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Modelling Aid Allocation

Issues, Approaches and Results

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Abstract

There is a widespread view that political criteria have received less emphasis in aid allocation since the end of the cold war, with a greater share of aid subsequently being based on developmental criteria. An observed increase in aid effectiveness is attributed to this shift. A reasonably large literature on aid allocation supports this view: a number of influential, widely cited studies conclude that developmental criteria played no role in the 1970s and 1980s inter-recipient aid allocation. This paper argues that the shift is not as significant as commonly thought. It points to a number of methodological weaknesses in the dominant modelling approach used within the literature, showing that more rigorous econometric methods suggest that developmental criteria have had a larger influence on cold war period aid allocation than previously thought. An alternative interpretation of the observed increase in aid effectiveness is provided.

Keywords: aid allocation, donor interest, recipient need, Tobit models, regression

JEL classification: F34, C24, C21, C12, I31

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1 Introduction

The allocation of development aid among recipient countries has received increased scrutiny in recent years. After decades of generally inconclusive results, studies of the macroeconomic impact of aid now almost without exception conclude that aid works in promoting growth (Svensson 1999; Hansen and Tarp 2000a, 2000b; Dalgaard and Hansen 2001; Guillaumont and Chauvet 2001; Hudson and Mosley 2001; Lu and Ram 2001; Dalgaard *et al.* 2002; Gounder 2001, 2002). Some studies have concluded that this impact is conditional on the quality of the recipient country policy regime (Burnside and Dollar 1997, 2000; Collier and Dollar 2002; Collier and Hoeffler 2002). On the basis of this second finding, aid donor countries are now under increasing international pressure to base inter-country aid allocation on the perceived quality of recipient country policy regimes (McGillivray 2003). This is thought to increase the 'poverty efficiency' of aid: giving preference in aid allocation to countries with better policy regimes means that the overall impact of aid on growth is higher, which in turns means that poverty reduction is greater.

There have been many attempts to interpret the conclusion that aid now works, and by implication better than before. A common interpretation is that donor agencies are now freer to pursue developmental or humanitarian as opposed to political, strategic commercial and related criteria in aid allocation following the end of the cold war. In short, these agencies now allocate more aid to countries which can use it better, and this accounts for the recent finding that aid now works in promoting growth. The decline in the share in total aid coming from the United States is also offered as an explanation. Aid from this donor is thought to have been especially influenced by non-developmental criteria, especially in the cold war period. These related assertions are derived in large part from studies of aid allocation conducted during the cold war. The most influential, widely-cited studies are those of McKinlay (1978), McKinlay and Little (1977, 1978a, 1978b, 1979) and Maizels and Nissanke (1984), which empirically model aid allocation. McKinlay and Little (1979: 243) concluded that there are 'no grounds for asserting that humanitarian criteria have any significant direct influence' on aid US allocation. Maizels and Nissanke (1984: 891) concluded that US, British, French, German and Japanese 'bilateral aid allocations are made ... solely ... in support of donors' perceived foreign economic, political and security interests'.

The McKinlay-Little and Maizels-Nissanke research use the 'recipient need' and 'donor interest' (RN-DI) modelling approach. This approach has dominated the literature on inter-recipient aid allocation from the late 1970s to the present. Recent RN-DI studies include Gounder (1999) and Gounder and Sen (1999). The approach involves separate estimation of two regression equations: one containing indicators of recipient need only and the other solely containing indicators of the donor interest. The former, the recipient need model, assumes that donors are motivated purely by humanitarian motives. The latter, the donor interest model, is premised on the assumption that donors are motivated purely by commercial, political and strategic self interests. Both models are fitted to sample data using the popular ordinary least squares (OLS) method of estimation. This estimation method is common not only to the recipient need-donor interest approach, but to aid allocation literature as a whole with the vast majority of studies using OLS.

This paper has two linked objectives. First, it seeks to examine the econometric veracity of the RN-DI approach. It does this by reviewing the econometric methods used by RN-DI studies, and then fitting a model very similar to that used by Maizels and Nissanke

(1984) to 1980 United States aid data using a more rigorous econometric approach. The results of this exercise indicate that much of the popular views on aid allocation may well be wrong, including that regarding the increased emphasis to developmental criteria and, consequently, the related inference regarding the increased effectiveness of aid. This is because the results of the RN-DI studies of cold war aid allocation will have almost certainly provided biased results. The second objective of the paper is to provide a general econometric procedure for the modelling of inter-recipient aid allocation. This procedure involves the application of limited dependent variable modelling techniques. These techniques are now used increasingly in recent aid allocation literature, although there remains significant scope for improvement in their application.

The paper is structured as follows. Section 2 outlines the perceived methodological shortcomings of the RN-DI approach and, in the context of foreign aid modelling, the OLS estimation method. Section 3 outlines an alternative, more econometrically rigorous approach hinging on the estimation of comprehensively specified (hybrid) models using limited dependent variable techniques. Two alternative limited dependent variable models are proposed along with a method of choosing between them. Section 4 applies this approach to 1980 US aid allocations, showing that both recipient need and donor interest variables are relevant. Concluding comments are provided in section 5, including an alternative interpretation of the observed increase in aid effectiveness.

2   Some methodological issues in modelling aid allocation

2.1   Sample selection and OLS estimation

A task facing all aid allocation studies is drawing up a sample of potential recipient countries.[1] Although not always made clear, studies have tended to include in the sample actual recipients—that is, those developing countries which have received non-zero aid allocations.[2] The other option is to include all developing countries for which data are available.[3] Most studies seem to have taken the second option, explicitly noting that the sample included both recipients and non-recipients of aid from the donor under consideration. Gounder (1994) explicitly discussed and elected for this section option.

Both options are necessarily flawed if one uses the OLS estimation method. Let us consider the second option first. A possible scenario is shown below in Figure 1. A_i denotes some measure of aid to country i and is a decreasing function of X_i. Four countries are denied aid under this scenario. We therefore observe zero aid for these countries and the corresponding observations lie on the horizontal axis of Figure 1. With these non-recipients included in the sample, the OLS regression line is approximated by AA. Ignore for the moment the line BB. The application of OLS

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[1] If the category of aid under consideration is official development assistance (ODA), this sample must be drawn from those classified by the OECD as developing. According to OECD guidelines, only developing countries are eligible for this category of aid.

[2] A variant of this approach is to include those which receive aid above some positive threshold.

[3] Other approaches are to include countries in a particular region or those belonging to a particular non-geographic grouping (such as low-income countries). But even if these approach are adopted, one must still decide whether to include or exclude non-recipients.

Figure 1
Regression lines
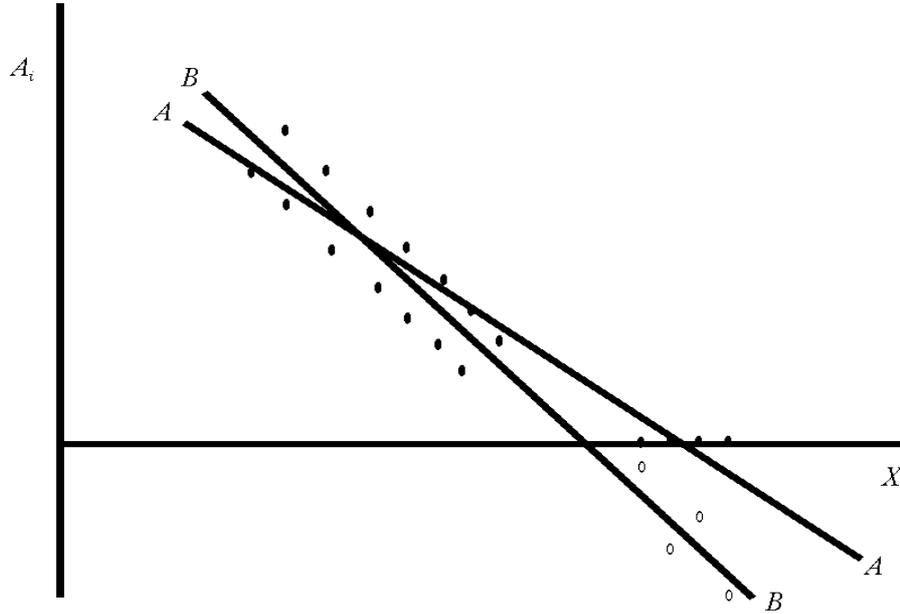
provides a regression line which is too flat in this example. As a result the absolute value of the regression coefficient is underestimated and the corresponding t ratio is overestimated. This particular result is due to the observations for which aid is zero lying to the right of all non-zero observations. But more generally, a misleading regression line will almost always be fitted if observations for which the aid variable equals zero are included in the sample and if these outcomes are the result of a non-random aid allocation process.

Let us now consider the other option: excluding non-recipients from the sample. The observed regression equation underlying Figure 1 is:[4]

$$A_i = \alpha + \beta X_i + \mu_i \qquad i = 1, 2, \ldots, n \tag{1}$$

where α is the vertical intercept, β is a slope (regression) coefficient which is less than zero and μ_i is an error term. Figure 1 implies some threshold value of X_i that must not be exceeded for aid to be provided. In other words, the donor has systematically used X_i to partition recipients from non-recipients of aid. This may be re-stated as follows:

$$A_i > 0 \quad \text{if} \quad \alpha + \beta X_i + \mu_i \leq Z \quad \text{or} \quad \mu_i \leq Z - \alpha + \beta X_i \tag{2}$$

where Z is the threshold. Clearly, by excluding observations for which aid is zero from the sample, one truncates μ_i and thus violates an assumption on which OLS is based:

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4   Strictly speaking, it can be stated that the regression equation underlying Figure 1 has a latent variable as its regressand. This variable is observable only when its values are greater than zero, in which case it is assumed to equal A_i. We return to this below.

that the expected value of the error term is zero (i.e., $E[\mu_i] = 0$). $E[\mu_i]$ will actually be a function of the explanatory variable X_i and the application of OLS provides inconsistent estimates of β. In Figure 1, the expected value of μ_i increases with increases in X_i and OLS estimates of β would, in this situation, be upward biased. This outcome is not dependent on the threshold being defined in terms of some value of a variable appearing on the right-hand side of the regression equation. Results will almost always be biased if there is non-random self-selectivity in the data. This applies to not only OLS, but all estimation techniques which do not recognise the limited (non-negative, non-zero) nature or aid allocations.[5]

2.2   Specification issues

Our attention now turns more directly to the RN-DI modelling approach. Here we make an obvious point regarding specification bias. Studies which have used this approach essentially postulate that:

$$A_i = f\{RN_i, DI_i\} \tag{3}$$

where A_i is some measure of aid to recipient i, RN_i and DI_i are vectors of recipient need and donor interest indicators, respectively. These studies then separately estimate the RN and DI models, which may respectively be written as follows:

$$A_i = \alpha_0 + \alpha_1 RN_i + \mu_i \tag{4}$$

$$A_i = \beta_0 + \beta_1 DI_i + \varepsilon_i \tag{5}$$

where α_0 and β_0 are constants, α_1 and β_1 are vectors of coefficients and μ_i and ε_i are error terms. This might well be an interesting approach to take, but it is inherently problematic econometrically if one posits *a priori* that both recipient need and donor interests influence aid allocation.[6] If this is the case, one must accept *a priori* that both models are mis-specified due to the omission of relevant variables. The consequences of this can be rather serious, as now demonstrated.

It follows that the comprehensive model, that which RN-DI studies in essence postulate, is:

$$A_i = \gamma_0 + \gamma_1 RN_i + \gamma_2 DI_{i,t} + v_i \ . \tag{6}$$

It follows from equations (4) to (6) that:

$$\mu_i = \gamma_{0'} + \gamma_2 RN_i + v_i' \tag{7}$$

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5   This includes weighted least squares and seemingly unrelated regressors, as have been used in the aid allocation literature. See, for example, Katada (1997).

6   It is also theoretically ambiguous. There is no obvious theoretical rationale for using the RN-DI approach, and no such case is provided by the relevant studies.

and

$$\varepsilon_i = \gamma_{0'} + \gamma_1 RN_i + v''_i \tag{8}$$

Unless it can be shown that none of the donor interest variables omitted from (4) are orthogonal with the recipient need variables omitted from (5), which is unlikely in the extreme, then it in turn follows that μ_i and ε_i are not independent of their respective explanatory variables. The t ratios, F tests and R^2s resulting from separate estimation of (4) and (5) are invalid, therefore, and the conclusions based on these statistics are likely to be misleading.

The preceding analysis was conducted at an *a priori* level. Is it necessarily the case that the RN-DI approach yields biased results in practice? The answer is almost certainly yes. If any one or more of the recipient need variables is actually relevant to aid allocation, then the donor interest equation provides biased results. Conversely, if any one or more of the donor interest variables are relevant, then the recipient need equation provides biased results. Of course, it follows that if recipient need *and* donor interest variables are relevant, then both recipient need and donor equations yield biased results.

The preceding outcome applies to many other categories of aid allocation studies, although unlike the RN-DI approach they are not inherently biased. These studies include those which have sought to test for biases in aid allocation,[7] as well as those which have sought to look at the relationship between aid allocation and political and/or human rights variables only[8] or developmental variables only.[9] Each of the studies falling into these categories has reported results which are likely to be biased due to failing to estimate a comprehensively specified model of aid allocation.

3   An alternative approach

3.1   Limited dependent variable models

If one continues modelling aid allocation using indicators of recipient need and donor interest (and there is merit in doing so), then the solution to the specification bias issue directly follows from the preceding analysis: estimate a comprehensively specified (hybrid) model of aid allocation. There is also a ready solution to the sample selection issue: retain all available observations in the sample and employ limited dependent variable techniques. The rationale for this approach can be demonstrated by the line BB in Figure 1. As mentioned, Figure 1 implies that there is some threshold value of X_i that must not be exceeded for aid to be provided. Only aid amounts taking the value of zero for countries above this threshold are observed since a donor cannot allocate negative

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7   See, for example, OECD (1974); Isenman (1976); Dowling and Hiemenz (1985) and Arvin and Drewes (2001).

8   See, for example, Wittkopf (1973); McKinlay and Little (1977, 1978a and 1978b); Schoultz (1981); Stohl *et al.* (1984) and Carleton and Stohl (1987).

9   See, for example, Davenport (1970); Henderson (1971); Kaplan (1975); Edelman and Chenery (1977); Anyadike-Danes and Anyadike-Danes (1992); Collins (1993); Trumball and Wall (1994) and Wall (1995).

aid amounts[10] Limited dependent variable techniques model the underlying or latent relationship, such as that shown by the line *BB*.[11] This line basically says that if one could observe negative aid allocations, countries above the threshold would receive amounts indicated by the hollow dots in Figure 1. These amounts, like the non-zero allocations, are treated as latent potential aid amounts, which are only observed if the actual amounts are greater than zero or some other positive threshold.

A family of limited dependent variable modelling techniques exists. Any number of specific techniques could be applied to aid allocation. Using the Amemiya (1984) classifications, the two seemingly most applicable are the Tobit Type I and Tobit Type II models, both of which are estimated using the maximum likelihood (ML) method. Those relatively few aid allocation studies which do use limited variables techniques tend to select one of these approaches on a seemingly arbitrary basis.[12] Outlining the differences between them, in the context of aid allocation, and providing a basis for selecting one over the other is thus warranted.

The Tobit Type II (sample selection) model describes a two-stage decisionmaking process in the context of aid allocation. In the first stage, the donor selects from a list of potential recipients a sample of countries which shall receive aid. Having done this, the donor in the second stage decides how much aid to allocate to each of these countries from a predetermined total pool of funds. Each of these countries receive a positive amount of aid. This has previously been described as a 'yes/no and if yes, how much?' process (see McGillivray and Oczkowski 1991, 1992).[13] The Type I model describes a one-stage process, where the donor deliberates simply between positive and zero aid amounts without first compiling a sample of countries which shall receive aid. We now formally outline these models.[14]

For our current purposes the Type I Tobit model can be formally written as follows:

$$A_i^* = \gamma_0 + \gamma_1 RN_i + \gamma_2 DI_i + u_i \qquad u_i - N\left(0, \ \sigma^2\right) \qquad (9)$$

where A_i^* denotes a latent potential amount of aid to country i, u_i is an error term and the other variables and terms are as before. Normalized coefficients are used in

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10 It is possible to observe negative aid amounts in practice if the measure of aid is net disbursements. This arises from recipient country repayments of previous period's loans and not through a reversal of donor and recipient roles due to the value of some variable X_i. In other words, negative net disbursements do not and cannot arise from a conscious decision of the donor to allocate a negative amount to a given country.

11 Strictly speaking, the line *BB* depicts only one of a number of possibilities and is represented by the Tobit Type I model outlined below.

12 For example, Gang and Lehman (1990) and Berthelemy and Tichit (2002) opt for Tobit Type I while McGillivray and Oczkowski (1991, 1992); Tarp *et al.* (1999) and Neumayer (2002) opt for Type II. McGillivray and Oczkowski do test for one model over the other, using a similar procedure to that outlined in this paper.

13 It could be argued that there is indeed a three-stage decisionmaking process, with the first decision being drawing up the list of potential recipients. But, in the context of individual donor decisions, this would be erroneous if the focus is ODA (as is almost always the case). As mentioned above, only countries on the OECD list of developing countries can potentially receive ODA. Membership of this list is predetermined and is quite separate to the aid allocation decisions of individual donors.

14 Additional details to those provided below can be found in Amemiya (1984).

estimation with the elements of γ_1 and γ_2 being divided by σ, the standard deviation of u_i. The actual aid variable is A_i. Its relationship to equation (9) is:

$$
\begin{aligned}
A_i &= A_i^* \quad \text{if} \quad A_i^* > 0 \\
A_i &= 0 \quad \text{if} \quad A_i^* \leq 0.
\end{aligned}
\tag{10}
$$

Both A_i and the vectors RN_i and DI_i are observed for $i = 1, 2, ..., n$, but A_i^* is only observed (and is observable) for values greater than zero.

The Tobit Type II model in the current context can be written as:[15]

$$
\begin{aligned}
E_i^* &= \delta_0 + \delta_1 RN_i + \delta_2 DI_i + z_{1,i} \qquad z_{1,i} - N\left(0, \sigma_1^2\right) \\
A_i^* &= \varphi_0 + \varphi_1 RN_i + \varphi_2 DI_i + z_{2,i} \qquad z_{2,i} - N\left(0, \sigma_2^2\right),
\end{aligned}
\tag{11}
$$

where E_i^* may be interpreted as the difference in the indirect utilities between allocating and not allocating aid to country i. E_i^* is assumed to be positive if aid is allocated and equal to or less than zero if aid is not allocated. The error terms z_{1i} and z_{2i} jointly distributed with covariance $\sigma_{1,2}$ and equations (11) are simultaneously estimated. In estimation each of the elements of φ_1 and φ_2 are divided by σ_2, the standard deviation of z_{2i}. The actual aid variables are A_i and a binary dummy D_i. Their relationships to equations (11) are:

$$
\begin{aligned}
D_i &= 1 \quad \text{if} \quad E_i^* > 0 \ \text{and} \ A_i > 0 \\
D_i &= 0 \quad \text{if} \quad E_i^* \leq 0 \ \text{and} \ A_i = 0 \\
A_i &= A_i^* \quad \text{if} \quad D_i = 1 \\
A_i &= 0 \quad \text{if} \quad D_i = 0
\end{aligned}
\tag{12}
$$

In the first equation of (11) we in effect observe the sign of E_i^* (as indicated by the value of D_i), along with the vectors RN_i and DI_i for $i = 1, 2, ..., n$. In the second equation, we observe the potential amount of aid only if the net utility from allocating aid is greater than zero (in which case $D_i = 1$). However, for those i for which this is not so (in which case $D_i = 0$), then neither the potential amount, the actual amount or vectors RN_i and DI_i are observed.

A fundamental issue is choosing between the two models of aid allocation. As mentioned, studies seem to arbitrarily opt for one over the other. Both models cannot simultaneously be true and it must be left to the data to choose between them. An appropriate and reasonably straightforward test exists. As Amemiya (1984) notes, the Type I model can be treated as a special case of its Type II counterpart. Provided the same set of explanatory variables is used in both of the latter's equations, it reduces to

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[15] Equations (11) assume that the same set of factors determine the decision to allocate aid *per* se and the amount of aid allocated. This is merely for presentational convenience and it will not necessarily be true in practice.

equation (9) if $\delta_0 = \varphi_0/\sigma_2$, $\delta_1 = \varphi_1/\sigma_2$, $\delta_2 = \varphi_2/\sigma_2$ and $\sigma_1^2 = \sigma_2^2 = \sigma_{1,2}$. The appropriate test basically involves treating equation (9) as a restricted version of equations (11) and comparing the maximum likelihood values obtained from estimating each model. Specifically, it involves testing the null hypothesis

$$H_0 : \delta_0 = \frac{\varphi_0}{\sigma_2}, \quad \delta_1 = \frac{\varphi_1}{\sigma_2}, \quad \delta_2 = \frac{\varphi_2}{\sigma_2} \quad \text{and} \quad \sigma_1^2 = \sigma_2^2 = \sigma_{1,2}$$

using a likelihood ratio (*LR*) test evaluated as

$$LR = 2\left[\ln L(\psi_{UR}) - \ln L(\psi_R)\right] \tag{13}$$

where $L(\psi_{UR})$ is the likelihood value for the unrestricted model (equations 11) and $L(\psi_R)$ is that for the restricted model (equation 9). *LR* is asymptotically distributed as χ_r^2 under H_0, where r is the number of restrictions required to define the null.

3.2 Further hypothesis tests

A rationale for using the RN-DI approach is to see whether a group of need variables is important to aid allocation. This is an entirely appropriate question: aid is in principle about the promotion of development in those countries with the greatest need. The distribution of aid ought reflect, therefore, the relative needs of recipient countries. A way of ascertaining whether this is the case in practice, which does not involve looking at the functional fit of a recipient need model (an approach typically used in RN-DI papers), is warranted. A relatively straightforward alternative is to test the joint significance of the chosen recipient need coefficients (that is, in our current context, those attached to the elements of RN_i). In the case of equation (9), for example, this involves testing the following null hypothesis:

$$H_0 : \frac{\gamma_{1,1}}{\sigma} = \frac{\gamma_{1,2}}{\sigma} = \ldots = \frac{\gamma_{1,j}}{\sigma} = 0 \tag{14}$$

where j is the total number of elements of the vector γ_1. This nested hypothesis may be tested using the *LR* ratio shown above. In this case, $L(\psi_R)$ is obtained by estimating equation (9) with each of the above recipient need coefficients restricted to zero (that is, with each of the corresponding variables dropped from the equation). $L(\psi_{UR})$ is obtained by estimating (9) with all variables retained in its specification.[16] This procedure can

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[16] If one persists with OLS, this hypothesis is evaluated by comparing the sum of squared residuals from the restricted equation (RSS_R) to that from the unrestricted equation (RSS_{UR}) using the following F test:

$$F = \frac{(RSS_R - RSS_{UR})/r}{RSS_{UR}/(N-k)}$$

where r is the number of restrictions (i.e., dropped variables), N is the number of observations and k is the total number of coefficients in the unrestricted equation. If the null hypothesis is true, this test statistic will have an F distribution with r degrees of freedom in the numerator and $N-k$ in the denominator.

also be used to test the joint significance of the donor interest, but with each of the elements of the vector DI_i dropped from the relevant equation. Again using (9), the corresponding null hypothesis is:

$$H_0: \frac{\gamma_{2,1}}{\sigma} = \frac{\gamma_{2,1}}{\sigma} = \ldots = \frac{\gamma_{2,k}}{\sigma} = 0 \qquad (15)$$

where k is the total number of elements of the vector γ_2.

4   United States cold war aid allocation

Does the use of the more econometrically correct modelling approach matter in practice? In particular, would it lead us to draw different conclusions? In this section we answer these questions by applying the limited dependent variable techniques to 1980 United States official development assistance (ODA) data for a sample of 96 developing countries.[17] US aid data, especially those for the late 1970s and early 1980s, are of particular interest. Not only have they received more scrutiny in the literature than those of any other donor, but were used by Maizels and Nissanke (1984) to reject need as a basis for aid allocation.[18] Moreover, the increase in observed effectiveness of aid is in part attributed to a decline in the share of US aid in total aid.

The sample of developing countries was chosen purely on the basis of data availability. It includes 20 countries which did not receive aid from the US in 1980. The indicators of recipient need are GNP per capita, population size, the infant mortality rate and annual GDP growth. The donor interest variables are the value of US arms transfers to country i, the value of US exports to i, a western hemisphere dummy taking the value of one if i is located in that part of the world and zero if otherwise and a special relationship dummy taking the value of one for Israel and Egypt and zero for all other countries. Arms transfers are expressed per head of i's population. Exports are expressed as a ratio of world exports (net of those from the US) to country i. These variables are typical of those used in RN-DI studies and most closely resemble the group of variables used by Maizels and Nissanke (1984). In keeping with the standard practice of these studies, the aid variable is expressed in per capita terms (that is, per head of i's population).[19] Data were obtained from United States Arms Control and Disarmament Agency (1987), Organisation for Economic Co-operation and Development (1984), World Bank (1992) and International Monetary Fund (1984).

Let us first consider the Tobit ML results. These and all other results are shown in Table 1. The hypothesis outlined in equation (13) above was rejected at the 95 per cent confidence level and, as such, the Tobit Type II model was rejected by the data in favour of its Type I counterpart. As shown in Table 1, a likelihood ratio testing the joint

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[17] Further details of the sample are available from the author.

[18] More precisely, Maizels and Nissanke (1984) used average 1978-80 ODA allocations.

[19] Note that the choice of per capita aid is a controversial one that is yet to be settled in the literature. There is a strong argument that absolute aid is the decision variable of donors. Here the former was chosen on the basis of the RN-DI studies using it.

Table 1
Econometric estimates of aid allocation models

		OLS estimates with observations for which A_i=0 included in sample			OLS estimates with observations for which A_i=0 excluded from sample			Tobit ML estimates
		RN model	DI model	Hybrid model	RN model	DI model	Hybrid model	Hybrid model
Constant	$(\alpha_0, \beta_0$ or $\gamma_0)$	0.03	0.03*	0.05	-0.11	0.05*	0.05	0.07
		(0.41)	(3.90)	(1.30)	(-1.55)	(4.94)	(1.01)	(1.63)
Income per capita	$(\alpha_{1,1}$ or $\gamma_{1,1})$	0.14		-0.11*	0.61*		0.01	-0.23*
		(1.77)		(-2.47)	(5.58)		(0.10)	(-3.51)
Infant mortality	$(\alpha_{1,2}$ or $\gamma_{1,2})$	0.02		-0.03	0.13		-0.02	-0.05
		(0.31)		(-0.90)	(1.96)		(-0.36)	(-1.25)
Population	$(\alpha_{1,3}$ or $\gamma_{1,3})$	-0.06		-0.01	-0.09		-0.13	-0.16*
		(-0.57)		(-1.65)	(-0.60)		(-1.37)	(-2.03)
Income growth	$(\alpha_{1,4}$ or $\gamma_{1,4})$	-0.01		0.04	0.07		0.01	0.03
		(-0.12)		(0.93)	(0.79)		(0.18)	(0.57)
Export share	$(\beta_{1,1}$ or $\gamma_{2,1})$		0.06	0.04			0.03	0.04	0.04
			(1.20)	(0.81)			(0.69)	(0.71)	(0.83)
Arms transfers	$(\beta_{1,2}$ or $\gamma_{2,2})$		0.73*	0.83*		0.80*	0.78*	0.91*
			(8.58)	(8.85)		(8.99)	(7.03)	(8.52)
Regional interests	$(\beta_{1,3}$ or $\gamma_{2,3})$		0.04	0.01		0.01	0.00	0.01
			(0.23)	(0.57)		(0.35)	(0.01)	(0.11)
Special relationships	$(\beta_{1,3}$ or $\gamma_{2,4})$		0.22*	0.20*		0.17*	0.18*	0.21*
			(3.51)	(3.21)		(2.68)	(2.67)	(3.01)
σ								0.06*
								(12.23)
Adjusted R^2		0.02	0.7	0.74	0.31	0.75	0.74	
F or LR		1.36	57.71*	31.21*	9.40*	56.99*	28.12*	111.30*
F_{RN} or L_{RN}				2.05			0.59	18.14*
F_{DI} or L_{DI}				57.67*			30.97*	109.11*
n $(A_i \exists 0)$		96	96	96	76	76	76	96
n $(A_i > 0)$		76	76	76	76	76	76	76
n $(A_i = 0)$		20	20	20	0	0	0	20

* denotes significant at the 95% level. LR tests apply to the Tobit ML estimates only. Numbers in the first section of the table not in parentheses are coefficients. Those in parentheses are *t* ratios.

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significance of all coefficients other than the constant was found to be significant at the 95 per cent level. The null hypothesis that $\gamma_{1,1} = \gamma_{1,2} = ... = \gamma_{2,4} = 0$ is therefore rejected.[20] The coefficients of four variables—GNP per capita, population, arms transfers and the special relations dummy—were each found to be significantly different from zero. Based on these results one would conclude, therefore, that both donor interest and recipient need variables seem relevant to 1980 US per capita aid allocation. This conclusion is further supported by the likelihood ratios LR_{RN} and LR_{DI}, which respectively test for the joint significance of the coefficients attached to the recipient need and donor interest variables. In particular, the sign attached to and significance of GNP per capita's coefficient is fully consistent with allocating aid according to need and related humanitarian principles. The only anomaly is the coefficient attached to population, $\gamma_{1,3}$. This coefficient is negative, suggesting that there is a bias favouring small countries in per capita aid. Known in the literature as the 'small country effect', this is in contradiction to the typical assumptions of the RN model and needs-based aid allocation principles in general.

Remarkably similar results to those reported by previous studies were obtained from the OLS regressions, especially those relating to the RN and DI models estimated with observations for which dependent variable is equal to zero retained in the sample. In particular, on the basis of these results, one would have wrongly concluded that recipient need variables individually and collectively have no significant impact on US aid allocation. Estimates of RN and DI models obtained with all observations included in the sample would lead to the conclusion that these variables jointly have no such impact, but that income per capita was positively and significantly related individually with inter-country US aid receipts. Both of these sets OLS estimates fail to detect the small country effect. OLS estimates of the hybrid model also fail to detect this effect and lead to the erroneous conclusion that recipient need variables collectively have no significant impact. OLS estimates of the hybrid model obtained with all observations retained in the sample at least detect the negative correlation between income per capita and US aid. All OLS estimates correctly identify the importance of donor interest variables.

What are the implications of our analysis for previous studies and popular opinion on aid allocation? Three points can be made. First, one must question the results of *all* studies which do not estimate comprehensively specified (or hybrid) models of aid allocation and do not take into account the limited nature of aid allocations. This is irrespective of the results that have been obtained by these studies. Second, further doubt is cast on those studies which have totally rejected need and accepted the importance of donor interest as criteria for aid allocation, especially with respect to US aid for the late 1970s and early 1980s. This is not to say that the conclusions of these studies are necessarily wrong, simply that one cannot rely at all on these conclusions to be correct. Third, and more profoundly, the fact that US aid seems to have been motivated by developmental criteria during at least one of cold war years calls for reconsideration of the view that the increase in development aid effectiveness is in part due to the declining share of this donor's aid in total aid. This is not to say that aid is now based more on developmental criteria than previously, but it does question the extent to which this is the case.

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20 Since the Tobit model has been estimated using the ML approach, a traditional goodness of fit statistic, such as an R^2, is not available.

5   Conclusion

This paper addressed two perceived methodological shortcomings in the aid allocation literature. Implicitly, as well, it questioned the validity of the conclusions drawn by some of the more influential studies belonging to this literature, including the rejection of relative need (and, hence, the humanitarian motive) as a criterion for aid allocation. The first shortcoming concerns aid as a limited dependent variable and applies to all previous inter-country aid allocation models estimated using the OLS method. This represents the overwhelming majority of aid allocation studies. The second shortcoming relates to studies which have used the recipient need/donor interest (RN-DI) modelling approach. The paper argued that this approach is inherently problematic due to specification bias in the recipient need and donor interest equations. At least one of these equations will almost certainly give biased results. Indeed, if one accepts that both the recipient need and donor interests influence aid allocation, then one must necessarily accept that all results of these studies are potentially biased. The paper subsequently suggested alternative procedures for testing the relevance of recipient need and donor interest variables and modelling aid allocation in general. These are related to estimating hybrid equations using limited dependent variable modelling techniques. Two limited dependent variable models were outlined—Tobit Type I and II. An application of these techniques to 1980 US development aid cast further doubt on the veracity of the conclusions drawn by RN-DI studies.

Given this doubt, alternative interpretations of the observed increase in development aid effectiveness is warranted. A number of alternatives could be identified, but here we briefly outline one. The observed increase in aid relies in part on the results of studies of aid effectiveness conducted throughout the 1970s, 1980s and early 1990s, in much the same way it relies on cold war aid allocation studies. Almost 30 years of research on aid and growth produced little or no evidence that aid worked in promoting growth. Burnside and Dollar (1997) represent a turning point in this respect. It was the first study to confidently conclude that aid worked, and its general result—that aid increases growth—has been confirmed by practically all subsequent studies. Yet these earlier aid effectiveness studies have been criticized very heavily on theoretical and empirical grounds. White (1992) is one of a number of studies which concludes that these studies tell us little if anything, about the effectiveness of aid. Among the criticisms of these studies is that they fail to control for non-aid impacts on growth, something which the Burnside and Dollar and subsequent studies address. It follows that the observed increase in aid effectiveness might not be real. That is, it could be the case that aid has always been effective in promoting growth, and the pre-Burnside and Dollar studies simply fail to detect this.

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