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Abstract

There exists ample evidence that the provision of official (governmental) aid relative to private aid to developing countries varies considerably between donor countries. A multi-household model of official and private aid provision is put forward to explain the said differences. The latter are explained in terms of different political economy equilibria, differences in country size and donor/non-donor household composition, the distribution of income in the donor country as well as differences in the extent of the coordination of private aid provision. The interaction between the government and the two types of donor households is modelled first as a simultaneous game and then as a two stage game in which the government or a donor group has a first mover advantage.

1 Introduction

The effects of international income transfers have been studied for more than seventy years in a huge and still growing literature. Some of the early literature is reviewed by Bhagwati, Brecher and Hatta (1984). Recent surveys are provided by Kemp (1992) and Brakman and van Marrewijk (1998). One of the most cited results of this literature is the so-called transfer paradox; i.e. donor enrichment and recipient impoverishment as a result of the transfer.[1] Recent contributions to this literature have focussed on the tying of aid,[2] and the allocation of aid to several recipient countries.[3]

One of the striking facts about foreign aid provision is that the ratio of official to private aid provision varies enormously between aid providing countries (see Appendix A for details).[4] Consider, for example, the cases of two of the major donor countries, Japan and the United States. In Japan the magnitude of official aid is 40 to 50 times higher than that of private aid. In sharp contrast, the ratio of official to private aid in the United States is about 3. As can be seen from the table in Appendix A, there are not only big differences in the relative importance of official aid between the aid providing countries but private aid provision plays an important part in several donor countries apart from the United States which has already been mentioned (Germany and the United Kingdom, for example). Given this fascinating diversity, it is therefore interesting to see if economic theory can explain the stylized facts. In this context one of the key shortcomings of the received literature is its failure to distinguish between official and private aid.

Our main purpose is to develop a multi-household model which can explain the differences in the relative importance of official aid in terms of free riding on non-donors (which contribute through taxes) and other donors in a simultaneous game equilibrium with three

[1] The seminal article is by Samuelson (1954). Paradoxes in distortion-free and distorted economies were also demonstrated by, for example, Ohyama (1974), Brecher and Bhagwati (1982), Bhagwati, Brecher and Hatta (1983 & 1985), Dixit (1983), Jones (1985), Turunen-Red and Woodland (1988), Kemp and Wong (1993) and very recently Yano and Nugent (1999).

[2] On the implications of the tying of aid, see, for example, Kemp and Kojima (1985), Schweinberger (1990), Lahiri and Raimondos (1995), Lahiri and Raimondos-Møller (1997) and very recently, Lahiri et al (2002).

[3] A very recent contribution which focuses on the allocation of aid determined, *inter alia*, by lobbying by ethnic groups is Lahiri and Raimondos-Møller (2000).

[4] Official aid is taken to be all governmental aid to developing countries including those channeled via NGO's (non-governmental organizations). Private aid is the aid provided by NGO's net of government subsidies.

players: two different types of donors and the government. Countries differ in terms of size and household composition (especially between donors and non-donors). We then consider differences in the distribution of income among the donor households as well as different degrees of coordination of private aid provision. The government finances official aid by means of an income tax which is levied on all the household types.

The importance of political factors in the shaping of economic policies is now well recognized. Rodrik (1995) surveys various approaches of modelling political economic interactions between the government and private agents.[5] In particular, he distinguishes between demand and supply determined political economy equilibria. We follow his suggestion and model a political economy equilibrium in terms of a first mover advantage of the government or a donor group in the context of a two stage non-cooperative game. The well-known concept of political markets then corresponds to the simultaneous game equilibrium, which forms the benchmark case in our analysis.

Last, but not least, it should be emphasized that our overall approach is related to the literature on the provision of public goods by the government and from voluntary contributions of private agents. The public good in our case is the utility of the recipient country which appears as an argument in the utility functions of the donor households.[6] However, there are key differences between our paper and this literature in terms of the focus of analysis and in terms of model formulation. To be more specific, the main focus of analysis in this paper is to explain the nature of the equilibrium in terms of a number of factors outline above, and not to examine the welfare effects of policy reforms as is the case in the above-mentioned literature on public goods. As for the modelling, our approach here is to consider political economy equilibria in simultaneous and two stage games. In doing so, we assume the existence of a political support function *a la* Long and Vousden (1991).

There is another strand in the literature on foreign aid that also treats foreign aid as a public good (see, for example, Olson and Zeckhauser (1966) and Dudley (1979)) as we do here. Olson and Zeckhauser (1966) proposed a theory of alliances to explain the allocation

[5] Rodrik (1995) also provides a brief survey of empirical work on international political economy.

[6] Recent contributions to this interesting literature include Itaya et al (1997), Boadway and Hayashi (1999), and Cornes and Sandler (2000).

of defense expenditures among Western nations in NATO. In particular their concern was to find reasons why small countries tend to be free riders in international organizations. Dudley (1979) extended this framework and applied it to multilateral foreign aid. There are a number of differences between our approach and the above mentioned articles. Most importantly, neither Olson and Zeckhauser (1966) nor Dudley (1979) focus on the interaction between the government and private agents as we do. Also, we consider many types of political economy equilibria which play no role in the said articles.

The paper consists of six sections. In section 2 we consider our benchmark model in which there are no groups and private and public donors play a simultaneous game. We compare this equilibrium with another one in which the government has a first mover advantage. We also analyze how exogenous changes in official aid (financed with the help of income tax levied by the government) affect the private aid provision as well as the amount of total aid (private and official).

In particular we focus on a rather neglected concept of crowding out in the simultaneous game equilibrium. We derive precise conditions under which the total amount of foreign aid is provided either only by private donors or only by the government. The strategic interactions between the two potential donor households with each other on the one hand and with the government on the other play a key part in this context.

In section 3 we examine the effects of differences in the size of countries and the household composition of countries on the provision of aid in various simultaneous game equilibria.

Section 4 focuses on the distribution of income among the household types in the donor country and how this affects the official/private aid mix in the context of our benchmark model. In particular we prove the counterintuitive result that a change in the distribution of income in favor of the donor household with the strongest preferences for foreign aid lowers rather than raises foreign aid.

In section 5 the effects of coordination in the provision of private aid on private and official aid are considered. We compare the simultaneous game equilibrium with perfect coordination within each donor type and between the donor types with the simultaneous game equilibrium without coordination.

The main results of the paper are summarized in section 6, which also provides a very tentative interpretation of the stylized facts in the light of the theoretical analysis, and points out a number of possible extensions.

2 The Model, Crowding Out and Political Economy

This section is subdivided into two subsections 2.1 and 2.2. The basic properties of the model as well as the key assumptions are explained in subsection 2.1. In this subsection the income tax rate(s) levied by the government on the various household types are exogenous. Subsection 2.2 endogenizes the tax rates and analyzes properties of the simultaneous game equilibrium. The simultaneous game equilibrium is also compared in subsection 2.2 with an equilibrium where the government has a first mover advantage.

2.1 Exogenous official aid

As explained in the introduction, the focus of this paper is on the relationship between official and private aid, a topic which in spite of its importance has not any received any attention in the literature on foreign aid.[7]

To this end we now put forward a simple model of a multi-household donor economy.[8] There are four types of households: three domestic and one foreign. One of the domestic household types – labeled household of type 1 – does not donate at all; but the other two domestic household types – labeled type 2 and 3 – at least potentially do. The three domestic household types differ in terms of preferences and incomes. The government may or may not provide official aid. If it does, it levies a proportionate income tax on all domestic households. The utility functions of the three domestic household types are assumed to take

[7] Since writing the paper, an empirical paper on private and official aid has been brought to our attention, see Hayashi (2002).

[8] Possible extensions of our model are pointed out in the last section of the paper.

the following forms:

$$W_1 = V_1[(1-\alpha)\bar{Y}_1], \tag{1}$$

$$W_2 = V_2[(1-\alpha)\bar{Y}_2 - F_2] + \lambda_2 U[\alpha\bar{Y} + F_2 + F_2^-], \tag{2}$$

$$W_3 = V_3[(1-\alpha)\bar{Y}_3 - F_3] + \lambda_3 U[\alpha\bar{Y} + F_3 + F_3^-], \tag{3}$$

$\bar{Y}_i$ stands for the before-tax income of each household of type i, $i = 1, 2, 3$. The aggregate before-tax income in the donor country is therefore given by, $\bar{Y} = N_1\bar{Y}_1 + N_2\bar{Y}_2 + N_3\bar{Y}_3$. N_i ($i = 1, 2, 3$) stands for the number of households of type i. F_i denotes the amount of private aid given by each household of type i, $i = 2, 3$. The utility function of the recipient household is $U[\alpha\bar{Y} + F_2 + F_2^-]$ (or, equivalently, $U[\alpha\bar{Y} + F_3 + F_3^-]$),[9] where $F_2^- = (N_2 - 1)F_2 + N_3F_3$ and $F_3^- = (N_3 - 1)F_3 + N_2F_2$. Finally note that λ_2 and λ_3 can be interpreted as 'altruism parameters', and that α stands for the rate of the proportionate income tax employed to pay for official foreign aid.[10]

We assume that all the utility functions exhibit positive and diminishing marginal utilities, i.e.

$$V_1^{'} > 0,\ V_2^{'} > 0,\ V_3^{'} > 0,\ U^{'} > 0 \qquad \text{and}$$
$$V_1^{''} < 0,\ V_2^{''} < 0,\ V_3^{''} < 0,\ U^{''} < 0.$$

We also assume that the product and factor markets are perfectly competitive, the economies are small open economies so that the commodity prices are exogenous, and the factor endowments are inelastically supplied. Because of these assumptions, all the income levels, $\bar{Y}$ and $\bar{Y}_i$ ($i = 1, 2, 3$) are exogenous variables in our model.

Initially treating α exogenously, each donor household decides upon an optimal level of private aid treating all the other aid parametrically. Assuming an interior solution, we

[9]In order to avoid unnecessary variables, without any loss of generality we assume that the recipient household has no income other than that received from the donor households.

[10]The assumption that all three household types are taxed at the same rate is relaxed below. An implicit assumption is that donor households generally are households with a higher income than non-donor households.

readily obtain the following first order conditions:

$$\frac{\partial W_2}{\partial F_2} = -V_2^{'} + \lambda_2 U^{'} = 0, \quad \text{and} \tag{4}$$

$$\frac{\partial W_3}{\partial F_3} = -V_3^{'} + \lambda_3 U^{'} = 0. \tag{5}$$

Note that the utility functions of the two donor households, $W_2(.)$ and $W_3(.)$ have a very convenient special property: the changes in the marginal utility brought about by changes in the own contributions always dominate the changes brought about by the changes in the contributions of the other household type, i.e.:

$$\left|\frac{\partial^2 W_2}{\partial {F_2}^2}\right| > \left|\frac{\partial^2 W_2}{\partial F_2 \partial F_3}\right| \text{ and } \left|\frac{\partial^2 W_3}{\partial {F_3}^2}\right| > \left|\frac{\partial^2 W_3}{\partial F_3 \partial F_2}\right|$$

Equations (4) and (5) yield the reaction curves of a household belonging to type 2 and 3 respectively, treating the income tax rate parametrically. It can be easily shown that both reactions functions are downward sloping, implying that the two types of donor households are strategic substitutes in aid giving. It is also to be noted that in this equilibrium, each household free rides on other households, whether they belong to the same type or not. There is therefore an underprovision of private aid (from the point of view of the donor households). As we shall note later on, in the presence of official aid, there is also free riding on the non-donor households, i.e. households of type 1.

Before proceeding further, let us analyze the properties of the equilibrium given by (4) and (5). If V_2 and V_3 have the same functional form, it follows at once that, $\lambda_3 \geq \lambda_2$ implies $V_3^{'} \geq V_2^{'}$ and given the concavity of the function we have:

$$\lambda_3 \geq \lambda_2 \quad \Longrightarrow \quad (1-\alpha)(\bar{Y}_3 - \bar{Y}_2) \leq (F_3 - F_2).$$

From the second inequality, we find that $\bar{Y}_3 > \bar{Y}_2$ implies $F_3 > F_2$. Therefore, we can conclude that if the more altruistic household types are also richer, then each member of this household type will also give more private aid.

We now proceed to prove some basic properties of the model of private and public aid provision treating α, the income tax rate, exogenously.

Differentiating totally equations (4) and (5) we readily obtain:

$$\bar{Y}_2 V_2^{''} d\alpha + V_2^{''} dF_2 = -\lambda_2 U^{''} dT \tag{6}$$

$$\bar{Y}_3 V_3^{''} d\alpha + V_3^{''} dF_3 = -\lambda_3 U^{''} dT \tag{7}$$

$$\text{where} \quad T = \alpha \bar{Y} + N_2 F_2 + N_3 F_3.$$

Dividing (6) and (7) by $V_2^{''}$ and $V_3^{''}$ respectively and multiplying (6) by N_2 and (7) by N_3 we arrive at:

$$dF = -U^{''} \left(\frac{\lambda_2 N_2}{V_2^{''}} + \frac{\lambda_3 N_3}{V_3^{''}} \right) dT - (\bar{Y} - N_1 \bar{Y}_1) d\alpha \tag{8}$$

$$\text{where} \quad F = N_2 F_2 + N_3 F_3.$$

Adding $\bar{Y} d\alpha$ on both sides of (8) and solving for $d \log T / d \log \alpha$ we have:

$$\frac{d \log T}{d \log \alpha} = \frac{\alpha N_1 \bar{Y}_1}{T} \left[\frac{V_2^{''} V_3^{''}}{V_2^{''} V_3^{''} + U^{''} (\lambda_2 N_2 V_3^{''} + \lambda_3 N_3 V_2^{''})} \right] \tag{9}$$

As for total private aid, substituting equation (9) for $dT/d\alpha$ into equation (8) and solving for $d \log F / d \log \alpha$ we find that:

$$\frac{d \log F}{d \log \alpha} = \frac{\alpha \bar{Y}}{F} \left[\frac{V_2^{''} V_3^{''} (\beta_1 - 1) - U^{''} (\lambda_2 N_2 V_3^{''} + \lambda_3 N_3 V_2^{''})}{V_2^{''} V_3^{''} + U^{''} (\lambda_2 N_2 V_3^{''} + \lambda_3 N_3 V_2^{''})} \right] \tag{10}$$

$$\text{where} \quad \beta_1 = N_1 \bar{Y}_1 / \bar{Y} < 1.$$

From equations (9) and (10) we derive our first set of preliminary results.

Proposition 1 *Assume the model of private and official aid provision given by equations (1) to (5).*

(i) As long as $N_1 > 0$, total aid increases with the income tax rate α, and the elasticity of total aid with respect to α is less than the official aid raised from the taxation of the noncontributing household 1 as a proportion of total aid.

(ii) When $N_1 = 0$, a change in α does not affect total aid.

(iii) An increase in α reduces total private aid, and, as long as $N_1 > 0$, the absolute value of

the elasticity of private aid with respect to α is less than the ratio of official to private aid. i.e.,

$$-\frac{d\log F}{d\log\alpha} < \frac{\alpha\bar{Y}}{F}. \tag{11}$$

We now take a closer look at proposition (1) which highlights the crucial role played by the income of household type 1 in the analysis and results. The model described by (1) to (5), as mentioned before, features two different kinds of free riding. It is well known that in any Cournot-Nash equilibrium with voluntary provision of public goods the households free ride on each other (if all of them contribute to the provision of the public good). What is special about the model represented by (1) to (5) is that the donor households (types 2 and 3) free ride on the non-donor household (type 1) if official aid is undertaken. It is this fact which explains why an increase in official aid (induced by an increase in the tax rate) outweighs the resultant decrease in private aid and why an increase in official aid completely crowds out private aid when $N_1 = 0$. Part (ii) of the above proposition can also be explained by appealing to a well known result from the theory of pure public goods, *viz.* the neutrality theorem due to Warr (1983). In the absence of any non-donor, the economy has three groups of agents all of whom provide the public good: the government and the two donor household groups. In this context, an increase in α effectively means a redistribution of income away from the private household groups to the government, and an application of the neutrality theorem implies no change in the total provision of the public good.

It can also be shown that an increase in α must raise W_2 and W_3 (the welfare of the contributing households) even though the underprovision of private aid due to the lack of coordination of aid provision by the contributing households 2 and 3 is exacerbated. If α rises there is an increase in the income transfer from household 1 to the two contributing households. This entails a fall in F_2 and F_3 which ceteris paribus would lower the welfare of the contributing households. However the latter effect is more than offset by the above mentioned transfer effect (which raises the welfare of the contributing households).

Differentiating expressions (2) and (3) totally we obtain:

$$\frac{dW_2}{d\alpha} = \lambda_2 \left[(\bar{Y} - \bar{Y}_2) + (N_2 - 1)\frac{dF_2}{d\alpha} + N_3 \frac{dF_3}{d\alpha} \right] \quad (12)$$

$$\frac{dW_3}{d\alpha} = \lambda_3 \left[(\bar{Y} - \bar{Y}_3) + (N_3 - 1)\frac{dF_3}{d\alpha} + N_2 \frac{dF_2}{d\alpha} \right] \quad (13)$$

Differentiating totally expressions (4) and (5) with respect to α and solving for $dF_2/d\alpha$ and $dF_3/d\alpha$ and finally substituting into equations (12) and (13) we arrive at (for a complete derivation, see Appendix B):

$$\frac{dW_2}{d\alpha} = [U'\lambda_2 N_1 \bar{Y}_1] \left(\frac{V_2'' V_3'' + \lambda_2 V_3'' U''}{D} \right) > 0, \quad (14)$$

$$\frac{dW_3}{d\alpha} = [U'\lambda_3 N_1 \bar{Y}_1] \left(\frac{V_2'' V_3'' + \lambda_3 V_2'' U''}{D} \right) > 0. \quad (15)$$

$$\text{where:} \quad D = V_2'' V_3'' + U''(\lambda_2 N_2 V_3'' + \lambda_3 N_3 V_2'').$$

This completes subsection 2.1. Before considering endogenous determination of α, we would like to note that there is some *prima facie* empirical support for the crowding out result in Proposition I. Of course, the level and composition of aid would depend on a very large number of factors. However, if we consider the two largest donors, viz. Japan and the United States, we find that whereas Japan allocates 0.28% of its GNP for official development assistance, the figure for the United States is only 0.10%. Interestingly, official to private aid ratio for Japan and the United States are 52.41 and 3.29 respectively (see table A in the appendix). Therefore, it seems that official aid in Japan has to some extent crowded out private aid, at least in relation to the United States.

A major limitation of subsection 2.1 is that the government does not figure as a player; hence α is exogenous. We shall show in the following subsection 2.2 that by assigning the government the role of a rational player we can focus on some novel concepts of crowding out of private aid by official aid or vice versa. This seems very important, given the huge variations of the relative importance of official to private aid between countries.

2.2 Endogenous Official aid

Throughout the paper we make use of the following political support function to model the behavior of the government:

$$PS = \bar{N}_1 W_1(.) + \bar{N}_2 W_2(.) + \bar{N}_3 W_3(.) \tag{16}$$

$$\text{where} \quad \bar{N}_1 = N_1/N, \ \bar{N}_2 = N_2/N, \ \bar{N}_3 = N_3/N.$$

This function is closely related to the political support function in Long and Vousden (1991).

We analyze two equilibria. First we focus on the simultaneous game equilibrium with three players: the two (potentially) contributing households 2 and 3 and the government. Then we characterize the equilibrium in which the government has a first mover advantage. In conclusion of section 2 the two equilibria are compared.

An interesting question which arises in the simultaneous game equilibrium is whether the official provision of foreign aid possibly crowds out completely private aid. In particular it may appear plausible that the possibility of crowding out grows if income taxation becomes more personal. By this we mean that we allow for differences in the income tax rate applied to different household types.

Before we state our first main result, Proposition I, we differentiate the political support function, expression (16), with respect to α to obtain the relevant first order condition:

$$\frac{\partial PS}{\partial \alpha} = -\frac{N_1 \bar{Y}_1}{\bar{Y}} V_1' - \frac{N_2 \bar{Y}_2}{\bar{Y}} V_2' - \frac{N_3 \bar{Y}_3}{\bar{Y}} V_3' + U'(\lambda_2 N_2 + \lambda_3 N_3) = 0 \tag{17}$$

Note that the function $PS(.)$ is concave in α because the functions $W_1(.), W_2(.)$ and $W_3(.)$ are concave in α. We now assume that an interior solution of equation (17) for α exists. This implies that equation (17) can be rewritten as follows [taking into account (4) and (5)]:

$$\frac{\partial PS}{\partial \alpha} = -N_1\bar{Y}_1V_1^{'} + U^{'}[\lambda_2N_2(\bar{Y} - \bar{Y}_2) + \lambda_3N_3(\bar{Y} - \bar{Y}_3)] = 0 \tag{17a}$$

Having considered the case where all three households are taxed at the same rate α, we then consider the following two cases of discriminatory taxes: (i) households 2 and 3 are taxed at the same rate α_{23} but household 1 is taxed at the rate $\bar{\alpha}_1$, and (ii) all three household types are taxed at different rates α_1, α_2 and α_3 respectively.

We are now in a position to state Proposition 2

Proposition 2 *If the optimal tax rates are all positive, then*

(a) the imposition of an optimal non-discriminatory income tax rate α^* entails the complete crowding out of either F_2 or F_3 or both if and only if:

$$N_2V_2^{'} + N_3V_3^{'} > \frac{N_1Y_1}{Y}V_1^{'} + \frac{N_2Y_2}{Y}V_2^{'} + \frac{N_3Y_3}{Y}V_3^{'},$$

(b) the imposition of the optimal tax rate α_{23}^* on households 2 and 3, and $\bar{\alpha}_1$ on household 1, entail the complete crowding out of either F_2 or F_3 or both,

(c) the imposition of complete discriminatory optimal tax rates α_1^*, α_2^* and α_3^* entails the complete crowding out of F_2 and F_3.

Proof: see Appendix C.

Proposition 2 contains one important message: the more personalized the income tax rates are the more likely it is that foreign aid will only be provided by the government. This general result follows from the efficiency property built into the political support function. For example, when the government can the three household types at different rates, the optimality of the tax rates imply equalization of the marginal 'direct' utilities of the three households types, and the marginal utility of each donor household is larger than what the optimality of private aid entails(see (61)-(63)). Thus, the donor households cannot raise their welfare by giving private aid. This result may to some extent explain why, compared to the US, the level of private aid is very low in the Scandinavian countries which tend to have more progressive income taxation than the US.

In deriving Proposition 2 we have assumed that it is optimal (in the simultaneous game equilibrium) for the government to provide positive amount of official aid. It is straightforward to show that if private aid is actually provided by households 2 and 3 there will be no official aid in the simultaneous game equilibrium if and only if:

$$N_2 V_2' + N_3 V_3' < \frac{N_1 Y_1}{Y} V_1' + \frac{N_2 Y_2}{Y} V_2' + \frac{N_3 Y_3}{Y} V_3'. \tag{18}$$

Expression (18) is likely to be be satisfied if:

$$\frac{N_1 Y_1}{Y} V_1' \approx V_1', \frac{N_2 Y_2}{Y} \approx 0, \frac{N_3 Y_3}{Y} \approx 0 \text{ and } V_1' > V_2' > V_3'$$

Having characterized the possibility of the crowding out of private by official aid in the simultaneous game equilibrium we now turn to a comparison of the simultaneous game equilibrium with the equilibrium in which the government has a first mover advantage, see the following Proposition 3.

Proposition 3 *Compare two countries in two different political economy equilibria. In one country there is a simultaneous game equilibrium such that official and private aid is undertaken. In the other country the government makes a credible commitment to undertake official aid in the first period and private aid is decided in the second period.*

Then the income tax rate α is lower in the country in which the government has a first mover advantage. The aid receiving country receives less aid from the country where the government has a first mover advantage.

Proof: If households 2 and 3 as well as the government provide aid in the simultaneous game equilibrium we can write:

$$\frac{\partial PS}{\partial \alpha} = -N_1 \bar{Y}_1 V_1' + U' [\lambda_2 N_2 (\bar{Y} - \bar{Y}_2) + \lambda_3 N_3 (\bar{Y} - \bar{Y}_3)] = 0 \tag{19}$$

The equilibrium values for α, F_2 and F_3 are thus determined by equations (4), (5) and (19). Also we have:

$$\frac{\partial PS}{\partial F_2} = U' [\lambda_2 N_2 (N_2 - 1) + \lambda_3 N_3 N_2] > 0 \tag{20}$$

and

$$\frac{\partial PS}{\partial F_3} = U' \left[\lambda_3 N_3(N_3 - 1) + \lambda_2 N_2 N_3\right] > 0 \tag{21}$$

Furthermore:

$$\frac{dPS}{d\alpha} = \frac{\partial PS}{\partial \alpha} + \frac{\partial PS}{\partial F_2}\frac{dF_2}{d\alpha} + \frac{\partial PS}{\partial F_3}\frac{dF_3}{d\alpha} \tag{22}$$

If the latter expression is evaluated in the simultaneous game equilibrium we can write

$$\left.\frac{dPS}{d\alpha}\right|_{\alpha=\alpha^*} = \frac{\partial PS}{\partial F_2}\frac{dF_2}{d\alpha} + \frac{\partial PS}{\partial F_3}\frac{dF_3}{d\alpha} < 0, \tag{23}$$

because of (19), (20), (21) and the fact that $dF_2/d\alpha < 0$, $dF_3/d\alpha < 0$ (see (54) and (55) in Appendix B).

From the concavity of the political support function and (23), it can be inferred that the optimal value of α is lower in the second game, i.e. the game where the government has a first mover advantage, than in the simultaneous game. **Q.E.D.**

Proposition 3 tells us that, contrary to what one might expect, that official aid is less rather than more in the country where the government has a first mover advantage, i.e.: can make a credible commitment to official aid in the first period. However the result that α is lower in the latter case is easy to understand. It follows again from the fact that efficiency plays an important part in the assumed political support function. The government in deciding α takes into account that a rise in α would exacerbate the underprovision of private foreign aid which is due to the strategic interaction between the two donor households.

3 Country Size and Household Composition

The countries listed in Appendix A differ considerably in terms of country size and very plausibly also in terms of household composition. By the latter we mean the relative importance of donors and non-donor households in the population. Our aim in this section is to analyze the effects of differences in country size and household composition (between the countries) on total aid, official and private aid. To focus on essentials we assume a simultaneous game equilibrium. Both donor households 2 and 3 actually provide - in addition to the government foreign aid. The income (poll) tax is the same for all households. It is endogenous. Given these assumptions we can make use of the following two equations:

$$\phi dT - N_1\bar{Y}_1 d\alpha \quad = \quad \alpha\bar{Y}_1 dN_1 + (F_2 + \alpha\bar{Y}_2)dN_2 + (F_3 + \alpha\bar{Y}_3)dN_3 \tag{24}$$

and

$$\gamma U^{''} dT + N_1\bar{Y}_1^2 V_1^{''} d\alpha \quad = \quad V_1^{'}\bar{Y}_1 dN_1 - \lambda_2 U^{'}(\bar{Y} - \bar{Y}_2)dN_2 - \lambda_3 U^{'}(\bar{Y} - \bar{Y}_3)dN_3 \tag{25}$$

where:

$$\begin{aligned}\phi &= [V_2^{''}V_3'' + U^{''}(\lambda_2 N_2 V_3^{''} + \lambda_3 N_3 V_2^{''})]/V_2^{''}V_3^{''} \\ \gamma &= \lambda_2 N_2(\bar{Y} - \bar{Y}_2) + \lambda_3 N_3(\bar{Y} - \bar{Y}_3)\end{aligned}$$

Equation (24) follows from total differentiations of equations (4) and (5) with respect to T, α, N_1, N_2 and N_3; proceeding as in the derivation of equations (6), (7) and (8). Equation (25) follows directly from equation (17a) having substituted for $V_2^{'}$ and $V_3^{'}$ from equations (4) and (5) after total differentiation.

We now turn to the analysis of the effects of differences in the country size on T, α and $F = N_2F_2 + N_3F_3$. First note that the Jacobian determinant of equations (24) and (25) is:

$$D = N_1\bar{Y}_1(\phi\bar{Y}_1 V_1^{''} + \gamma U^{''}) < 0 \tag{26}$$

Since we are interested in the effects of differences in country size we set:

$$\frac{dN_1}{N_1} = \frac{dN_2}{N_2} = \frac{dN_3}{N_3} = \frac{dN}{N} \tag{27}$$

Equation (27) entails that the R.H.S. of equation (25) vanishes and that the R.H.S. of equation (24) can be rewritten as: TdN/N.

It is now straightforward to show that:

$$\frac{dT}{T} = \frac{N_1\bar{Y}_1 V_1^{''}}{\phi N_1\bar{Y}_1 V_1^{''} + N_1\gamma U^{''}}\frac{dN}{N}, \tag{28}$$

and therefore:

$$\frac{dN}{N} > \frac{dT}{T} > 0 \tag{29}$$

Equation (29) represents our first result in section 3. It may be conjectured that the relatively low level of foreign aid provided by large countries such as the USA and the low level of official aid can be explained in terms of expression (29) and the fact that country size crowds out official aid. The latter conclusion follows from equation (25) remembering that the R.H.S. is equal to zero. Equally important it follows at once that country size "crowds in" private aid, i.e.: F rises. These results are now stated as Proposition 4.

Proposition 4 *Assume that the players in the two countries are in a simultaneous game equilibrium in which the two donor households (2 and 3) as well as the government provide foreign aid. The two countries differ in size but not in terms of household composition. Then it follows that official aid is smaller and private aid bigger in the more populous country.*

Proof: see the derivation of equations (24) to (29).

Q.E.D.

We now turn to the effects of differences in the household composition between countries on T, α and F. Setting $dN_2 = dN_3 = 0$ in equations (24) and (25) and solving for $d\alpha/dN_1$, we obtain:

$$\frac{d\alpha}{dN_1} = \frac{(\phi V_1' \bar{Y}_1 - \gamma U'' \alpha \bar{Y}_1)}{D} < 0 \tag{30}$$

Hence we conclude that a country with more noncontributing households provides less official aid. Equation (30) therefore yields another potential (ceteris paribus) explanation of the relatively low level of official aid in the USA.

How will a ceteris paribus greater number of noncontributors N_1 affect total aid? The answer is provided by the following expression (31):

$$dT = \frac{(N_1 \bar{Y}_1)^2 V_1' (1 - \rho \alpha \bar{Y}_1)}{D} \quad \frac{dN_1}{N_1} \tag{31}$$

where $\rho = -\frac{V_1''}{V_1'}$ stands for a well known measure of absolute risk aversion of household 1.

Equations (30) and (31) give rise to the following Proposition 5

Proposition 5 *Assume the players in the two countries are in a simultaneous game equilibrium in which the two donor households 2 and 3 as well as the government provide foreign aid. Further assume that the two countries only differ in terms of the number of non-donors (household 1). Then there is less official aid in the more populous country. Let the symbol* ρ *stand for the absolute risk aversion of household 1, i.e.:* $-V_1''/V_1'$. *Total aid is smaller in the more populous country if and only if:* $0 < \rho\alpha\bar{Y}_1 < 1$. *If* $\rho\alpha\bar{Y}_1 > 1$ *then private foreign aid is bigger in the more populous country.*

Proof: see equations (30) and (31).

Q.E.D.

Proposition 5 is of considerable interest because it explains the crowding out of official aid in terms of the household composition of the country. Furthermore it also highlights the possibility (in contrast to Proposition 4) that the more populous country may provide less rather than more total aid, a counterintuitive result.

It is now convenient to make the following assumption: $\frac{dN_2}{N_2} = \frac{dN_3}{N_3} > 0$. Making use of the first order condition of the maximization of the political support function $PS(.)$ with respect to α (and noting that the donor households as well as the government provide foreign aid) we can rewrite equations (24) and (25) as follows:

$$\phi dT - N_1\bar{Y}_1 d\alpha = T_{23}\frac{dN}{N} \tag{32}$$

$$\gamma U'' dT + N_1\bar{Y}_1^2 V_1'' d\alpha = -N_1\bar{Y}_1 V_1' \frac{dN}{N} \tag{33}$$

where $\frac{dN}{N} = \frac{dN_2}{N_2} = \frac{dN_3}{N_3}$ and $T_{23} = N_2(F_2 + \alpha\bar{Y}_2) + N_3(F_3 + \alpha\bar{Y}_3)$

Solving equations (32) and (33) we readily obtain the expected result that total aid T must rise. However official aid may fall or rise. An increase in donor households has two conflicting effects on α as can be seen from:

$$N_1\bar{Y}_1 V_1' = U'\gamma \tag{34}$$

On the one hand it implies, ceteris paribus, a fall in α because T rises. This entails that U' falls and therefore V_1' must fall (and the disposable income of household 1 rise). On the other hand there is the fact that γ must rise. This leads to the conclusion that ceteris paribus α must rise, because an increase in α lowers the disposable income of household one and therefore raises $V_1^{'}$. To be precise official aid rises if and only if:

$$-\gamma U^{''}T_{23} < \phi N_1 \bar{Y}_1 V_1^{'} \tag{35}$$

In the latter case we obtain the surprising result that the country with the greater number of donor households may provide less private aid than the country with fewer donor households, see the proof below.

Substituting for $dT = \bar{Y}d\alpha + dF$ in equations (32) and (33) we readily arrive at:

$$\phi dF + \bar{Y}(\phi - \frac{N_1\bar{Y}_1}{\bar{Y}})d\alpha = T_{23} \quad \frac{dN}{N} \tag{36}$$

$$\gamma U^{''}dF + \bar{Y}(\gamma U^{''} + \frac{N_1\bar{Y}_1}{\bar{Y}}\bar{Y}_1 V_1^{''})d\alpha = -N_1\bar{Y}_1 V_1^{'} \quad \frac{dN}{N} \tag{37}$$

Solving equations (36) and (37) for dF we have

$$\bar{D}dF = \bar{Y}[T_{23}(\gamma U^{''} + \frac{N_1\bar{Y}_1}{\bar{Y}}\bar{Y}_1 V_1^{''}) + N_1\bar{Y}_1 V_1^{'}(\phi - \frac{N_1\bar{Y}_1}{\bar{Y}})] \quad \frac{dN}{N} \tag{38}$$

where $\bar{D} = N_1\bar{Y}_1(\gamma U^{''} + \phi\bar{Y}_1 V_1^{''}) < 0$

Equation (38) formalize two conflicting effects of an increase in the number of donor households on private aid. As explained before an increase in T implies that $U^{'}$ falls. This is associated with a fall in official aid and a "crowding in" of private aid. This is formalized in the first term in the square brackets. On the other hand γ rises because the number of donor households rises. This raises $V_1^{'}$ and therefore implies an increase in α and therefore, ceteris paribus, a crowding out of private by official aid [see the second term of expression (38)].

The preceding analysis and results give rise to the following Proposition 6.

Proposition 6 *Assume that there are two countries. In each country the players are in a simultaneously game equilibrium. One of these two countries is more populous because there are more donor households in the sense of* $\frac{dN_2}{N_2} = \frac{dN_3}{N_3} = \frac{dN}{N} > 0$. *The more populous country provides more total aid but private aid may be higher or lower.*

Proof: see the derivation of equations (32) to (38).

It is interesting to compare Propositions 5 and 6. If the difference in the population is due to a higher number of noncontributing households total aid may be higher or lower; however private aid must be higher. On the other hand if the more populous country has more contributing households total aid must be higher in this country but private aid may be lower (contrary to what one may expect).

4 Income Distribution and the Structure of Foreign Aid

In this section we examine how differences in the distribution of income between the households affect private and official aid provision. In order to focus on the effect of income distribution, we consider an equilibrium in which the private donor households and the government act simultaneously. We consider two specific exercises. In the first, it is assumed that the non-donor household's income remains unchanged, but income is redistributed among the donor households. In the second exercise, we assume that income is taken away from the non-donor household and given to the donor households. Formally, the two exercises are:

<u>Exercise 1</u>: $dY_1 = 0,\ N_2 dY_2 + N_3 dY_3 = 0,$

<u>Exercise 2</u>: $dY_1 < 0,\ dY_2 > 0,\ dY_3 > 0,\ N_1 dY_1 + N_2 dY_2 + N_3 dY_3 = 0.$

Assuming, *pro tempore*, that α is fixed, we totally differentiate the reaction functions of the two donor households, (4) and (5), to solve for dF_2 and dF_3 as:

$$\begin{aligned} DN_2 dF_2 &= V_2^{''}(1-\alpha)(V_3^{''} + \lambda_3 U^{''} N_3) N_2 d\bar{Y}_2 - \lambda_2 U^{''} N_2 V_3^{''}(1-\alpha) N_3 d\bar{Y}_3, \\ DN_3 dF_3 &= V_3^{''}(1-\alpha)(V_2^{''} + \lambda_2 U^{''} N_2) N_3 d\bar{Y}_3 - \lambda_3 U^{''} N_3 V_2^{''}(1-\alpha) N_2 d\bar{Y}_2, \end{aligned}$$

where D is given by: $V_2'' V_3'' + (\lambda_2 N_2 V_3'' + \lambda_3 N_3 V_2'')U''$.

Adding the above two equations it is easy to show that:

$$(N_2 dF_2 + N_3 dF_3)_{\alpha \text{ const.}} = \frac{(1-\alpha) V_2^{''} V_3^{''} (N_2 d\bar{Y}_2 + N_3 d\bar{Y}_3)}{D}. \tag{39}$$

From (39) we can derive two intermediate results. First, it is evident that exercise 1 will not affect the total provision of private aid, for a given level of official aid. That is, the neutrality theorem familiar from the theory of public goods (see, for example, Warr (1983)) also applies in our model if the redistribution affects only the two donor households (see section 2 for details). As we shall see later, the total private provision will be affected via induced changes in α.

Second, it follows that exercise 2 will result in a higher provision of private aid, for a given level of official aid. That is, *ceteris paribus*, if the distribution of income favors the donor households at the expense of the non-donors in one donor country as compared to another, then there will be more private aid from the former country. Furthermore, since $(1-\alpha)V_2^{''}V_3^{''}/D$ is less than one, the difference in private aid is less than the differences in the aggregate income of the donors.

It is interesting to compare the second result with the results stated in proposition 1. As explained before, in some sense an increase in α amounts to a transfer from the non-donor household to the donor household. However, whereas in that case the 'transfer' crowds out private aid, in the present case it increases private aid for a given level of α. Note that the amount of official aid does not change in the present exercise since α is taken as given.

Having derived two intermediate results, we now endogenize α. To this end we introduce the concept of net marginal political support (NMPS) for official aid. That is,[11]

$$\text{NMPS} = U^{'}\Theta - \bar{N}_1 V_1^{'}\bar{Y}_1, \tag{40}$$

where $\Theta = \lambda_2\bar{N}_2(\bar{Y}-\bar{Y}_2) + \lambda_3\bar{N}_3(\bar{Y}-\bar{Y}_3)$.

We proceed as follows. First, note that the equilibrium value of α is obtained by setting NMPS $= 0$. From the monotonicity of the NMPS function with respect to α (see footnote 11), it then follows that as a result of the assumed changes in the distribution of income the equilibrium value of α will increase (decrease) if we are able to show that NMPS increases (decreases) for every value of α (for the assumed changes in the distribution of income).

[11]It is straightforward to show that NMPS is a declining function of α.

$$\frac{\partial \text{NMPS}}{\partial \alpha} = U^{''}\Theta[N_2\frac{\partial F_2}{\partial \alpha} + N_3\frac{\partial F_3}{\partial \alpha} + \bar{Y}] + \bar{N}_1 V_1^{''}\bar{Y}_1^2 < 0.$$

Note that the term in the square brackets is positive.

Differentiating NMPS, for a given value of α, we obtain:

$$\begin{aligned} d\text{NMPS}|_{\alpha \text{ const.}} &= U^{''}\Theta(N_2dF_2 + N_3dF_3)_{\alpha \text{ const.}} \\ &\quad -U^{'}(\lambda_2\bar{N}_2d\bar{Y}_2 + \lambda_3\bar{N}_3d\bar{Y}_3) - V_1^{'}\bar{N}_1d\bar{Y}_1. \end{aligned} \tag{41}$$

Using $\bar{N}_1d\bar{Y}_1 = -\bar{N}_2d\bar{Y}_2 - \bar{N}_3d\bar{Y}_3$, equation (41) may be rewritten as:

$$\begin{aligned} d\text{NMPS}|_{\alpha \text{ const.}} &= U^{''}\Theta(N_2dF_2 + N_3dF_3)_{\alpha \text{ const.}} \\ &\quad -(\lambda_2U^{'} - V_1^{'})\bar{N}_2d\bar{Y}_2 - (\lambda_3U^{'} - V_1^{'})\bar{N}_3d\bar{Y}_3, \end{aligned} \tag{42}$$

where $(N_2dF_2 + N_3dF_3)_{\alpha \text{ const.}}$ is given by (39).

From (41) and (42) we derive the effects of exercises 1 and 2 on both private and official foreign aid. First, under exercise 1, $N_1dY_1 + N_2dY_2 = 0$ and $(N_2dF_2 + N_3dF_3)_{\alpha \text{ const.}} = 0$ (from (39)). Therefore, we get from (40)

$$d\text{NMPS}|_{\alpha \text{ const.}} = (\lambda_2 - \lambda_3)U'\bar{N}_3d\bar{Y}_3,$$

whence it follows that the official aid will fall if and only if $(\lambda_2 - \lambda_3)d\bar{Y}_3 < 0$. From Proposition 2, we also know that a fall in α unambiguously increases private aid but reduces total foreign aid. Formally,

Proposition 7 *Let the political economy equilibrium be a simultaneous game equilibrium. A redistribution of income between the two donor households will reduce official aid, increase private aid, and reduce the level of total (private plus official) aid if and only if the redistribution is in favor of the more altruistic household.*

It follows from Proposition7 that if the two donor countries are identical in all respects except in relation to distribution of income between the donor households, the country where the distribution of income favors the more altruistic donor household will give less total aid and will have a higher private to official aid ratio.

This is a remarkable result because it is counterintuitive. Also one may tentatively suggest that it could make a contribution towards the explanation of the differences in the relative importance of official aid and also total aid in countries like Sweden on the one and the USA on the other hand. It is well known that the distribution of income is more unequal in the USA than in Sweden. This should apply to the distribution of income not only between different donor households but also between donor and non-donor households [see Proposition 8 below].

Turning now to exercise 2, note that the first term on the right hand side of (20) is positive and therefore we have:

Proposition 8 *Let the political economy equilibrium be a simultaneous game equilibrium. If income is redistributed from the non-donor household to the donor households, there will be less official aid, more private aid and less total aid if* $\lambda_2 > V_1'/U'$ *and* $\lambda_3 > V_1'/U'$.

As can be seen from (42) a change in the distribution of income in favor of the donor households has a direct and an indirect effect on the net marginal support for official aid. Changes in the distribution of income entail changes in the provision of private aid, for a given α (see (39)). This is the indirect effect. A change in favor of the donor households brings about an increase in private aid and this, *ceteris paribus*, lowers the net marginal political support for official aid (again for a given α) (see (42)). The direct effect on NMPS is equal to:

$$-[(\lambda_2 U' - V_1')\bar{N}_2 d\bar{Y}_2 + (\lambda_3 U' - V_1')\bar{N}_3 d\bar{Y}_3],$$

which reinforces the indirect effect if $\lambda_2 > V_1'/U'$ and $\lambda_3 > V_1'/U'$.

An additional insight into the meaning of the effect of the redistribution on NMPS can be obtained by rewriting the direct effect as follows:

$$-[(V_2' - V_1')\bar{N}_2 d\bar{Y}_2 + (V_3' - V_1')\bar{N}_3 d\bar{Y}_3].$$

If V_1, V_2 and V_3 have the same functional form, it can be seen that exercise 2 entails a crowding out of official aid by private aid if the disposable income of the two donor households is below that of the non-donor. If, as one may presume, the consumption expenditure of the two donor households is higher than the expenditure of the non-donor household, the country with a distribution of income favoring the donor households may well have a higher level of official aid. The latter effect could crowd out private aid provision but not to such an extent that total aid is lower.

To conclude section 4 we only point out that distributional policies may be considered as alternatives to changes in the income tax rate α to augment the political support for the government. However, it should be noted that, it may be much more difficult to implement targeted and personalized changes in the distribution of income than impersonal changes in income tax rates.

5 The Effect of Coordination among Donors on the Structure of Foreign Aid

In this section we assume that households coordinate their decisions on private aid provision. In the present context donor households face two types of coordination problems. There is a coordination problem within each donor type and there is a coordination problem between donor types. We therefore assume that the private donors perfectly coordinate their decisions both within each group and also between the two groups. That is they maximize the total welfare of the two groups, given by[12]:

$$W = N_2 W_2 + N_3 W_3, \tag{43}$$

$$\text{where} \qquad \begin{aligned} W_2 &= V_2\left[(1-\alpha)\bar{Y}_2 - F_2\right] + \lambda_2 U\left[\alpha\bar{Y} + N_2F_2 + N_3F_3\right], \\ W_3 &= V_3\left[(1-\alpha)\bar{Y}_3 - F_3\right] + \lambda_3 U\left[\alpha\bar{Y} + N_2F_2 + N_3F_3\right], \end{aligned}$$

with respect to F_2 and F_3 in a fully coordinated way, i.e. each does not take the amount donated by others as given.

Assuming, to start with, that the private agents and the government act simultaneously, the first order condition for the private agents are given by:

$$\frac{\partial W}{\partial F_2} = -V_2' + (\lambda_2 N_2 + \lambda_3 N_3)U' = 0, \tag{44}$$

$$\frac{\partial W}{\partial F_3} = -V_3' + (\lambda_2 N_2 + \lambda_3 N_3)U' = 0. \tag{45}$$

[12]It is easy to show that all the results of this section can be extended qualitatively to the case where there is only coordination within one household type or only within the two donor household types.

The coordination equilibrium is described by (44), (45) and the condition $\partial\mathrm{PS}/\partial\alpha = 0$. We shall now compare this equilibrium with the original equilibrium. For this purpose, we shall follow our approach in section 4 and consider the concept of net marginal political support (NMPS) defined in (40). However, first of all, by comparing (4) and (5) on the one hand with (44) and (45) on the other, we shall show that total private aid is larger under the coordination equilibrium, *for a given value of alpha (say, $\bar{\alpha}$).* Formally,

LEMMA 1: $(N_2F_2^c + N_3F_3^c)_{\alpha=\bar{\alpha}} \geq (N_2F_2^u + N_3F_3^u)_{\alpha=\bar{\alpha}}$, *where the superscripts u and c stand for uncoordinated and coordinated equilibrium respectively.*

Proof: First, we write (4), (5), (44) and (45) fully as:

$$V_2'\left[(1-\bar{\alpha})\bar{Y}_2) - F_2^u\right] = \lambda_2 U'\left[\bar{\alpha}\bar{Y} + N_2F_2^u + N_3F_3^u\right], \tag{46}$$

$$V_3'\left[(1-\bar{\alpha})\bar{Y}_3) - F_3^u\right] = \lambda_3 U'\left[\bar{\alpha}\bar{Y} + N_2F_2^u + N_3F_3^u\right], \tag{47}$$

$$V_2'\left[(1-\bar{\alpha})\bar{Y}_2) - F_2^c\right] = (\lambda_2N_2 + \lambda_3N_3)U'\left[\bar{\alpha}\bar{Y} + N_2F_2^c + N_3F_3^c\right], \tag{48}$$

$$V_3'\left[(1-\bar{\alpha})\bar{Y}_3) - F_3^c\right] = (\lambda_2N_2 + \lambda_3N_3)U'\left[\bar{\alpha}\bar{Y} + N_2F_2^c + N_3F_3^c\right]. \tag{49}$$

We prove the lemma by the logic of contradiction. Suppose, contrary to the statement of the lemma, that

$$(N_2F_2^c + N_3F_3^c)_{\alpha=\bar{\alpha}} < (N_2F_2^u + N_3F_3^u)_{\alpha=\bar{\alpha}}\,.$$

It then follows that, at the minimum, private aid by one of the groups has to be lower under coordination. Without loss of generality, assume that

$$F_2^c < F_2^u.$$

Since $N_2 \geq 1$, it then follows from the concavity of the utility functions and the above two inequalities that whereas the left hand side of (46) is larger than that of (48), the right hand side of (46) is smaller than that of (48). Thus, both (46) and (48) cannot hold at the same time. This is a contradiction. Therefore,

$(N_2F_2^c + N_3F_3^c)_{\alpha=\bar{\alpha}} \geq (N_2F_2^u + N_3F_3^u)_{\alpha=\bar{\alpha}}$. **Q.E.D.**

Since the above lemma is valid for all values of $\bar{\alpha}$ such that $0 \leq \bar{\alpha} \leq 1$, it follows from (40) that for every value of $\bar{\alpha}$ the value of NMPS is smaller in the coordinated than in the uncoordinated equilibrium. Since NMPS = 0 determines the equilibrium value of α, it then follows at once that $\alpha^c \leq \alpha^u$. Moreover, since NMPS = 0 under both equilibria, we have:

$$\Theta \left(U' \left[\alpha^c \bar{Y} + N_2 F_2^c + N_3 F_3^c \right] - U' \left[\alpha^u \bar{Y} + N_2 F_2^u + N_3 F_3^u \right] \right)$$
$$= \bar{N}_1 \bar{Y}_1 \left(V_1' \left[(1 - \alpha^c) \bar{Y} \right] - V_1' \left[(1 - \alpha^u) \bar{Y} \right] \right).$$

Since $\alpha^c \leq \alpha^u$, from the concavity of the utility function V_1 it follows that the right hand side of the above equation is negative and thence from the concavity of the utility function U and the right hand side of the equation that $\alpha^c \bar{Y} + N_2 F_2^c + N_3 F_3^c \geq \alpha^u \bar{Y} + N_2 F_2^u + N_3 F_3^u$ and therefore that $N_2 F_2^c + N_3 F_3^c \geq N_2 F_2^u + N_3 F_3^u$. The above results are formally stated as:

Proposition 9 *Assume that the private donors and the government act simultaneously. Consider then the following two equilibria. First, the private agents do not coordinate their actions at all. Second, the private donors coordinate their actions fully both within and between groups.*

Private and total (private plus official) aid is larger, and official aid smaller, under the second (coordinated) equilibrium than the first (uncoordinated) one.

We now turn to the derivation of our final result. We assume not only that all donor households perfectly coordinate their aid provision but also that the group of donor households has a first mover advantage vis à vis the government, i.e.: the group of donors makes a credible commitment to provide a certain amount of private aid in the first period such that it maximizes the function $W = N_2 W_2 + N_3 W_3$ with respect to private aid subject to the reaction function of the government, see equation (17a). For convenience we assume that all donor households provide the same amount of aid, i.e.: $F_2 = F_3 = F$. The government then decides on official aid in the second period.

First, from the reaction function of the government given by (17a), we obtain:

$$[N_1 V_1^{''}(\bar{Y}_1)^2 + N_2 V_2^{''}(\bar{Y}_2)^2 + N_3 V_3^{''}(\bar{Y}_3)^2 + (\lambda_2 N_2 + \lambda_3 N_3) U^{''}(\bar{Y})^2] d\alpha$$
$$= -[N_2 V_2^{''} \bar{Y}_2 + N_3 V_3^{''} \bar{Y}_3 + U^{''} \bar{Y} (N_2 + N_3)(\lambda_2 N_2 + \lambda_3 N_3)] dF. \tag{50}$$

That is, private and official aid are negatively related. As we shall see later on, this relationship provides the strong pressure group to induce a higher level of official aid by lowering the volume of private aid.

Turning now to the donor group, its objective function $W = N_2W_2 + N_3W_3$, be written as $W(F, \alpha(F))$ where the slope of the reaction function $\alpha(F)$ is given by (50). Differentiating this welfare function with respect to F, we obtain the first order condition for the donor group's optimization problem as:

$$\frac{dW}{dF} = \frac{\partial W}{\partial F} + \frac{\partial W}{\partial \alpha} \cdot \frac{d\alpha}{dF}, \tag{51}$$

$$\begin{aligned} \text{where} \quad \frac{\partial W}{\partial F} &= -V_2^{'} - V_3^{'} + 2U^{'}(\lambda_2 N_2 + \lambda_3 N_3), \\ \frac{\partial W}{\partial \alpha} &= (-V_2^{'}\bar{Y}_2 + \lambda_2 U^{'}\bar{Y})N_2 + (-V_3^{'}\bar{Y}_3 + \lambda_3 U^{'}\bar{Y})N_3, \end{aligned}$$

and $d\alpha/dF$ is given in (50).

Having derived the equilibrium conditions if the donor group has a first mover advantage, we shall now compare the property of this equilibrium when the donor group does not have a first mover advantage.

It can be easily shown that the first term on the right hand side of (50) is zero when it is evaluated at the simultaneous game equilibrium with a donor group. At the equilibrium, we also have

$$\frac{\partial W}{\partial \alpha} = N_1\bar{Y}_1(\lambda_2 N_2 + \lambda_3 N_3)U^{'} > 0$$

From these facts together with an earlier result that $d\alpha/dF < 0$ [(50)], it follows that dW/dF [given in (51)], evaluated at the simultaneous game equilibrium with a donor group, is negative. It then follows from the concavity of the objective function that the equilibrium value of private aid is lower when the donor group has a first mover advantage, compared to the case when it acts simultaneously with the government. From (50) we can then also derive that the level of official aid is higher in the former equilibrium than in the latter. These results are summarized in the following proposition.

Proposition 10 *Assume that a donor group in the sense of Proposition 9 exists and that it has a first mover advantage. Then total private aid is smaller and official aid larger compared to the case where the donor group and the government act simultaneously.*

The economic rationale of Proposition 10 is clear. The formation of a donor group creates incentives to raise private contributions F_2 and F_3 to overcome the underproduction of private aid from the point of view of both donor type households. If a donor group already exists such welfare improvements are impossible. The welfare of the group can then only be raised by engineering an increase in official aid which is equivalent to an income transfer from the non-donor to the donor households. In order to achieve this, given the constraint of reaction function of the government, the donor group has to decide upon a reduction of private contributions.

6 Conclusions and Possible Extensions

As mentioned in the Introduction, the relative importance of official aid in the provision of total (private and official) aid varies considerably between countries, see Appendix A. To shed light on this we have developed a game theoretic model with three players: the government and two (potential) donor household types. Official aid is financed by an income tax levied on three households: one household which never provides private aid and the two donor households.

The simultaneous game equilibrium represents our benchmark model; however we also examine models in which either the government or the group of donor households have a first mover advantage in a two stage game.

The main results of the paper are formalized in ten propositions. One of our main aims has been to explain the striking fact that the USA compared with many other countries provides relatively less official and more private aid.

Our analysis suggests several possible explanations. First it has been shown in the simultaneous game equilibrium that in the more populous country there is less official but more private aid, see Proposition 4. However not only country size (in terms of population) but also household composition (between nondonors and donors) can make for a lower aid provision by the government. Proposition 5 states that there is less official aid in the more populous country if the number of nondonor is (ceteris paribus) higher in that country. In fact in the latter case even total aid may be lower in the more populous country: an interesting result because it is counterintuitive. Another counterintuitive result is stated in Propositions 7 and 8. A redistribution of income in favor of the most altruistic household results not only in a reduction of official but also of total aid. This result appears to be relevant if we compare aid provision in Sweden or other Scandinavian countries on the one hand and the USA on the other.

Furthermore we have also shown that, ceteris paribus, a country provides less official and more private aid if the government has a first mover advantage as compared with another country in which aid is provided in a simultaneous game equilibrium, see Proposition 3. Finally, see Proposition 2, the less personalized progressive income tax rates are, the greater the probability that private aid provision plays a relatively more important part.

Needless to emphasize that all the results of the paper hold only *ceteris paribus*. The analytical framework developed in the paper is not only applicable to the analysis of the structure of foreign aid provision but much more generally to the active research topic of international public goods. Many extensions are possible. We mention only a few. First, one can allow for the income taxes to be distortionary. Secondly, in the light of empirical analysis it seems desirable that the assumption that official and private aid are perfect substitutes should be relaxed. Also it can be argued that warm glow effects should be introduced because they may be important from a theoretical as well as practical viewpoint. Finally, there is the well known issue of the effectiveness of foreign aid in the presence of corruption in the recipient country. Again in the latter context the distinction between official and private aid may turn out to be crucial.

Appendix A

Table: Official and private foreign aid

Donor	Official to Private Aid Ratio[a,b] 1997	Official to Private Aid Ratio 1998	Official Aid ($ millions) 1998	Private Aid ($ millions) 1998	Official Aid to GNP Ratio 1998
Australia	7.03	8.67	960	111	0.27
Austria	15.97	9.91	456	46	0.22
Belgium	19.70	24.53	883	36	0.35
Canada	11.69	10.91	1691	155	0.30
Denmark	54.57	48.69	1704	35	0.99
Finland	37.9	79.2	396	5	0.32
France	– [c]	– [c]	5742	– [c]	0.40
Germany	6.17	5.74	5581	972	0.26
Italy	30.88	56.95	2278	40	0.20
Japan	41.96	52.41	10640	203	0.28
Luxemburg	15.83	18.66	112	6	0.65
Netherlands	– [d]	19.25	3042	158	0.8
New Zealand	10.27	10.83	130	12	0.27
Norway	10.79	10.48	1321	126	0.91
Portugal	62.75	37.00	259	7	0.24
Spain	10.23	10.34	1376	133	0.24
Sweden	64.11	39.33	1573	40	0.72
United Kingdom	10.93	9.47	3864	408	0.27
United States	2.73	3.29	8786	2671	0.10

Notes:

[a] Official aid is defined to be total official development assistance given to List I countries, i.e the developing countries that are not reasonably advanced in the development process.

[b] Private aid is grants by NGOs, net of subsidies from government.

[c] Net private aid from France is almost non-existent

[d] Net private aid from the Netherlands in 1997 is negative.

Source: www.worldbank.org/data/wdi2000/pdfs/tab6_ 8.pdf

Appendix B

Differentiating totally equation (4) and (5) with respect to α we obtain:

$$(V_2^{''} + \lambda_2 U^{''} N_2) dF_2 + \lambda_2 U^{''} N_3 \, dF_3 = -(\bar{Y}_2 V_2^{''} + \lambda_2 U^{''} \bar{Y}) d\alpha \quad (52)$$

$$\lambda_3 U^{''} N_3 \, dF_2 + (V_3^{''} + \lambda_3 U^{''} N_3) dF_3 = -(\bar{Y}_3 V_3^{''} + \lambda_3 U^{''} \bar{Y}) d\alpha \quad (53)$$

Solving (52) and (53) for $dF_2/d\alpha$ and $dF_3/d\alpha$ we obtain:

$$\frac{dF_2}{d\alpha} = \frac{-\lambda_2 V_3^{''} U^{''} (\bar{Y} - N_3 \bar{Y}_3) - V_2^{''} V_3^{''} \bar{Y}_2 - \lambda_3 V_2^{''} U^{''} N_3 \bar{Y}_2}{D} \quad (54)$$

$$\frac{dF_3}{d\alpha} = \frac{-\lambda_3 V_2^{''} U^{''} (\bar{Y} - N_2 \bar{Y}_2) - V_2^{''} V_3^{''} \bar{Y}_3 - \lambda_2 V_3^{''} U^{''} N_2 \bar{Y}_3}{D} \quad (55)$$

$$\text{where} \quad D = V_2^{''}V_3^{''} + U^{''}(\lambda_2 V_3^{''} N_2 + \lambda_3 V_2^{''} N_3) > 0$$

Substituting (54) and (55) into equations (12) and (13) of the text we arrive at (14) and (15).

Appendix C

We first prove subsection (a), then (b) and then (c) of Proposition 2.

(a) We know from from equation (17) that:

$$U^{'}(\lambda_2 N_2 + \lambda_3 N_3) - \frac{N_1 \bar{Y}_1 V_1^{'}}{\bar{Y}} - \frac{N_2 \bar{Y}_2 V_2^{'}}{\bar{Y}} - \frac{N_3 \bar{Y}_3 V_3^{'}}{\bar{Y}} = 0$$

From (4) and (5) it follows after multiplying (4) by N_2 and (5) by N_3 after addition that at least one donor household does not contribute in the simultaneous game equilibrium if and only if:

$$-N_2 V_2^{'} - N_3 V_3^{'} + U^{'}(\lambda_2 N_2 + \lambda_3 N_3) < 0 \tag{56}$$

Taking into account (17) and (56) it is easy to see that (56) is satisfied if and only if:

$$N_2 V_2^{'} + N_3 V_3^{'} > \frac{N_1 \bar{Y}_1}{\bar{Y}} V_1^{'} + \frac{N_2 \bar{Y}_2}{\bar{Y}} V_2^{'} + \frac{N_3 \bar{Y}_3}{\bar{Y}} V_1^{'} \tag{57}$$

(b) Proceeding as under (a) but assuming that the government taxes household 1 at a different rate from households 2 and 3, we obtain the following two expressions:

$$\frac{\partial PS(.)}{\partial \alpha_{23}} = -V_2^{'} N_2 \bar{Y}_2 - V_3^{'} N_3 \bar{Y}_3 + U^{'}(\lambda_2 N_2 + \lambda_3 N_3)(N_2 \bar{Y}_2 + N_3 \bar{Y}_3) = 0 \tag{58}$$

Multiplying (4) and (5) by $N_2 \bar{Y}_2$ and $N_3 \bar{Y}_3$ respectively and adding (having assumed that at least one of the households (2) and/or (3) does not contribute) we have:

$$= -N_2 \bar{Y}_2 V_2^{'} - N_3 \bar{Y}_3 V_3^{'} + U^{'}(\lambda_2 N_2 \bar{Y}_2 + \lambda_3 N_3 \bar{Y}_3) < 0 \tag{59}$$

Expression (59) may be rewritten as:

$$-\frac{N_2 \bar{Y}_2 V_2^{'}}{N_2 \bar{Y}_2 + N_3 \bar{Y}_3} - \frac{N_3 \bar{Y}_3 V_3^{'}}{N_2 \bar{Y}_2 + N_3 \bar{Y}_3} + \frac{(\lambda_2 N_2 \bar{Y}_2 + \lambda_3 N_3 \bar{Y}_3)}{N_2 \bar{Y}_2 + N_3 \bar{Y}_3} U^{'} < 0 \tag{60}$$

Dividing (58) by $N_2 \bar{Y}_2 + N_3 \bar{Y}_3$ and substituting the resulting expression into (60) we have:

$$U^{'}[\lambda_2 N_2 \bar{Y}_2 + \lambda_3 N_3 \bar{Y}_3 - (\lambda_2 N_2 + \lambda_3 N_3)(N_2 \bar{Y}_2 + N_3 \bar{Y}_3)] < 0$$

Multiplying out the expression in square brackets we find that:

$$\lambda_2 N_2 \bar{Y}_2 + \lambda_3 N_3 \bar{Y}_3 - \lambda_2 N_2^2 \bar{Y}_2 - \lambda_2 N_2 N_3 \bar{Y}_3 - \lambda_3 N_3 N_2 \bar{Y}_2 - \lambda_3 N_3^2 \bar{Y}_3 < 0$$

Q.E.D.

(c) Differentiating the political support function partially with respect to α_1, α_2 and α_3 we have:

$$\frac{\partial PS(.)}{\partial \alpha_1} = N_1\bar{Y_1}[-V_1^{'} + U^{'}(\lambda_2 N_2 + \lambda_3 N_3)] \quad = \quad 0 \tag{61}$$

$$\frac{\partial PS(.)}{\partial \alpha_2} = N_2\bar{Y_2}[-V_2^{'} + U^{'}(\lambda_2 N_2 + \lambda_3 N_3)] \quad = \quad 0 \quad \text{and} \tag{62}$$

$$\frac{\partial PS(.)}{\partial \alpha_3} = N_3\bar{Y_3}[-V_3^{'} + U^{'}(\lambda_2 N_2 + \lambda_3 N_3)] \quad = \quad 0 \tag{63}$$

The last two equations imply:

$$-V_2^{'} + \lambda_2 U^{'} < -V_2^{'} + \lambda_2 N_2 U^{'} < -V_2 + U^{'}(\lambda_2 N_2 + \lambda_3 N_3) = 0 \tag{64}$$

$$-V_3^{'} + \lambda_3 U^{'} < -V_3^{'} + \lambda_3 N_3 U^{'} < -V_3 + U^{'}(\lambda_2 N_2 + \lambda_3 N_3) = 0 \tag{65}$$

Q.E.D.

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