve the second-best problem (section 2.4), with the aggregate aid budget, A^n, equal to $\sum_{i=1}^{2} a_i(s, \mu)$, $\forall s \in S$. That is:

$$\max_{\{\mathbf{a}_1, \mathbf{a}_2\}} \left[\sum_{i=1}^{2} \sum_{s \in S} Q(s) u(C_i(s)) \right] \tag{4.4}$$

subject to:

$$v(\bar{c}) + \varphi(y - d_{i1}^* - k_i) + 2 \sum_{s \in S} Q(s) u(C_i(s)) \geq Ew_i^0, \quad i = 1, 2 \tag{4.5}$$

$$d'(k)\left[\Omega_i - \Lambda_i\right] = \varphi, \quad i = 1, 2 \tag{4.6}$$

$$\sum_{i=1}^{2} a_i(s, \mu) \leq A^n, \quad \forall s \in S \tag{4.7}$$

and where:

$$A^n = \sum_{i=1}^{2} a_i(s) + 2(1 - \mu)t = A - 2\mu t \tag{4.8}$$

Second, for such a problem we have shown that incentives for higher effort require an optimal allocation of aid such that the marginal utilities of aid are not equalized across countries in mixed states.

[10] An equivalent way to solve the problem is through backward induction. However, due to nested implicit functions, the evaluation of how the endogenous variables change with μ is simplified by exploiting the previous result of the model as described above.

With these observations in hand we can solve for the optimal composition of non-tied aid, that is the last stage of the game, denoted by superscripts nt as:

$$a_1^{nt}(\gamma,\beta) = a_2^{nt}(\beta,\gamma) = 0 \tag{4.9}$$
$$a_1^{nt}(\gamma,\gamma) = a_2^{nt}(\beta,\beta) = \tfrac{1}{2}(A-2t) \tag{4.10}$$
$$a_1^{nt}(\beta,\gamma) = a_2^{nt}(\gamma,\beta) = A-2t \tag{4.11}$$

where t is the level of tied aid. (4.9)-(4.11) implies that it is always optimal *ex post* to allocate all available funds to the country in most need.

Using the composition of non-tied aid given in (4.9)-(4.11), and given the vectors of net-aid flows from the maximization program (4.4)-(4.7), we can solve for the equilibrium level of tied aid, given by:

$$t(\mu) = a_1\left((\gamma,\beta),\mu)\right)/(1-\mu) \tag{4.12}$$

For a given μ, equation (4.12) gives a mapping from the space of possible t into itself: a given t implies a given net level of aid disbursed from (4.8), and from the maximization program (4.4)-(4.7) vectors of net-aid flows $[\mathbf{a}_1(s,\mu),\ \mathbf{a}_2(s,\mu)]$, which in turn implies a new level of tied aid from (4.12). The fixed point of this mapping is denoted by t^*. The following Lemma states the important result of this section.

Lemma 4.4. *If the amount of tied aid is given by t^*, the donor minimizes the waste of aid resources while at the same time creating incentives to induce the recipients to choose a given effort level, $\bar{k}$.*

Proof. Note first that since it is always optimal *ex post* to allocate all available aid funds to the country in most need, the total net aid allocated to country 2 in state (γ,β), and symmetrically to country 1 in state (β,γ), is equal to:

$$(1-\mu)t^* + A - 2t^* = a_1\left((\gamma,\beta),\mu\right) + A^n - 2t^*(1-\mu) = a_2\left((\gamma,\beta),\mu\right) \tag{4.13}$$

Hence, the implemented net allocation will be given by: $[\mathbf{a}_1(s,\mu),\ \mathbf{a}_2(s,\mu)]$. Notice furthermore that the IC-constraints (4.6) bind when the allocation of aid follows $[\mathbf{a}_1(s,\mu),\ \mathbf{a}_2(s,\mu)]$. Thus, $t < t^*$ cannot be optimal since this would increase aid flows to the country in most need, resulting in too low effort by the recipients *ex ante*, that is $k_i < \bar{k}$. On the other hand, $t > t^*$ cannot be optimal either. This is so for two reasons. First, more resources than necessary are wasted in order to create the incentives for the recipients to choose $\bar{k}$. Second, too little aid is given to the country in most need. Both effects unambiguously reduce the donor's welfare. ■

Corollary 4.5. *An increase in μ leads to a reduction in t^* and in the optimal level of $\bar{e}$.*

Proof. See appendix A.4. ■

When μ rises the cost of creating incentives for high effort also increases. As a result, less incentives are created. This can be implemented in two ways, either by reducing the level of tied aid or by lowering the equilibrium level of effort. Because both t^* and e are continuous in μ, the donor will choose to adjust both variables.

4.2. Delegation

A well known result from the political economy literature on monetary and fiscal policy is that delegation to an agent with different objectives may help to relax binding incentive constraints.[11] In this section we show that a similar result applies to the time consistency problem in foreign aid policy.

In real life there are many donors interacting on the aid-scene. Of these the World Bank and the IMF have come to play an important role. The policies of these institutions are often criticized for being to too conservative and inflexible, pursuing policies that may increase efficiency but at the cost of increased poverty, that is cuts in social spending. It is argued that a more flexible donor with stronger emphasis on poverty alleviation will strike a better balance between efficiency and flexibility [see e.g. Havnevik (1987) and the discussion in Summers et al. (1993)]. However, we show below that this claim may in fact be reversed. A less flexible donor, that is a donor with less aversion to poverty, or stronger emphasis on aggregate efficiency, will increase welfare of the poor.[12]

To simplify we assume that the relative poverty aversion, denoted by η, is constant. Hence:

$$\eta = \frac{u''(c_1)\, c_1}{u'(c_1)} \tag{4.14}$$

Given this assumption, we can exploit the first-order condition (3.2) to determine the relative poverty aversion for the donor considered above as:

$$\hat{\eta} = \frac{C_1^1(\gamma,\beta)u''\left(C_1^1(\gamma,\beta)\right) u'\left(C_2^1(\gamma,\beta)\right) h'(a_2^1(\gamma,\beta))}{\left[u'\left(C_1^1(\gamma,\beta)\right)\right]^2 h'(a_1^1(\gamma,\beta))} \tag{4.15}$$

[11] For a survey of the political economy literature, see Persson & Tabellini (1990). For a model of delegation in an international context, see e.g. Persson & Tabellini (1995).

[12] Of course, the World Bank (and the IMF) also have other aims than poverty alleviation, which may result in other binding incentive constraints [see e.g. Rodrik (1995) and Boycko et al. (1996)].

Notice that the donor's welfare function is utilitarian if $\eta = 0$ in which only total income counts and becomes more Rawlsian as η increases. In other words a higher η implies a higher aversion to relative poverty or less emphasis on aggregate consumption or efficiency [cf. Behrman & Sah (1984)].

Evaluating equation (4.15), it is obvious that a lower η leads to a shift in aid flows away from the recipient country with the lowest income (revenue). In the limit as $\eta \to 0$, aid will be split equally between the two countries irrespective of the state of the world. We can now state the main result of this section.

Proposition 4.6. *The second-best outcome can be implemented by delegating responsibility to a donor agency with less relative aversion to poverty.*

Proof. It is immediate from (4.15) that a donor agency with relative aversion to poverty given by η^*, where:

$$\eta^* = \frac{C_1^2(\gamma,\beta)u''\left(C_1^2(\gamma,\beta)\right)u'\left(C_2^2(\gamma,\beta)\right)h'(a_2^2(\gamma,\beta))}{\left[u'\left(C_1^2(\gamma,\beta)\right)\right]^2 h'(a_1^2(\gamma,\beta))} \tag{4.16}$$

will implement the second-best. Since the numerator is smaller and the denominator is larger in (4.16) than (4.15), $\eta^* < \hat{\eta}$. ∎

Hence, due to the time-inconsistency problem present in the allocation of foreign aid, it is optimal for a bilateral donor to delegate responsibility to a donor agency with less relative aversion to poverty. The second-best entails giving less aid for social spending to those countries in most need in order to induce more effort *ex ante*. A donor with less aversion to poverty will do just that, and the recipients will react by increasing adjustment efforts.

One remark about this result is in order. In the case considered above, the execution of the whole aid program is delegated to an agency with $\eta = \eta^*$. However, the second-best could also be implemented by delegating part of the aid budget to an agency with $\eta < \eta^*$ and disburse the remaining aid according to the first-order condition (3.2).

This result has a strong implication. If the policy game described above is important in reality, the advocates of the poor may do themselves (and the poor) a disservice by calling for a more poverty oriented foreign aid approach, in the sense that the donors should be more responsive to the needs of the poor. The recipients will be aware of changes in the donors' agenda, and may exploit them in a way that the total impact on the poor may be low or even negative. On the contrary, a stronger emphasis on aggregate efficiency relative poverty alleviation will on average, through the internal policy formation process, increase welfare of the poor.

5. Some Preliminary Evidence

In this section we take a first step to empirically test the general prediction of the theory. The principal implication of the model is that concessional assistance is allocated according to the needs of the poor ("recipients' needs"), and that the anticipation of this adversely affects the recipients' incentives to carry out policies that would improve the poor's welfare. Our objective is to test this prediction on pooled 10-year-averaged cross-country data for the period 1971-1990.[13] We will estimate systems of equations given by:

$$a_{it} = \alpha^a + \beta^a z_{it} + \gamma x_{it-1} + \varepsilon^a_{it} \tag{5.1}$$

$$\Delta \log n^j_{it} = \alpha^n + \beta^n v_{it} + \zeta a_{it} + \varepsilon^n_{it} \tag{5.2}$$

where a_{it} is the average level of aid disbursed to country i at time t, x_{it} is a composite measure of recipients' needs, n^j_{it} is the jth indicator of recipients' need, and z_{it} and v_{it} are vectors of other variables that might be thought to affect policy choices. The main coefficients of interest are γ and ζ. The model's basic prediction is that $\gamma > 0$ and $\zeta = 0$. Due to the limitation in data coverage, we have to focus on the medium-run implication of the model.

We employ four different measures of recipients' needs as explanatory variables: infant survival rate (INF), life expectancy rate (LIF), primary school enrollment rate (PRI), and the log of real GDP per capita ($LGDP$). The human development indicators are highly correlated with each other and with real income. For example, the simple correlations between LIF and INF, and LIF and $LGDP$, respectively, are 0.93 and 0.75.[14] To avoid multicollinearity among the recipients' needs indicators in (5.1), we create a composite measure of INF, LIF, PRI and $LGDP$ by the method of principal components. We denote the first principal component from the set of recipients' needs proxies by RN. Previous studies on the determinants of aid have not taken the possibility of multicollinearity into account, and consequently, in most cases rejected the hypothesis that aid flows are directed towards countries with low levels of social development.

There exist a vast literature on the impact of aid on growth. However, the relationship between aid and social development have received very little attention.[15] For this reason we concentrate on the latter. We choose log differences

[13]The choice of the length of sub-periods, as well as the sample of countries included, are determined by data availability.

[14]The two social indicators INF and LIF are derived from the same source for several countries, which partly explains the high correlation.

[15]For recent contributions see for example Boone (1996), Mosley et al. (1987), Burnside & Dollar (1996). These authors find that on average aid is insignificantly correlated with growth. Boone (1996) also reports result on the effect of aid on social development. We discuss the differences between our results and those obtained by Boone in the text.

(denoted by ΔL) rather than levels of the social indicators (INF, LIF and PRI) as dependent variables in equation (5.2) because investment in health care and education takes time.

Previous studies of foreign aid have used a measure of aid that lumps together grants and concessional loans. The World Bank has developed a new data base on foreign aid, where the grant component of each concessional loan has been calculated and added to outright grants to provide a more accurate measure of foreign aid. The raw aid data is in current U.S. dollars. Following Burnside & Dollar (1996), we convert the data into constant 1987 dollars using the unit-value of import price index from the IFS, and divide the converted data by real GDP in constant 1987 prices from the Summers and Heston (Penn World Tables 5.6) data set. This provides a real measure of aid (denoted by AID) that is constant in terms of its purchasing power over a representative bundle of world imports.

We include as control variables in equation (5.1) the log of population ($LPOP$), the log of real GDP per capita, and regional specific dummies for Sub-Saharan Africa (AFR), East-Asia ($ASIA$) and Central America (CAM). In equation (5.2) we include $LGDP$ together with the average terms of trade growth (TT) and the log of the initial value of the explanatory variable. The latter is included to allow for a non-linear response to initial conditions. We expect $LPOP$ to have a negative impact on the disbursement of foreign aid due to a "population bias" in the allocation of aid across recipients [see for instance Trumbull & Wall (1994)]. The three regional dummies are meant to capture donors' strategic interests.[16] $LGDP$ is included in (5.2) to take into account how initial differences in income affect growth in human capital. These control variables are chosen so as to mimic other empirical studies on aid. To minimize problems of reverse causality, they are, unless otherwise noted, measured at the start of the time period.

5.1. Empirical results

Since c_{it-1} in (5.1) is a predetermined variable, equations (5.1)-(5.2) define a recursive system in which there is unidirectional dependency among the endogenous variables. Hence, as long as there are no contemporaneous correlation between ε^a and ε^n, i.e. $E[\varepsilon^a \varepsilon^n] = 0$, OLS applied to equation (5.1) and (5.2) separately is a consistent and efficient estimator. Table 1 shows the result of least squares estimation.

The composite measure of recipients' needs is highly significant, and with the predicted sign. The magnitude of this effect is considerable. A one-standard deviation decrease in the recipient's needs measure, RN, is associated with an

[16] European countries direct most aid to Sub-Saharan Africa, Central America is in the U.S. sphere of influence, and Japan directs most of its aid towards East Asia.

increase in the inflow of constant aid with 1.24 percent of real GDP. In accordance with previous empirical findings, there also seems to be a population bias present in the overall allocation of aid. The coefficient on $LPOP$ is negative and highly significant, indicating that smaller countries on average receive more aid. Apart from these two variables, only the dummy variable for East Asia is significantly different from zero.

Table 1

	AID	$\Delta LPRI$	$\Delta LLIF$	$\Delta LINF$	AID
Expl.var.	(1a)	(1b)	(1c)	(1d)	(1e)
$LPOP$	-2.12**				-1.73**
	(0.39)				(.28)
RN	-1.24**				-1.34**
	(0.27)				(.22)
AFR	.70				.37
	(.53)				(.40)
$ASIA$	.99*				.80*
	(.46)				(.40)
CA	-.57				-.38
	(.35)				(.34)
$LGDP$		.04	.01	.003	
		(.03)	(.01)	(.002)	
TT		.26	.04	.013	
		(.14)	(.02)	(.008)	
AID		-.18	.007	-.02	
		(.41)	(.04)	(.013)	
$LPRI_{t-1}$		-.43**			
		(.07)			
$LLIF_{t-1}$			-.09**		
			(.03)		
$LINF_{t-1}$				-.14	
				(.03)	
no. obs.	162	135	176	176	160
adj. R2	0.47	0.47	0.13	0.21	0.53

Note: OLS estimation on pooled (1971-80, 81-90) data. Heteroskedastic-consistent standard errors [White (1980)] in parenthesis. * (**) denote significance at the 5 (1) % level. The coefficients and standard errors on AID are multiplied by 100. Each regression include a constant and a time dummy not reported here.

In column (1b)-(1d) the results of the reverse relationship are depicted. As predicted, in neither of the specifications the coefficient on aid is significant. It is revealing to compare the coefficients on AID and TT. The reason for this is twofold. First, higher export prices are likely to benefit a large part of the poor population (in rural areas) directly, while foreign aid is channeled through the government. Second, since trade taxes are important sources of revenue in many developing countries, TT shows the effect of an exogenous change in government revenue holding the level of aid constant. If aid was treated as a exogenous source of income by the recipient governments, the government induced impact on poverty reduction from AID and TT should be similar. However, as shown in table 1, the coefficient on TT is positive and significant at the 10 % level in (1b) and only barely insignificant in (1c)-(1d), while the signs on AID are highly insignificant and in fact even negative in two specifications. These findings suggest that the aid relationship might create adverse incentive effects that reduce the effectiveness of foreign assistance. Finally, in all specifications the coefficient on the initial value of the dependent variable is negative and highly significant, indicating diminishing marginal returns to human capital.

An important question is whether the results in table 1 are robust to alternative specifications and particular observations. An examination of the residuals [columns (1a)-(1d)] reveals a few outlying observations. However, as shown in column (1e) and table 2, dropping these observations from the sample only strengthen the results.[17] Notice that the effects of TT are positive and highly significant, while the impact of foreign aid is similar to that reported in table 1. This distinction neatly fits the prediction of the model and underlies the general idea of the paper that the aid relationship may create adverse incentive constraints that undermine the overall purpose of assisting the poor.

The results reported in table 1 are also robust to alternative specifications. For example, we included two more dummy variables to proxy for recipients' needs: Egypt (which receives a large share of U.S. aid) and Franc zone (which gets special treatment from France), as well as a measure of arms imports as a share of total imports lagged one period. We also added two variables to equation (5.2) to proxy for political polarization and instability that might influence the allocation of public funds: ethnolinguistic fractionalization and frequency of major cabinet changes.[18] Moreover, we included the square of the log of real GDP per capita to capture the potentially non-linear relationship between initial income and human capital accumulation. The results can be summarized as follows. The highly significant effect of recipients' needs motives on foreign aid disbursements

[17] Only the results on TT and AID are shown in table 2. The full regression results are available on request.

[18] See Easterly & Levine for a discussion of the impact of ethnolinguistic fractionalization and Svensson (1996) for a model of aid and the allocation of public funds under a divided policy process.

continues to hold, while AID is insignificantly different from zero in all three specifications. All three proxies for donors' interest have the right sign, but only the dummy variable for Egypt is significant at conventional levels. The political variables are in two out of three specifications insignificant and initial income seems to have a non-linear effect on human capital accumulation: the square of the log of real GDP is significantly negative.

So far we have carried out the analysis under the assumption that $E[\varepsilon^a \varepsilon^n] = 0$. However, if this is not true a_{it} and ε^n_{it} may be contemporaneously correlated, implying that OLS is an inconsistent estimator. We can test for contemporaneous correlation between the two equations using the Langrange multiplier statistic suggested by Breusch & Pagan (1980). For the bench-mark specifications, columns (1a)-(1b:d) the statistics are [0.16 5.24 1.86]. The 5 % critical value from the $\chi^2_{(1)}$-distribution is 3.84, implying that the null hypothesis of no contemporaneous correlation is rejected in one out of three cases. One way to cope with contemporaneous correlation is to jointly estimate the model (5.1)-(5.2). Table 3 reports the result on the human development indicators of 2SLS regressions. As evident the results are similar to those reported in table 2.

Table 2

	$\Delta LPRI$	$\Delta LLIF$	$\Delta LINF$
Expl.var.	(2a)	(2b)	(2c)
AID	-.10	-.04	-.04*
	(.42)	(.03)	(.02)
TT	.30*	.029*	.025**
	(.13)	(.015)	(.007)
no. obs.	133	171	125
adj.R2	0.55	0.16	0.37

Note: OLS estimation on pooled (1971-80, 81-90) data. Heteroskedastic-consistent standard errors [White (1980)] in parenthesis. * (**) denote significance at the 5 (1) % level. The coefficients and standard errors on AID are multiplied by 100. Each regression include a constant, time dummy, and the same regressors as in column (1b) not reported here.

The results reported above differ partly from those obtained by Boone (1996). Boone finds no evidence that the poor benefits from aid, nor that aid is primarily motivated to assist the poor. On the contrary we find a robust relationship between aid flows and recipients' needs. The reason for this difference is threefold. First, we use a different data set which only includes foreign aid in the form of grants (cf. discussion above). Second, we explicitly test a simultaneous system. Finally, we construct a composite measure of recipients' needs to avoid multicollinearity among the different social and economic indicators.

In summary, the data reveals a positive and robust effect of recipients' needs on the allocation of foreign aid. At the same time, there is no evidence that these aid flows have helped the poor. This result is even more striking when compared to an exogenous increase in income (due to a change in terms of trade), which have a positive impact on the welfare of the poor. One, but not the only, interpretation of these findings is that aid is (partly) motivated to assist the poor, and that the anticipation of this adversely affects the recipient governments' incentives to carry out policies that would alleviate poverty. Overall, these findings stress the importance of viewing aid flows and macroeconomic outcome as a simultaneous relation.

Table 3

Expl.var.	$\Delta LPRI$ (3a)	$\Delta LLIF$ (3b)	$\Delta LINF$ (3c)
$LGDP$	.63	.19**	.05*
	(.57)	(.07)	(.02)
$LGDP^2$	-.09	-.03**	-.008*
	(.09)	(.01)	(.003)
TT	.27*	.030	.016*
	(.13)	(.021)	(.008)
AID	-.41	-.13	-.06*
	(.63)	(.08)	-.02
$LPRI_{t-1}$	-.46**		
	(.07)		
$LLIF_{t-1}$		-.08	
		(.03)	
$LINF_{t-1}$			-.13**
			(.03)
no. obs.	135	101	159

Note: White's Two-Stage-Instrumental-Variable estimation [White (1980)] on pooled (1971-80, 81-90) data. * (**) denote significance at the 5 (1) % level. The coefficients and standard errors on AID are multiplied by 100. Each regression include a constant and a time dummy not reported here.

6. Conclusion

The present model has abstracted from a number of issues influencing the game between the donor and the recipient. The analysis may therefore be biased and it would be inappropriate to draw definite conclusions, let alone to make final policy recommendations. Nevertheless, some important insights emerge from the analysis. First it is shown that one reason for the poor aggregate record of foreign aid may be a moral hazard problem that adversely affects the aid recipients' incentives to undertake structural reforms. In principle, conditionality could partly solve the problem, but this requires a strong commitment ability by the altruistic donor. Contrary to conventional wisdom in the aid literature, we show that without such a commitment technology, delegation of part of the aid budget to an international agency with less aversion to poverty as well as tied project aid may improve welfare for all parties.

The empirical implication of the model is that aid (partly) is allocated according to the needs of the poor, and the anticipation of this adversely affects the recipients' incentives to carry out policies that would improve the poor's welfare. We provide some preliminary support for this conjecture. In particular we show that the effects of an exogenous change in income (due to variations in the terms of trade) is distinctively different from the effects of changes in foreign aid, indicating that the aid relationship may create adverse incentive constraints undermining the overall purpose of assisting the poor.

By looking at a two-period model we have disregarded reputational forces. The fact that the donor and the recipients interact repeatedly, may create forces that can substitute for commitment. On the other hand, these forces may not be strong enough to sustain the second-best outcome, since the donor and the recipient governments can communicate and renegotiate pledged commitments, which undermines the threat of punishment [see Fundenberg & Tirole (1992) for a textbook treatment of these issues].

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A. Appendix

A.1. Optimal contract when adjustment effort is verifiable

The first-order conditions with respect to $a_1(s)$ are:

$$Q(s)\left[u'\left(C_1(s)\right)h'\left(a_1(s)\right)-u'\left(C_2(s)\right)h'\left(a_2(s)\right)\right] \tag{A.1}$$

$$+2Q(s)\left[\lambda_1 u'\left(C_1(s)\right)h'\left(a_1(s)\right)-\lambda_2 u'\left(C_2(s)\right)h'\left(a_2(s)\right)\right]=0, \text{ for all } s\in S$$

where λ_i is the Lagrange multiplier associated with the IR-constraint. By symmetry, $\lambda_i = \lambda$ in equilibrium. By concavity of $u(\cdot)$ it is the only solution. Thus, the first-best equilibrium entails full consumption smoothing across countries, independent of q and φ. At an optimum, the marginal utility of aid is equalized across countries in all states. That is: $a_1^1(s) = A/2$, for all $s \in S_s$, and $a_1^1(\beta,\gamma) = a_2^1(\gamma,\beta) > A/2$, and $a_1^1(\gamma,\beta) = a_2^1(\beta,\gamma) < A/2$.

Denote the equilibrium without aid with superscript 0. Since the donor does not derive any utility from government consumption, the IR-constraints bind in equilibrium. Hence, the optimal amount of effort (or investment) is implicitly defined by the individual rationality constraint (2.6). That is:

$$\begin{aligned}&\left[q(k_1)\Omega_1^1+(1-q(k_1))\,\Lambda_1^1\right]-2\left[q(k^0)u(\tfrac{1}{2}\gamma)+(1-q(k^0))\,u(\tfrac{1}{2}\beta)\right]\\&=\varphi(k_1-k^0+\Delta d_i)\end{aligned} \tag{A.2}$$

where $d_{i1}^0 \equiv v_c^{-1}(\varphi)$ and $\Delta d_i \equiv (d_{i1}^* - d_{i1}^0) < 0$, and where:

$$\Omega_1^1 \equiv 2q(k_2)u\left(C_1^1(\gamma,\gamma)\right) + 2(1-q(k_2))\,u\left(C_1^1(\gamma,\beta)\right) \tag{A.3}$$

$$\Lambda_1^1 \equiv 2q(k_2)u\left(C_1^1(\beta,\gamma)\right) + 2(1-q(k_2))\,u\left(C_1^1(\beta,\beta)\right) \tag{A.4}$$

Suppose that $k_1 = k_1^0$. Then since $\Omega_1^1 > u(\frac{1}{2}\gamma)$ and $\Lambda_1^1 > u(\frac{1}{2}\beta)$ the left-hand side of (A.2) is strictly positive. So $k_1 \neq k_1^0$. Because the left-hand side of (A.2) is an increasing and concave function of k_1, we know there, at the most, exists two effort levels, $k_1 > k_1^0$ and $k_1 < k_1^0$, such that (A.2) holds. Note that the donor's welfare is strictly increasing k_1. Hence, $k_1^1 > k_1^0$. Because of symmetry and concavity of q, $k_1^1 = k_2^1 = k^1$.

A.2. Optimal contract when adjustment effort is not verifiable

For a given level of adjustment effort, $k_i = \bar{k}$, the optimal contract is found by solving the following maximization program:

$$\max_{\{\mathbf{a}_1,\mathbf{a}_2\}} \sum_{i=1}^{2}\sum_{s\in S}\bar{Q}(s)u\left(C_i(s)\right) \tag{A.5}$$

s.t. (2.5), (2.6), and:

$$2\sum_{s\in S}\bar{Q}(s)u\left(C_i(s)\right) - \varphi\bar{k} \geq 2\sum_{s\in S}Q(s)u\left(C_i(s)\right) - \varphi k_i,\ \forall k_i \in [0,y] \tag{A.6}$$

where $\bar{Q}(s)$ denotes the probability of aggregate state s, given adjustment level $\bar{k}$. Since $q(k)$ is concave and differentiable, and the total development spending scheme is non-decreasing, the indirect utility function $W(k_i,k_j)$ is concave and differentiable. The infinite set of relative incentive constraints for recipient i, given in (A.6), can therefore be replaced with a single "first-order constraint" [see Laffont (1989) for the validity of the first-order approach]:

$$q'(\bar{k})\left[\Omega_i - \Lambda_i\right] = \varphi, \quad i = 1,2 \tag{A.7}$$

where Ω_i and Λ_i are defined in section 2.3. The Lagrangian for this problem is:

$$\max L(\mathbf{a}_1,\boldsymbol{\lambda},\boldsymbol{\nu}) = \sum_{i=1}^{2}\sum_{s\in S}\bar{Q}(s)u\left(C_i(s)\right) \tag{A.8}$$

$$+\lambda_1\left[v\left(\bar{c}\right) + \varphi[y - d_{i1}^* - \bar{k}] + 2\sum_{s\in S}\bar{Q}(s)u\left(C_1(s)\right)\right]$$

$$+\lambda_2\left[v\left(\bar{c}\right) + \varphi[y - d_{i1}^* - \bar{k}] + 2\sum_{s\in S}\bar{Q}(s)u\left(C_2(s)\right)\right]$$

$$+\nu_1\left[q'(\bar{k})\left(\Omega_1-\Lambda_1\right)\right]+\nu_2\left[q'(\bar{k})\left(\Omega_2-\Lambda_2\right)\right]$$

The first-order conditions are:

$$\bar{Q}(s)[u'\left(C_1(\gamma,\gamma)\right)h'\left(a_1(\gamma,\gamma)\right)-u'\left(C_2(\gamma,\gamma)\right)h'\left(a_2(\gamma,\gamma)\right)] \tag{A.9}$$

$$+2\bar{Q}(s)[\lambda_1 u'\left(C_1(\gamma,\gamma)\right)h'\left(a_1(\gamma,\gamma)\right)-\lambda_2 u'\left(C_2(\gamma,\gamma)\right)h'\left(a_2(\gamma,\gamma)\right)]$$

$$+2q'(e)q(e)[\nu_1 u'\left(C_1(\gamma,\gamma)\right)h'\left(a_1(\gamma,\gamma)\right)-\nu_2 u'\left(C_2(\gamma,\gamma)\right)h'\left(a_2(\gamma,\gamma)\right)]=0$$

$$\bar{Q}(s)[u'\left(C_1(\beta,\beta)\right)h'\left(a_1(\beta,\beta)\right)-u'\left(C_2(\beta,\beta)\right)h'\left(a_2(\beta,\beta)\right)] \tag{A.10}$$

$$+2\bar{Q}(s)[\lambda_1 u'\left(C_1(\beta,\beta)\right)h'\left(a_1(\beta,\beta)\right)-\lambda_2 u'\left(C_2(\beta,\beta)\right)h'\left(a_2(\beta,\beta)\right)]$$

$$-2q'(e)\left(1-q(e)\right)[\nu_1 u'\left(C_1(\beta,\beta)\right)h'\left(a_1(\beta,\beta)\right)-\nu_2 u'\left(C_2(\beta,\beta)\right)h'\left(a_2(\beta,\beta)\right)]=0$$

$$\bar{Q}(\gamma,\beta)[u'\left(C_1(\gamma,\beta)\right)h'\left(a_1(\gamma,\beta)\right)-u'\left(C_2(\gamma,\beta)\right)h'\left(a_2(\gamma,\beta)\right)] \tag{A.11}$$

$$+2\bar{Q}(\gamma,\beta)[\lambda_1 u'\left(C_1(\gamma,\beta)\right)h'\left(a_1(\gamma,\beta)\right)-\lambda_2 u'\left(C_2(\gamma,\beta)\right)h'\left(a_2(\gamma,\beta)\right)]$$

$$+2q'(\bar{e})[\nu_1(1-q(\bar{e}))u'\left(C_1(\gamma,\beta)\right)h'\left(a_1(\gamma,\beta)\right)+\nu_2 q(\bar{e})u'\left(C_2(\gamma,\beta)\right)h'\left(a_2(\gamma,\beta)\right)]=0$$

$$\bar{Q}(\beta,\gamma)[u'\left(C_1(\beta,\gamma)\right)h'\left(a_1(\beta,\gamma)\right)-u'\left(C_2(\beta,\gamma)\right)h'\left(a_2(\beta,\gamma)\right)] \tag{A.12}$$

$$+2\bar{Q}(\beta,\gamma)[\lambda_1 u'\left(C_1(\beta,\gamma)\right)h'\left(a_1(\beta,\gamma)\right)-\lambda_2 u'\left(C_2(\beta,\gamma)\right)h'\left(a_2(\beta,\gamma)\right)]$$

$$-2q'(\bar{e})[\nu_1 q(\bar{e})u'\left(C_1(\beta,\gamma)\right)h'\left(a_1(\beta,\gamma)\right)+\nu_2(1-q(\bar{e}))u'\left(C_2(\beta,\gamma)\right)h'\left(a_2(\beta,\gamma)\right)]=0$$

The constraints are given by (2.6), (A.7) and the inequality constraints:

$$\lambda_i\geq 0,\ \ \nu_i\geq 0\quad i=1,2 \tag{A.13}$$

and the four complementary slackness conditions are:

$$\lambda_i\left[v\left(\bar{c}\right)+\varphi[y-d_{i1}^*-\bar{k}]+2\sum_{s\in S}Q(s)u\left(C_i(s)\right)-Ew_i^0\right]=0,\ \ i=1,2 \tag{A.14}$$

$$\nu_i[q'(\bar{e})\left(\Omega_i-\Lambda_i\right)-\varphi]=0,\quad i=1,2 \tag{A.15}$$

By symmetry, $\lambda_i=\lambda$, $\nu_i=\nu$ and $C_i(\gamma,\beta)=C_j(\beta,\gamma)$ for $i=1,2$, $j=1,2$, $i\neq j$. By concavity of $u(\cdot)$ it is the only solution. Exploiting the symmetry of the model to simplify, the first-order conditions of the program can be written as:

$$[(1+2\lambda)Q(s)+2\nu\hat{p}]\left[u'\left(C_1(s)\right)h'\left(a_1(s)\right)-u'\left(C_2(s)\right)h'\left(a_2(s)\right)\right]=0,\text{ for all } s\in S_s \tag{A.16}$$

and:

$$(1+2\lambda)Q(s)\left[u'\left(C_1(s)\right)h'(a_1(s))-u'\left(C_2(s)\right)h'(a_2(s))\right]+ \tag{A.17}$$

$$2\nu\pi q'(e)\left[\check{p}u'\left(C_1(s)\right)h_1'(a_1(s))+(1-\check{p})u'\left(C_1(s)\right)h_2'(a_2(s))\right]=0,\text{ for all } s\in S_a$$

In a symmetric equilibrium, $\lambda_i=\lambda$ and $\nu_i=\nu$. The variables $\hat{p}$ and $\check{p}$ are defined as:

$$\hat{p}=\begin{cases} q'(k)q(k) & \text{in state }(\gamma,\gamma)\\ -q'(k)(1-q(k)) & \text{in state }(\beta,\beta)\end{cases}\qquad \check{p}=\begin{cases} q(k) & \text{in state }(\beta,\gamma)\\ (1-q(k)) & \text{in state }(\gamma,\beta)\end{cases} \tag{A.18}$$

and $\pi = 1$ in state (γ, β) and $\pi = -1$ in state (β, γ). We denote the second-best equilibrium with superscripts 2.

If the IC-constraints do not bind, then the first-order conditions result in the first-best levels of aid flows. Hence, when there are no incentive problems, the optimal arrangement implies equalization of the marginal utilities of aid. However, when the IC-constraints do bind, implying that $\nu > 0$, the level of aid depends on the probability function q, as well as the risk aversion of the donor, the marginal utility of non-development spending, φ, and the difference between good and bad states.

To pin down the optimal effort level, we define the optimal aid flows as a function of $\mathbf{k}$ as $a_i(s, \mathbf{k})$, where $\mathbf{k} = [k_1 \; k_2]$ is a vector of adjustment effort levels. This function is implicitly given by the first–order conditions (A.16)-(A.17). Note that, independent of $\mathbf{k}$, $a_i(s, \mathbf{k}) = \frac{1}{2}A$ for all $s \in S_s$. By differentiating the IC-constraints (A.7) and invoking the donor's budget constraint, we have:

$$\frac{d}{dk_1}\left[a_1\left((\gamma,\beta),\mathbf{k}\right)\right] \equiv a_1'\left((\gamma,\beta),\mathbf{k}\right) = -a_1'\left((\beta,\gamma),\mathbf{k}\right) > 0 \qquad \text{(A.19)}$$

and symmetrically for $a_2(s, \mathbf{k})$. That is, in order to induce the recipients to exert higher effort, the donor must lower the level of aid to countries with fiscal difficulties and increase aid to countries in less need. By substituting $a_i(s, \mathbf{k})$ for a_i in (A.5), and using the budget constraint to substitute for $a_2(s, \mathbf{k})$, expected utility can be expressed as a function of $\mathbf{k}$ only. Maximizing W_1 with respect to k_1 results in the following first-order condition:

$$2q'(k_1)\left[\sum_{i=1}^{2}\left[q(k_2)\left(u\left(C_i(\gamma,\gamma)\right) - u\left(C_i(\beta,\gamma)\right)\right) + \left(1-q\left(k_2\right)\right)\left(u\left(C_i(\gamma,\beta)\right) - u\left(C_i(\beta,\beta)\right)\right)\right]\right]$$

$$+\sum_{s\in S_a} Q(s)a_1'(s,\mathbf{k})\left[u'\left(C_1(s)\right)h'(a_1(s)) - u'\left(C_2(s)\right)h'(a_2(s))\right] = 0 \qquad \text{(A.20)}$$

and symmetrically for k_2. Equation (A.20) compares the marginal gain of increased effort, the first term, with the expected marginal cost, the last term. The marginal gain takes the form of increased expected consumption since the likelihood of the good states increase. The cost arises because the marginal utilities of aid across the two countries are not equalized. Thus, the cost is the relative loss of not giving aid to those in most need. Notice that if the disbursement of aid follows the first-best allocation, the second term in (A.20) will vanish. In that case, the first-order condition (A.20) is strictly positive for all k. Hence, when k is not verifiable, it is no longer optimal for the donor to allocate aid so as to smooth public consumption of the poor.

Given that assumption 1 holds, it is now straightforward to show that the IR-constraints never bind. From the IC-constraints it follows that it is possible to implement $k_i > k_i^0$ only if more aid is given to the country in good state than to the country in bad state. However, by assumption this is not optimal. Consequently, the recipient governments are strictly better off in the second-best equilibrium than in the equilibrium without aid.

A.3. Proof of Lemma 3.4

The IC-constraint for recipient i in the cooperative environment is found by maximizing the sum of the two recipients expected utility with respect to k_i. That is:

$$\max_{\{k_1,k_2\}} \sum_{i=1}^{2} \sum_{s\in S} [v(\bar{c}) + \varphi(y - d_{i1}^* - k_i) + Q(s)u(C_i(s))] \tag{A.21}$$

Using the assumption of symmetry, the IC-constraint for recipient 1 can be stated as:

$$2q'(k_1)[\Omega_1 - \Lambda_1] + 2q'(k_1)[u(C_1(\beta,\gamma)) - u(C_1(\gamma,\beta))] = \varphi \tag{A.22}$$

Equation (A.22) has the same interpretation as the IC-constraint (2.7), except that now the benefit of higher adjustment effort also accrue to recipient 2. In the cooperative environment the benefits of higher adjustment effort are fully internalized. Hence, the left hand side of (A.22) is basically two times the left hand side of equation (2.7).The first-order condition with respect to k_1 in the cooperative outcome is given in (A.22).

To prove that $k_i > k_i^3$, we can rewrite (A.22) as:

$$\varphi - q'(k_1)\left[\Omega_1^1 - \Lambda_1^1\right] = q'(k_1)\Upsilon_1 \tag{A.23}$$

where $\Upsilon_1 > 0$ is defined as:

$$\begin{aligned} \Upsilon_1 = \quad & 2q(k_2)[u(C_1(\gamma,\gamma)) - u(C_1(\gamma,\beta))] + \\ & 2(1-q(k_2))[u(C_1(\beta,\gamma)) - u(C_1(\beta,\beta))] \end{aligned} \tag{A.24}$$

Suppose that $k_1 = k_1^3$. Then the left-hand side of (A.23) is zero, while $q'(k_1)\Upsilon_1 > 0$. Hence, $k_1 \neq k_1^3$. Suppose instead that $k_1 < k_1^3$. As the right-hand side of (A.23) is falling in k_1 while the left-hand side is increasing, this cannot be true either. Thus, $k_1 > k_1^3$. Because of symmetry, $k_1 = k_2$.

A.4. Proof of Corollary 4.6

For a given k and t^*, denoted by $\bar{t}^*$, a higher μ implies a smaller A^n from (4.8). This in turn results in lower net-aid flows. That is, $a_i(s,\mu) < a_i(s,\tilde{\mu})\ \forall\ \mu > \tilde{\mu}$ and $\forall\ s \in S$. From (4.13) it follows that:

$$a_2((\gamma,\beta),\mu) = a_1((\gamma,\beta),\mu) + A - 2t \tag{A.25}$$

Assume first that when μ increases t is constant ($= \bar{t}^*$). Then from (A.25):

$$[a_2((\gamma,\beta),\mu) - a_1((\gamma,\beta),\mu)] \tag{A.26}$$

is constant. Assume instead that $t > \bar{t}^*$ then:

$$[a_2((\gamma,\beta),\mu) - a_1((\gamma,\beta),\mu)] \tag{A.27}$$

falls. However, evaluating the effects of a reduction in A^n from the IC-constraint (4.6), we obtain:

$$\frac{d}{dA^n}\left[a_2\left((\gamma,\beta),\mu\right)-a_1\left((\gamma,\beta),\mu\right)\right]>0 \tag{A.28}$$

which contradicts the assumptions that $t \geq t^*$. Hence, when μ increases t^* must fall.

The second part in Corollary 4.6. can be shown by following the same steps as in section 2.4. First, define the optimal aid flows as a function of k and μ: $a_i(s,\mathbf{k},\mu)$. Then, inserting $a_i(s,\mathbf{k},\mu)$ into the donor's expected utility function and taking the first-order condition with respect to k_1 yields:

$$\begin{aligned}
&2q'(e_1)\left[\textstyle\sum_{i=1}^{2}\left[q\left(u\left(C_i(\gamma,\gamma)\right)-u\left(C_i(\beta,\gamma)\right)\right)+(1-q)\left(u\left(C_i(\gamma,\beta)\right)-u\left(C_i(\beta,\beta)\right)\right)\right]\right] \\
&+a_1'(s,\mathbf{k},\mu)\Big[Q(\gamma,\beta)\left(u'\left(C_1(\gamma,\beta)\right)h'(a_1(\gamma,\beta))-u'\left(C_2(\gamma,\beta)\right)h'(a_2(\gamma,\beta))\right) \\
&-2\frac{1+\mu}{1-\mu}\left(u'\left(C_1(\beta,\gamma)\right)h'(a_1(\beta,\gamma))-u'\left(C_2(\beta,\gamma)\right)h'(a_2(\beta,\gamma))\right)\Big]=0
\end{aligned} \tag{A.29}$$

where the first term in bracket is positive and the second negative, and where $q=q(k_2)$. An increase in μ implies that the first term in the brackets in (A.29) will fall since the net level of aid will fall.[19] Moreover, a rise in μ would increase the second term in brackets in absolute values. Moreover, since $\frac{d}{dk_1}a_1((\gamma,\beta),\mathbf{k},\mu)>0$ and $q''(k_1)<0$, k_1 must fall in order to restore the equilibrium condition (A.29) when μ increases.

[19] An increase in μ cannot be completely crowded in by a reduction in t, since then $a_1\left((\gamma,\beta),\mu\right)$ would not change, implying that t would increase - a contradiction.

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