Rev Int Org (2006) 1: 337–357
DOI 10.1007/s11558-006-9491-7

Do donors cooperatively fund foreign aid?

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Received: 25 March 2006 / Accepted: 4 May 2006

Abstract Donor's demand equations for alternative forms of aid are derived for three allocation processes: noncooperative Nash-Cournot, cooperative Lindahl, and bureaucratic. Based on OECD data for official development assistance for 1970–2001, we apply non-nested tests to distinguish between Nash-Cournot and Lindahl reduced-form equations for 15 major donor nations. Noncooperative Nash-Cournot behavior characterizes many donors, with a few abiding by bureaucratic behavior and none by Lindahl behavior. Joint products are present for multilateral and bilateral giving. Despite the common-pool nature of giving to multilateral organizations, countries derive donor-specific benefits and often view others' donations as complementary to their own gifts.

Keywords Foreign aid · Multilateral organizations · Donor demand · Public goods · Joint products · Lindahl · Nash-Cournot

JEL codes H41 · F35 · H87

1 Introduction

Foreign aid transfers from developed countries (i.e., donors) to less-developed countries (i.e., recipients) are an established feature of the international system since the end of World War II. In recent years, aid flows are perceived by some as

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conferring purely public benefits so that free riding amongst donors may be a concern (Anand, 2004; Kanbur, Sandler, & Morrison, 1999). Foreign aid has been estimated as providing a large and growing share (over 40% of all aid) in the form of public goods to recipient nations (e.g., Ferroni & Mody, 2002; World Bank, 2001). For example, funding a recipient's adoption of non-ozone-depleting technology provides benefits worldwide. Moreover, reduced poverty provides purely public altruistic benefits to all would-be donor countries. If, however, aid flows generate joint products (i.e., multiple outputs that vary in their degree of publicness), then aid-funded activities may yield purely public *and* donor-specific private benefits. Tied aid, like technical assistance, often involves using manpower from the donor that yields country-specific benefits to the latter, while the recipient and potential donors gain public benefits. Aid as a payoff for votes in international organizations contains donor-specific benefits (see, e.g., Dreher & Sturm, 2006). Donor-specific benefits dissuade donor nations from free riding on other nations' foreign aid contributions, because these benefits can only be achieved by giving.

Foreign aid is targeted at the core sectors of developing countries like health, education, environment, governance, and security. The activities financed through foreign aid transfers can be viewed as yielding some transnational public goods (TPGs), whose benefits are at least regionally, if not globally, nonrivalrous and nonexcludable.[1] As donors disburse funds to the same set of less-developed nations, donors may be viewed as members of a collective whose efforts reduce poverty, which is a TPG for richer nations that care for poorer nations. Coordination amongst donors in disbursing foreign aid is an ideal aspired to by the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD), which provides guidance for donors in pursuing their foreign aid programs. Aid flows to developing countries are channeled either through multilateral organizations (like the World Bank) or through direct bilateral transfers from a donor country to the recipient.

The purpose of this paper is to identify donors' demand for giving foreign assistance when the public good nature of these donations are explicitly taken into account. As such, the strategic interaction *among* donors becomes a crucial consideration. Based on donors' estimated demand for foreign assistance, we identify the underlying allocation process that drives foreign aid donations, which provides national public goods (NPGs) and TPGs while alleviating poverty. In so doing, this paper compares and contrasts donors' behavior for gifts given to multilateral organizations with those given as bilateral aid. Bilateral donations potentially give donor countries more control than multilateral giving over their gifts. By analyzing total, multilateral, and bilateral foreign aid commitments, the paper determines whether donors' foreign aid contributions in their various forms adhere to noncooperative (Nash-Cournot) behavior, cooperative (Lindahl) behavior, or bureaucratic behavior. For bilateral donations, which comprise three-quarters of foreign aid, the paper identifies the underlying allocation process for four geographical regions. To accomplish this identification, we derive reduced-form

[1] Anand (2004), Kaul, Stern & Grunberg (1999), Kaul et al. (2003), and Sandler (1997, 2004) cover several issues related to global and regional public goods, ranging from financing considerations to the underlying nature of these public goods.

donors' demand equations for giving aid for each of these processes. Based on OECD data for 15 primary donor nations for 1970–2001, we apply non-nested tests to distinguish between noncooperative and cooperative behavior among donors. Bureaucratic behavior is tested for those nations whose demand for aid provision abides by neither noncooperative nor cooperative behavior.

Despite over five decades of foreign assistance, we find that no major donor country displays cooperative behavior with respect to multilateral or bilateral giving. For a large number of donors, noncooperative Nash-Cournot behavior best describes the underlying allocation process. In such cases, aid provides *joint products* with essential donor-specific benefits that may be complementary to altruistic-motivated reductions in poverty. Donors tend to view other nations' contributions as complementary when there is spatial propinquity between donor and recipient, past colonial ties, and/or large donations involved. The absence of cooperation bodes badly for free riding, *but* the presence of complementarity among aid-associated joint products attenuates this free riding. Thus, aid may be less undersupplied than usually presupposed owing to donor-specific joint products.[2] Both multilateral and bilateral donations are characterized by joint products. Even though multilateral giving involves common-pool funding, large donor countries apparently derive essential donor-specific benefits. This is a surprising and important insight.

2 Literature Review

The literature on allocation processes within collectives is extensive with most empirical applications pertaining to military alliances that share a public good of defense (McGuire & Groth, 1985; Olson & Zeckhauser, 1996; Sandler & Murdoch, 1990). Olson (1965) highlights the suboptimality of provision levels when allies share a purely public defense output whose benefits are nonrival in consumption (i.e., one ally's defense consumption does not detract from the amount available for other allies to consume) and nonexcludable among allies. Alternative resource allocation processes may underlie allies' contributions to defense or contributors' financing of a shared public good. Noncooperative Nash-Cournot behavior is where each agent chooses its public good provision to optimize its welfare, while taking the choice of the public good by the other agent(s) as given. Noncooperative behavior for a purely public good generally results in suboptimal provision levels that worsen as group size increases (Sandler & Hartley, 2001). The presence of ally-specific benefits in conjunction with alliance-wide public benefits implies that each ally has to make its own contribution to ensure receipt of private benefits. A larger share of the jointly produced private benefits thus diminishes the incentive for free riding and thereby reduces the extent of provision suboptimality.

A second kind of allocative process is Lindahl or cooperative behavior, where each country chooses the ideal total defense provision, given a set of contribution

[2] Donor-specific joint products privatize an activity and limits suboptimality. As the ratio of private joint products to all derived products goes to one, the activity becomes a private good with no free-rider concerns.

shares. When all contributors choose the same overall public good level based on the announced set of shares, a Lindahl equilibrium is obtained that is Pareto optimal. A simple bureaucratic process represents a third allocation method to determine a nation's public good provision. For instance, a country's current period commitment to a public good may reflect the previous period's commitment as bureaucrats try to maintain or slowly expand their responsibilities (Sandler & Hartley, 1995: 90–92).

A group of donors contributing to foreign aid is analogous to an alliance sharing the burden of a public good because donors receive benefits from their own donations as well as those of other countries. Few attempts have been made to study the underlying allocation process of donor nations' commitments to foreign aid. Rowlands & Ketcheson (2002) test for two broad concepts of coordination: complementary[3] (i.e., donors coordinate their activities to achieve an overall distributional goal) and supplementary (i.e., donors share the burden of foreign aid in an equitable manner). The authors test these concepts for data on sub-Saharan Africa for sample donors, and find little support for supplementary coordination. Overall, no clear pattern was discernible.

One of the more comprehensive efforts at examining the determinants of aid allocation by multilateral institutions is by Neumayer (2003), who analyzes the lending behavior of two sets of multilateral agencies: the United Nations (UN) and the regional development banks. His study uncovers some evidence of the multilateral aid agencies furthering bilateral strategic interests when disbursing funds—e.g., providing more aid to former colonies of donor countries. The regional development banks are found to focus on the economic needs of the recipient as measured by per capita income. While Neumayer (2003) analyzes the lending behavior of multilaterals, our paper studies the allocation behavior of donors contributing to these institutions for normative insights—e.g., the extent of free riding implied. For multilateral aid, the presence of Nash behavior and joint products in our study is *entirely consistent* with Neumayer's findings of bilateral strategic interests.

Other recent papers also relate donors' aid contributions to strategic and political considerations. Alesina & Dollar (2000) indicate that strategic interests (e.g., recipients' location), colonial ties, trade considerations, and democratic values motivate rich donor countries to provide aid. In a follow-up study, Gates & Hoeffler (2004) show that the Nordic countries are less driven by these donor-specific gains from aid. Poverty, as measured by low income in recipient countries, drives Nordic donations. Donor-specific benefits can also arise from recipients aligning their political orientation to that of the donor (Andersen, Harr, & Tarp, 2006; Mavrotas & Villanger, 2006; Thacker, 1999). All of these donor-specific motives are consistent with our joint-product representation, where poverty reduction is jointly produced with outcomes that benefit the donor. These earlier papers do not, however, examine a public good motive for aid and, thus, do not investigate the strategic interaction *among donor countries*.

[3] These authors do not use complementarity in the sense of the standard utility-based notion of two goods' enhancing one another's utility. It is this latter sense that we use in referring to complementary joint products.

3 Theoretical Models

Foreign aid supports, in part, public good activities whose benefits may spill over the borders of the recipient nation. For example, efforts to rid a country of a pest or security concern provide protection to neighboring countries. Even actions to alleviate poverty make for a healthier population which is more resistant to diseases that could spread abroad. Spillovers may also arise from altruistic rewards as a recipient population's well-being is improved. Thus, foreign aid is an activity that yields global purely public, recipient-specific, and donor-specific benefits. We treat a donor nation as a single decision-making entity.

3.1 Nash-Cournot Pure Public Goods and Joint-Product Models

First consider the Nash-Cournot pure public goods representation of foreign assistance. Each donor nation consumes a pure private good, y^i, and a pure public activity, Q^i, to which each nation contributes q^i. Contributions may take various forms in the ensuing empirical analysis, so that q^i may represent a donor's multilateral contributions, or its bilateral contributions, or the sum of the two types of contributions. The public good, derived from foreign assistance, equals the sum of all donor nations' contribution levels; i.e., $Q^i = q^i + \tilde{Q}^i$, where $\tilde{Q}^i = \sum_{j \neq i} q^j$ is the contribution to the public activity of all donor nations excluding nation i. Donor nation i's well-behaved utility function, U^i is represented by

$$U^i = U^i\left(y^i, q^i + \tilde{Q}^i\right), \tag{1}$$

where both goods are normal. Its budget constraint is

$$I^i = p_y y^i + p_Q q^i, \tag{2}$$

where I^i is the national income of nation i, p_y is the price of the private good, and p_Q is the price of the public activity. This representation implicitly assumes that donors benefit from the potential poverty-reducing outcome that is anticipated to arise from their contributions. The term $p_Q\tilde{Q}^i$ (the value of others' aid contributions) is added to both sides of Eq. 2 to convert the budget constraint to the full-income form. Full income, $F^i = I^i + p_Q\tilde{Q}^i$, indicates *the total disposable income* available to nation *i and includes the spillovers* from the other donor nations' contributions to the public good activity.

The problem confronting nation i is to

$$\max_{\{y^i, Q^i\}} \left\{U^i\left(y^i, Q^i\right) \middle| F^i = p_y y^i + p_Q Q^i\right\}, \tag{3}$$

in which each donor views itself as choosing the total foreign assistance, subject to a budget constraint incorporating the value of the exogenously fixed donations from others. This full-income representation results in a demand equation system that can be compared with that derived from a Lindahl process. In Eq. 3, we assume that $Q^i > \tilde{Q}^i$ because we have donor countries in our sample. The first-order conditions associated with Eq. 3 immediately give donor i's demand for total foreign assistance as a function of the price of the private good, the price of foreign assistance, and

full income:

$$Q^i = Q^i\left(p_y, p_Q, F^i\right). \tag{4}$$

A Nash-Cournot equilibrium results when all donor nations desire the same Q allocation. The resulting equilibrium implies a Pareto-suboptimal allocation owing to free riding. Since the public activity is assumed to be a normal good, a change in full income will increase each nation's equilibrium demand, so that $\partial Q^i/\partial F^i > 0$ for every nation i and the Nash equilibrium is unique (Cornes & Sandler, 1996).

For the joint-product representation, a donor receives multiple benefits that include a purely public benefit from altruistic motives and donor-specific benefits from selfish gains. The latter may capture derived benefits from conditionality, induced political changes in the recipient, or votes in multilateral organizations. The reduced-form equation for donor i's demand function for foreign assistance is:[4]

$$Q^i = Q^i\left(p_y, p_Q, F^i, \tilde{Q}^i\right). \tag{5}$$

Donor i's foreign assistance demand depends on the price of the private good, the price of the foreign assistance activity, full income, and the *spillin* contributions (bilateral, multilateral, or both) of other donor countries. The Nash-Cournot equilibrium results when every donor nation chooses the same level of Q^e for Eq. 5. The partial effect of a change in foreign aid spillovers on the total provision of the joint-product activity can be broken down into: $\frac{\partial Q^i}{\partial \tilde{Q}^i} = \frac{\partial\left(q^i + \tilde{Q}^i\right)}{\partial \tilde{Q}^i} = \frac{\partial q^i}{\partial \tilde{Q}^i} + 1$. If $\partial q^i/\partial \tilde{Q}^i > 0$, then donor nation i views its own contribution to the joint-product activity as complementary to the contributions of all other donors. If $\partial q^i/\partial \tilde{Q}^i < 0$, then donor nation i views the other donor nations' contributions to the joint-product activity as a substitute for its own assistance. In the latter case, a donor nation free rides on the donations of others. For complementary joint products, increased donations by others induce i to augment its own donations to get more of the donor-specific complementary output (e.g., political concessions or trade agreements) that can come only from its own charity. Complementarity curbs free riding (Cornes & Sandler, 1996).

Comparison of the Nash-Cournot demand in Eq. 4 for the pure public representation and in Eq. 5 for the joint-product representation of foreign assistance indicates the presence of an added $\tilde{Q}^i$ term in Eq. 5. This allows for a simple *nested* test to distinguish between the two models based on the significance of the coefficient associated with the spillin term.

3.2 Lindahl Pure Public Goods and Joint-Product Models

Lindahl behavior involves donor nations cooperating with each other to determine the total amount of foreign aid. The share of the total cost of the public good borne by nation i is θ^i. The sum of the cost shares for the set of donor nations must add up to unity, so that bilateral (multilateral) donors bear the total cost of bilateral (multilateral) aid provision.

[4] We refer the reader to a longer version of the paper, available from the authors, for details. Alternatively, the reader can examine Sandler & Murdoch (1990) for the derivation of Eq. 5.

For either the pure public good or joint-product representation, donor i's reduced-form Lindahl demand for foreign assistance is:

$$Q^i = Q^i\left(p_y, \theta^i p_Q, I^i\right). \tag{6}$$

In Eq. 6, foreign assistance is a function of the price of the private good, the aid-share price of donor i, and the income of donor i (Cornes & Sandler, 1996: 497–498). An equilibrium under the Lindahl process is reached when every nation desires the same overall level of foreign assistance, $Q^e = Q^i$ such that $\sum_i \theta^i = 1$. A change in the cost share term θ^i results in an income effect and a substitution effect. The substitution effect is negative. For normal goods, an increase in the cost share also results in a decrease in the nation's demand for foreign assistance. As a cooperative process, the Lindahl equilibrium represents a Pareto-optimal solution because donor nations internalize all benefit spillovers.

3.3 Bureaucratic Allocation Processes

When nations subscribe to neither Nash-Cournot nor Lindahl behavior, there may be some underlying bureaucratic allocation process that determines foreign aid commitments. A bureaucrat is typically characterized as seeking to maximize his/her budget or responsibilities, since remuneration is often based on these responsibilities (Mueller, 2003). In the case of foreign aid, a bureaucrat not only wants to spend the previous year's aid budget, but would ideally desire to see a small increase in its next year's budget and will lobby for this increase. Thus, a naïve model of bureaucratic-based foreign aid allocation characterizes this year's aid contribution to be k times last year's allocation. Such a representation eschews any public good considerations. This naïve model is displayed as:

$$q_t^i = c + kq_{t-1}^i, \quad (\text{Model } B1) \tag{7}$$

where q_t^i is i's foreign aid commitment in the current period, c is a constant, q_{t-1}^i is its commitment in the previous period, and k is a constant coefficient. If the bureaucratic inertia is, instead, based solely on budgetary considerations, then the bureaucratic foreign aid allocation in the current period would be a proportion of its previous period's national income $\left(I_{t-1}^i\right)$:

$$q_t^i = \overline{c} + \overline{k}I_{t-1}^i, \quad (\text{Model } B2) \tag{8}$$

where $\overline{c}$ is a constant intercept and $\overline{k} > 0$. A joint model with both the previous year's aid commitment and income is also considered as a possible bureaucratic allocation process, where

$$q_t^i = \widehat{c} + \widehat{k}q_{t-1}^i + mI_{t-1}^i. \quad (\text{Model } B3) \tag{9}$$

These bureaucratic models capture some sort of inertia that allocates foreign aid based on past allocations, share of past national income, or both. The goodness of fit of the model (in terms of the coefficient of determination) is utilized to conclude which of these three models best describes the type of bureaucratic allocation process when such a process appears relevant.

4 Empirical Specification

The allocation behavior of 15 primary aid donor countries—Australia, Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, United Kingdom, and United States—are investigated. Foreign aid commitments for 1970–2001 are judged to be the outcome of an equilibrium process involving either Nash-Cournot or Lindahl behavior. Not all DAC donor countries are examined in this study, because there are insufficient observations for some donors to carry out a meaningful data analysis. Countries like Finland, Ireland, Iceland, Luxembourg, New Zealand, Portugal, and Spain give aid to developing countries but not for all 32 sample years. Because the foreign aid contributions given by these countries are substantial in a few years, these flows are included in the contribution spillins that each donor receives from other donor nations so that the spillover effects are not underestimated.

Given the diverse activities funded in developing countries by foreign aid transfers, the prices of these activities cannot be gauged. For this study, we assume that the prices of foreign assistance and the private numèraire good change by the same proportion over time, while this assumption might be regarded as highly restrictive there is no reasonable alternative to capture this proportion. Deflated expenditure figures for all variables—I^i, F^i, Q^i and $\tilde{Q}^i$—are used to incorporate the price of the private good.

A log-linear statistical specification of the models is utilized that allows us to interpret the coefficients as elasticities. The statistical model for the Nash-Cournot joint-product demand for contributions based on Eq. 5 is

$$ln\,\mathrm{ODA}_t = \beta_{i0} + \beta_{i1}\ ln\,\mathrm{FULLINCOME}_{it} + \beta_{i2}\,ln\,\mathrm{SPILLIN}_{it} + \varepsilon_{it}^N, \qquad (10)$$

where ODA_t is the total official development assistance (ODA) in terms of bilateral donations, multilateral donations, or both, given by all DAC donor countries in time period t; $\mathrm{FULLINCOME}_{it}$ is the sum of donor i's national income (i.e., gross domestic product) *and* the spillins from the other nations' aid donations; $\mathrm{SPILLIN}_{it}$ is the relevant contributions from all DAC nations, excluding nation i; and ε_{it}^N is the error term. The β_is are unknown parameters. By setting $\beta_{i2} = 0$, we get the Nash-Cournot pure public representation of foreign assistance. A nested test of this coefficient thus *distinguishes* between the pure public good and the joint-product Nash-Cournot representation of foreign assistance. Given the log-linear specification, the β_{i2} coefficient indicates the responsiveness of various aid provision levels to changes in aid spillovers:[5] $\beta_{i2} = \frac{\tilde{Q}^i}{Q^i}\left(\frac{\partial q^i}{\partial \tilde{Q}^i} + 1\right)$. Therefore, the partial effect of a change in nation i's aid commitments in response to a change in spillovers consists of $\frac{\partial q^i}{\partial \tilde{Q}^i} = \frac{\beta_{i2}}{\tilde{Q}^i/Q^i} - 1$.

The log-linear specification of the Lindahl model, based on Eq. 6, is

$$ln\,\mathrm{ODA}_t = \lambda_{i0} + \lambda_{i1}\,ln\,\mathrm{GDP}_{it} + \lambda_{i2}\,ln\,\mathrm{SHARE}_{it} + \varepsilon_{it}^L, \qquad (11)$$

where GDP_{it} is donor i's gross domestic product in time period t; SHARE_{it} is donor i's share of the total relevant contributions made to ODA by all DAC donor

[5] The elasticity of total commitments equals $\beta_{i2} = \frac{\partial Q^i/Q^i}{\partial \tilde{Q}^i/\tilde{Q}^i} = \frac{\partial Q^i}{\partial \tilde{Q}^i}\frac{\tilde{Q}^i}{Q^i} = \frac{\tilde{Q}^i}{Q^i}\left(\frac{\partial q^i}{\partial \tilde{Q}^i} + \frac{\partial \tilde{Q}^i}{\partial \tilde{Q}^i}\right) = \frac{\tilde{Q}^i}{Q^i}\left(\frac{\partial q^i}{\partial \tilde{Q}^i} + 1\right)$.

countries [i.e., SHARE_{it} = (Commitment_{it}/ODA_t) where Commitment_{it} is the contribution of nation i in time period t]; λs are unknown parameters; and ε_{it}^{L} is the error term.

Some empirical issues arise from the above specifications. Endogeneity is a concern because the FULLINCOME_{it} and the SPILLIN_{it} terms are correlated with the error term in the Nash-Cournot specification, while the SHARE_{it} term is correlated with the error term in the Lindahl specification. To address this problem, we apply two-stage least squares (2SLS) with the exogenous variables in the system (i.e., the GDPs of all donor nations) as instrumental variables. The standard practice is to use all the exogenous variables, not correlated with the error term as instruments to estimate the endogenous variables. Autocorrelation of the error terms in both models is also a problem and the Durbin–Watson test was performed to check for the presence of autocorrelation. If the autoregressive process is found to be of the first order, it can be represented as $\varepsilon_{it}^{N} = \rho^{N}\varepsilon_{it-1}^{N} + u_{it}$ for the Nash-Cournot model and $\varepsilon_{it}^{L} = \rho^{L}\varepsilon_{it-1}^{L} + v_{it}$ for the Lindahl model (Greene, 1997). Reliable estimates for ρ^{N} and ρ^{L} can be obtained using the residuals from the 2SLS procedure, given by:

$$\widehat{\rho}^{\,j} = \frac{\sum_{t=2}^{32} \widehat{\varepsilon}_{it}^{j}\widehat{\varepsilon}_{it-1}^{j}}{\sum_{t=2}^{32}\left(\widehat{\varepsilon}_{it}^{j}\right)^{2}}, \text{ for } j = N,\ L. \tag{12}$$

These estimates for $\widehat{\rho}^{N}$ and $\widehat{\rho}^{L}$ are then used to transform the variables in the Nash-Cournot joint product and Lindahl specifications.

Whenever autocorrelation is found to be a problem, the coefficients used to transform the variables are displayed in the tables along with the other parameter estimates. The transformation of the variables using the autocorrelation coefficient does not alter either the value or the interpretation of the parameter estimates.

The empirical specification for bureaucratic behavior again uses the log-linear form, where the three models are:

$$ln\ \text{Commitment}_{it} = \delta_{i0} + \delta_{i1}\ ln\,\text{Commitment}_{it-1} + \mu_{it}, \tag{13}$$

$$ln\,\text{Commitment}_{it} = \phi_{i0} + \phi_{i1}\ ln\,\text{GDP}_{it-1} + \upsilon_{it}, \tag{14}$$

$$ln\,\text{Commitment}_{it} = \varphi_{i0} + \varphi_{i1}\ ln\,\text{Commitment}_{it-1} + \varphi_{i2}\ ln\,\text{GDP}_{it-1} + \omega_{it}, \tag{15}$$

where μ_{it}, υ_{it} and ω_{it} denote the error terms. In Eqs. 13–15, δs, ϕs, and φs represent unknown parameters. Since autocorrelation of the error terms in the bureaucratic models is a possibility, it is tested and corrected whenever encountered. We also test the stationarity of the time series for all three bureaucratic models. If the time series is found to have a unit root, then the series is first differenced to achieve stationarity. For the third bureaucratic model, we check for possible cointegration

of the explanatory variables and correct for it when encountered.

4.1 Choosing between the Nash-Cournot and the Lindahl Allocation Process: *J* Test

On comparing the foreign assistance demand equations for the Nash-Cournot joint-product representation in Eq. 5 and the Lindahl model in Eq. 6, we see that these equations are non-nested, but since they can be made to share the same dependent variable, a *J* test (MacKinnon, White, & Davidson, 1983) can be utilized to distinguish between the two models. The *J* test requires the two models to have the same instrumental variables, independent and identically distributed error terms, and identical dependent variables. The first condition is satisfied, and the second condition is assumed. Due to the presence of autocorrelation, the variables in the models are transformed using the estimated coefficients $\widehat{\rho}^N$ and $\widehat{\rho}^L$. After correcting for autocorrelation, we transform the dependent variables in the two specifications so that both have the identical dependent variable, $ln\text{ODA}_t$.[6]

The resulting equations are then estimated by 2SLS to obtain predicted values of the dependent variable $ln\text{ODA}_t$ under the two behavioral assumptions. The predicted value of ODA_t under the Lindahl model (i.e., $ln\text{ODA}_t^L$) is plugged into the Nash-Cournot specification and the combined model is then estimated. The coefficient associated with this predicted value in the combined model is α_i^L. Similarly, the predicted value of $ln\text{ODA}_t$ under the Nash-Cournot model (i.e., $ln\text{ODA}_t^N$) is plugged into the Lindahl specification with the coefficient α_i^N in the combined model. The *J* test is based on the significance of the *t*-ratios associated with the coefficients α_i^N and α_i^L. The following two hypothesis and their alternatives must be tested:

Hypothesis 1 Maintain the Nash-Cournot joint-product model.

This hypothesis can be tested by using the following linear restrictions:

$$H1_0 : \alpha_i^L = 0,\ H1_A : \alpha_i^L \neq 0, \text{ for each } i.$$

The null hypothesis implies that the Lindahl predicted value does not significantly explain the dependent variable under the Nash-Cournot specification. Failure to reject $H1_0$ provides support for Nash-Cournot behavior. If, however, $H1_0$ is rejected, we must reject Nash-Cournot as the allocative process.

Next, we define:

Hypothesis 2 Maintain the Lindahl specification.

This hypothesis is tested with the following linear restrictions:

$$H2_0 : \alpha_i^N = 0,\ H2_A : \alpha_i^N \neq 0, \text{ for each } i.$$

If we do not reject null hypothesis 2, then the Nash-Cournot predicted value does not explain the dependent variable, so that Lindahl behavior applies. If, instead, we

[6] The required transformation is displayed in the longer version of the paper.

reject null hypothesis 2, then the Lindahl allocative mechanism does *not* describe the allocative behavior of donors. With the *J* test, it is possible that both models are rejected or that neither model is rejected, in which case there is no way to choose between competing paradigms.

5 Data

The International Development Statistics Online Database of the OECD provides data on the foreign aid commitments of DAC donor countries.[7] This database provides information on volume, origin, and types of aid and resource flows to over 180 aid recipients. The present study utilizes transfers categorized as ODA and OA that encompass multilateral and bilateral aid flows from donors to developing nations and countries in transition, respectively, that are concessional in nature and aimed at poverty alleviation and fostering economic development. Foreign aid commitments, rather than actual disbursements, by donors are utilized for the analysis. Commitments constitute a written obligation backed by funds on the part of the donor to provide these resources for development assistance.[8] Disbursements involve placing these funds at the disposal of the recipient country, and may be measured in different ways depending on the transfer process and length of the project. For this study, the annual outlays of donor countries are viewed as the outcome of some equilibrium process and, hence, commitments are the more appropriate measure.

The database provides information on the geographical destination of commitments that allows an investigation of aid flows to specific regions for *bilateral* transfers. Regional analysis of aid flows provides a better mapping of donors with benefits accruing to them from giving development assistance. Bilateral foreign aid commitments to four main regions: Africa, America, Asia, and Europe are studied. The data covers 1970–2001 so there are 32 years of observations, unless otherwise noted. Data on individual donor countries' GDP and price deflator are taken from the *World Development Indicators* maintained by the World Bank. GDP for each donor is in current US dollars employing the current exchange rate for the conversion from the local currency. The implicit GDP deflator of the United States is then used to obtain the real GDP for all donor countries with the base year 1995. Estimates for $\tilde{Q}^i/Q$ are obtained by taking the average of the ratio of SPILLINS to total bilateral aid commitments for each donor over the entire time period under consideration.

[7] The paper uses data from the Destination of Official Development Assistance and Official Aid Commitments (Table 3a) which is part of the DAC online Database on Annual Aggregates. The International Development Statistics database that encompasses the DAC online database is available online at http://www.oecd.org/dataoecd/50/17/5037721.htm.

[8] The DAC Statistical Reporting Directives provides the guidelines that donors use for reporting foreign aid. The directives are available online at http://www.oecd.org/dataoecd/36/32/31723929.htm.

6 Results

6.1 Total Foreign Aid

Total foreign aid is the sum of bilateral donations given directly to recipient nations and donations given to multilateral institutions (e.g., the World Bank and regional development banks). These latter institutions disburse funds from a common pool to recipients. As such, multilateral aid is anticipated to possess a greater degree of purely public, altruistic benefits with fewer donor-specific benefits. Based on the *J* test (see Table 1), we find that seven donors—Canada, Demark, France, Germany, Japan, the Netherlands, and Sweden—abide by Nash-Cournot behavior when committing total foreign aid. For these seven countries, we cannot reject null hypothesis 1 so that the Lindahl predictive values are *not* different than zero, thereby supporting the Nash-Cournot model—see hypothesis 1 columns in Table 1. For all sample countries, we reject null hypothesis 2 so that there is *no evidence for Lindahl behavior*—see hypothesis 2 columns in Table 2. In no case is there evidence of both Nash-Cournot and Lindahl behavior. Eight donors abide by neither Nash-Cournot or Lindahl behavior. For these donors, we test for bureaucratic behavior. After we adjust for unit roots, only Norway follows a bureaucratic model (B1), where $\delta_{t1} = 0.8060$ and $R^2 = 0.90$. The other seven donors do not conform to any of the three allocation processes.

The parameter estimates for the Nash-Cournot model are presented in Table 2 along with autocorrelation coefficient if relevant. The coefficients associated with the full-income terms are positive and significant at the 10% level or better for ten donor nations. Thus, there is strong evidence of income normality for donations. The spillin term is positive and significant at the 5% level for all donor nations, thus

Table 1 *J*-test results for the Nash-Cournot model and the Lindahl model for total foreign aid

Country	Hypothesis 1: Nash–Counot			Hypothesis 2: Lindahl		
	$\widehat{\alpha}^L$	*t*-ratio	Conclusion	$\widehat{\alpha}^N$	*t*-ratio	Conclusion
Australia	−0.16628	−6.66	Reject	1.02800	569.82	Reject
Austria	−0.17583	−2.97	Reject	0.96567	150.09	Reject
Belgium	0.70406	5.29	Reject	0.94966	372.18	Reject
Canada	0.05623	0.72	Cannot reject	0.98913	126.68	Reject
Denmark	−0.05417	−1.53	Cannot reject	0.95441	191.17	Reject
France	−0.09102	−0.41	Cannot reject	0.90037	65.19	Reject
Germany	−0.09064	−0.43	Cannot reject	0.94561	88.87	Reject
Italy	0.84206	5.07	Reject	1.05861	42.72	Reject
Japan	−0.12813	−1.94	Cannot reject	1.15438	32.22	Reject
Netherlands	0.18262	1.65	Cannot reject	0.94470	113.48	Reject
Norway	0.42929	4.11	Reject	0.95858	208.54	Reject
Sweden	−0.03678	−0.87	Cannot reject	0.96023	214.41	Reject
Switzerland	0.09515	2.90	Reject	1.03618	136.64	Reject
United Kingdom	0.51169	3.27	Reject	0.93604	77.52	Reject
United States	11.74617	6.38	Reject	1.18708	19.42	Reject

The *t*-ratios are distributed normal with zero mean and unit variance. The critical value of the *t*-ratio is 2.45, giving a confidence level of 0.025.

Table 2 Parameter estimates of the Nash-Cournot joint-product model for total foreign aid

Country	$\hat{\rho}^N$	$\hat{\beta}_0$ (intercept)	$\hat{\beta}_1$ (fullincome)	$\hat{\beta}_2$ (spillin)	$\frac{\partial q}{\partial Q} = \frac{\hat{\beta}_2}{Q/Q} - 1$
Australia	–	0.366419**	0.012785*	0.972244**	−0.006792
Austria	–	−0.150230**	0.015291**	0.990346**	−0.001583
Belgium	0.675977	0.046384	0.033232**	0.959677**	−0.023600
Canada	0.544269	0.418910*	0.021783	0.940726**	−0.013882
Denmark	–	−0.290262**	0.026398**	0.984850**	0.002854
France	0.253603	−0.316456	−0.002851	1.025082**	0.149597
Germany	0.634243	−0.211540	0.043686	0.979334**	0.123989
Italy	0.839470	−0.009687	0.055390*	0.942691**	−0.013996
Japan	–	−0.191563	0.210572**	0.755252**	−0.080999
Netherlands	0.559779	−0.104421	0.045622**	0.962510**	0.008225
Norway	0.438704	−0.058495	0.020264**	0.983714**	−0.000902
Sweden	–	−0.191224	0.045621**	0.960436**	−0.010576
Switzerland	–	−0.223000**	0.013532	0.995123**	0.005955
United Kingdom	0.473923	0.473426**	0.040426*	0.920869**	−0.020733
United States	0.299763	5.429334**	−0.041825	0.744588**	−0.002566

* Statistical significance at the 10% two-tailed levels of significance.
** Statistical significance at the 5% two-tailed level of significance.

validating the joint-product representation of donor commitments for total foreign aid. Five donors—Denmark, France, Germany, the Netherlands, and Switzerland—treat the other nations' donations as complementary to their own donations. Germany and France are the third and fourth largest contributors of total aid. This means that these five countries are motivated to contribute more as others increase their contributions. The other countries display free riding; however, the *degree of free riding is rather modest* as can be seen by the small absolute values of the reaction paths' slopes, displayed in the right-hand column of Table 2. These donors are not greatly cutting back their foreign aid as others give more, which may stem from donor-specific benefits. The absence of any cooperative behavior is quite noteworthy in light of these donors having given aid for so many years.

6.2 Total Multilateral Commitments

Next, we investigate total multilateral giving for the sample donors. Based on the J tests, five donors—Australia, Austria, Canada, Switzerland, and the United Kingdom—conform to Nash-Cournot independent behavior, while *no* donor displays cooperative Lindahl behavior. There is no instance where there is evidence of Nash-Cournot and Lindahl behavior. The J-test results for this and the remaining cases are in Appendix tables, available upon request. We again test for bureaucratic behavior for sample countries that abide by neither allocative process. Norway continues to subscribe to the first type of bureaucratic behavior ($\delta_{i1} = 0.7540$ and $R^2 = 0.92$), while Japan abides by the third type of bureaucratic behavior ($\varphi_{i1} = 0.3414$, $\varphi_{i2} = 0.4246$ and $R^2 = 0.63$). Eight of the donors do not follow any of the allocative behaviors.

Table 3 provides the parameter estimates of the Nash-Cournot model for multilateral commitments. The full-income coefficients are positive for 13 donors and are significant at the 10% level or better for nine donors; thus, there is again

Table 3 Parameter estimates of the Nash-Cournot joint-product model for total multilateral commitments

Country	$\hat{\rho}^N$	$\hat{\beta}_0$ (intercept)	$\hat{\beta}_1$ (fullincome)	$\hat{\beta}_2$ (spillin)	$\frac{\partial q}{\partial Q} = \frac{\hat{\beta}_2}{Q/Q} - 1$
Australia	0.461273	−0.102892	0.014255	0.992769**	0.009838
Austria	0.320241	−0.019798	0.010683*	0.989891**	−0.000991
Belgium	0.338078	0.029659	0.021021**	0.975766**	0.000532
Canada	0.530706	0.374505	0.027858	0.936051**	−0.007494
Denmark	0.374558	−0.212186**	0.038938**	0.973139**	0.002755
France	0.484001	−0.573626**	0.068945**	0.969853**	0.065493
Germany	0.551203	−1.384184**	0.154042**	0.953894**	0.118387
Italy	0.455742	−0.562601	0.054168	0.984552**	0.075770
Japan	–	−1.043726*	0.064158**	0.972313**	0.117854
Netherlands	–	−0.419779	0.007007	1.012168**	0.062155
Norway	0.403187	0.073449	−0.000564	0.996363**	0.019720
Sweden	0.492279	0.110732	0.044359**	0.942679**	−0.021981
Switzerland	–	−0.206136*	0.019696*	0.987411**	−0.000686
United Kingdom	–	−0.703887**	0.036076*	0.991515**	0.082458
United States	–	6.570428**	−0.087354	0.836913**	0.053783

* Statistical significance at the 10% two-tailed levels of significance.
** Statistical significance at the 5% two-tailed level of significance.

strong evidence of income normality. The spillin coefficients are positive and significant for all donors, thereby indicating that donors receive private benefits in addition to public altruistic benefits from their multilateral gifts. This result is rather surprising since most donations are lumped together in a common pool for the recipient. Eleven of the donors treat commitments to multilateral institutions as complementary to those of other donors, including the six largest donors—the United States, Germany, Japan, France, Italy, and the United Kingdom. Because the largest stakeholders have the greatest say in the distribution of multilateral funding to developing nations, these sizable donors capture some donor-specific private benefits by exercising this influence. For instance, donor-specific benefits can arise from large stakeholders in the World Bank and other multilateral aid agencies obtaining political and strategic concessions from recipient nations (Alesina & Dollar, 2000; Andersen et al., 2006; Gates & Hoeffler, 2004; Mavrotas & Villanger, 2006; Dreher & Sturm, 2006). This, then, may explain why joint products characterize multilateral giving. The presence of complementary joint outputs is a hopeful sign that free riding is attenuated somewhat despite the absence of cooperation. The absence of cooperative behavior is another surprising result for multilateral donations.

6.3 Total Bilateral Commitments

Now, we turn to total bilateral commitments. On average, 74% of foreign aid is given via bilateral transfers from donor nation to recipient nations, so that only 26% is in the form of multilateral giving. Austria, Canada, Germany, Italy, the Netherlands, and Sweden abide by Nash-Cournot behavior, while no donor displays cooperative Lindahl behavior. For those donors, not just adhering to either Nash-Cournot or Lindahl behavior, we tested for bureaucratic behavior. Norway's actions

are consistent with last year's commitment to bilateral aid explaining the variation in current donations (δ_{i1} = 0.8155 and R^2 = 0.83). Switzerland bases its current bilateral donations on the previous year's contribution (φ_{i1} = 0.5236) and GDP (φ_{i2} = 0.7485) with R^2 = 0.84. The other seven sample donors do not abide by any of the three allocation processes.

The Nash-Cournot parameter estimates are presented in Table 4. The full-income coefficient is positive for most donors and significant for seven donors, indicating that donors generally view bilateral foreign aid as a normal good. The estimated full-income coefficients appear to be fairly similar for several donors. In Table 4, the Nash-Cournot joint-product specification can be seen to dominate the pure public specification by examining the estimates on the spillin coefficient, $\widehat{\beta}_{i2}$. For all donors, the spillin coefficients are positive and highly significant; hence, a nested test on this coefficient would reject the pure public good hypothesis in favor of the joint-product specification. Thus, all donor countries view bilateral foreign aid as providing donor-specific gains (e.g., political concessions) along with purely public altruistic benefits.

The slopes of the donors' Nash reaction paths (i.e., $\partial q/\partial \tilde{Q}$) are computed in the right-hand column of Table 4. Some important contributors—Austria, Canada, Denmark, France, Germany, Switzerland, and the United Kingdom—view bilateral donations as complementary. For these countries, donor-specific benefits promote aid despite some purely public altruistic benefits. The largest donors—the United States and Japan—free ride on the bilateral contributions of other donors. However, four of the seven largest bilateral contributors view their donations as complementarity to those of other donors. As a whole, multilateral donations display greater complementarity compared with bilateral donations, which is surprising.

The distribution of bilateral development assistance to the four major aid receiving regions is depicted in Fig. 1, where all amounts are in constant US dollars with a base year of 1995. Bilateral assistance peaks around 1990 after which there

Table 4 Parameter estimates of the Nash-Cournot joint-product model for total bilateral commitments

Country	$\widehat{\rho}^N$	$\widehat{\beta}_0$ (intercept)	$\widehat{\beta}_1$ (fullincome)	$\widehat{\beta}_2$ (spillin)	$\frac{\partial q}{\partial \tilde{Q}} = \frac{\widehat{\beta}_2}{\tilde{Q}/Q} - 1$
Australia	–	0.541719**	0.009556	0.968283**	−0.009320
Austria	–	−0.231208*	0.009922	0.999281**	0.007098
Belgium	0.661995	0.040942	0.025931**	0.967854**	−0.017625
Canada	0.367983	0.587598*	0.002174	0.961169**	0.003794
Denmark	–	−0.209596**	0.021721**	0.986218**	0.000216
France	–	0.007181	−0.034253	1.043876**	0.179989
Germany	0.648166	0.115017	0.003385	0.988042**	0.126246
Italy	0.801096	−0.051977	0.041773	0.964777**	−0.006869
Japan	–	0.241777	0.239535**	0.716646**	−0.107826
Netherlands	0.527173	−0.053617	0.055876**	0.945839**	−0.009521
Norway	–	−0.167547**	0.028240**	0.977659**	−0.009627
Sweden	–	−0.309921*	0.042200**	0.968527**	−0.003815
Switzerland	–	−0.237270	0.011081*	0.998296**	0.008854
United Kingdom	0.488488	0.407621*	0.011532	0.956457**	0.010440
United States	0.389955	4.857467**	−0.031334	0.720413**	−0.012951

* Statistical significance at the 10% two-tailed levels of significance.
** Statistical significance at the 5% two-tailed level of significance.

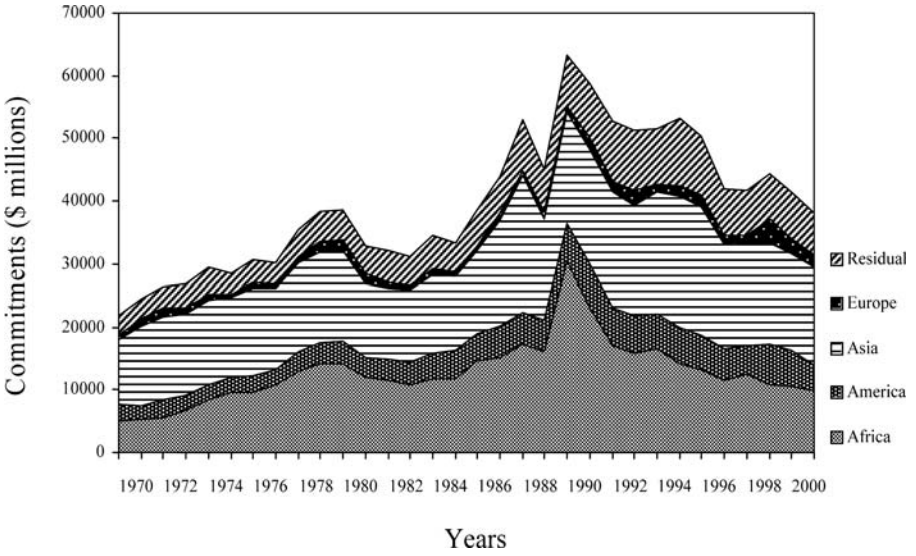

Figure 1 Bilateral foreign aid commitments by region (1970–2001)

is a decline, with the shares going to different regions remaining roughly stable. The largest shares of bilateral aid donations go to Africa and Asia. Much smaller amounts are given to the Americas (South and Central) and the developing and transition economies of Europe. The residual represents the amount that either goes to the Oceania region or is not classified as flowing to a particular region. The Oceania region is not studied due to insufficient observations.

6.4 Africa

Africa as a whole indicates that the overwhelming majority of sample donors behave noncooperatively with none of the donors acting cooperatively or bureaucratically regarding bilateral gifts. Australia, Belgium, Canada, Denmark, France, Japan, the Netherlands, Norway, Sweden, and Switzerland conform to Nash-Cournot independent behavior. The remaining five donors—Austria, Germany, Italy, the United Kingdom, and the United States—do not abide by any of the three allocative processes. Africa consists not only of some of the world's least developed nations, but is also governed by some of the most corrupt governments, which have squandered large amounts of development assistance. Donors have in the past viewed themselves as far removed from the problems on the African continent; thus, many donors understandably behave noncooperatively.

Table 5 provides the parameter estimates for the Nash-Cournot model for Africa. The full-income coefficient is positive for 13 donors and is significant for six of them; thus, bilateral giving is a normal good for most donors. The spillin coefficient is significant at the 5% level for all sample donors; bilateral donations to Africa yield joint products and are not purely public. The associated donor-specific benefits can motivate generosity. Many donors with past African colonies—i.e., Belgium,

Table 5 Estimates of the Nash-Cournot joint-product model for bilateral commitments to Africa

Country	$\hat{\rho}^N$	$\hat{\beta}_0$ (intercept)	$\hat{\beta}_1$ (fullincome)	$\hat{\beta}_2$ (spillin)	$\frac{\partial q}{\partial Q} = \frac{\hat{\beta}_2}{Q/Q} - 1$
Australia	0.551112	−0.050658	0.005408	0.998866**	0.002605
Austria	–	−0.220160	0.010329	0.998491**	0.008620
Belgium	0.582208	−0.049702	0.006284	0.999215**	0.027957
Canada	0.368623	1.277679**	−0.053038	0.976408**	0.023657
Denmark	–	−0.282238**	0.022222**	0.988541**	0.008717
France	0.303739	1.558372*	0.054880	0.847523**	0.100314
Germany	0.579305	0.192804	0.006385	0.978432**	0.122489
Italy	0.785594	−0.082598	0.071592	0.934167**	−0.015912
Japan	–	−1.465894**	0.092771**	0.952549**	0.029179
Netherlands	0.527517	−0.232266	0.045252**	0.971638**	0.013023
Norway	–	−0.218778**	0.024663**	0.983221**	0.002957
Sweden	0.344967	0.106096	0.005263	0.988642**	0.024873
Switzerland	–	−0.295508**	0.013166**	0.998485**	0.009953
United Kingdom	0.481465	0.361060	0.045054*	0.919286**	−0.019773
United States	0.333279	0.734421	−0.080074	1.065688**	0.367804

* Statistical significance at the 10% two-tailed level of significance.
** Statistical significance at the 5% two-tailed level of significance.

France, Germany, and the Netherlands—view bilateral aid commitments as complementary, thereby alleviating free riding. The exceptions to this rule are Italy and the United Kingdom, which display a very small degree of free riding. The four largest donors—France, United States, Germany, and Japan—display complementarity. In fact, eight of the ten largest donors view donations as complementary. There is a surprisingly small amount of free riding on aid in Africa, so that the pursuit of donor-specific benefits is not necessarily reducing the giving of others.

6.5 America

Based on the *J* test, 11 of the sample donors adhere to Nash-Cournot behavior with respect to their bilateral donations to South and Central America. No donor exhibits cooperative or bureaucratic behavior. Only Belgium, Canada, Germany, and the United States do not conform to any of the three allocation processes. This finding is noteworthy for the United States, since it is the largest donor to the region with the greatest spatial propinquity.

The Nash-Cournot parameter estimates for bilateral commitments to America are indicated in Table 6. The full-income coefficients are positive for 14 donors and are significant for nine of them. For all sample donors, the spillin coefficient is positive and significant at the 5% level, thus supporting the presence of joint products. The computed reaction paths'; slopes, in the right-hand column of Table 6, show that over one half of the donors view their donations as complementary to that of other donors. This is true for Denmark, France, and Sweden, which once had Caribbean colonies. Aid complementarity is also displayed by Australia, Belgium, Italy, Norway, and Switzerland. Although Canada and the United States do not abide by any of the allocation processes, the nearest donors exhibit free riding on others' aid, which is particularly strong for the United States.

Table 6 Estimates of the Nash-Cournot joint-product model for bilateral commitments to America

Country	$\hat{\rho}^N$	$\hat{\beta}_0$ (intercept)	$\hat{\beta}_1$ (fullincome)	$\hat{\beta}_2$ (spillin)	$\frac{\partial q}{\partial Q} = \frac{\hat{\beta}_2}{Q/Q} - 1$
Australia$^+$	0.37404	0.008601*	−0.000729*	1.000258**	0.000433
Austria$^+$	–	−0.073800	0.009128	0.993007**	−0.001514
Belgium$^+$	–	−0.238297**	0.014010**	0.994716**	0.002835
Canada	0.451116	−0.560451	0.108212*	0.916155**	−0.042519
Denmark	–	−0.182080**	0.008201**	0.998991**	0.003704
France	–	0.090078	0.002191	0.995593**	0.050016
Germany	0.344048	−0.198122	0.175256**	0.797244**	−0.075545
Italy	0.636705	−0.464015	0.049279	0.998176**	0.031103
Japan	–	−2.41961**	0.223899**	0.827463**	−0.026810
Netherlands	–	0.965766	0.166647**	0.761497**	−0.159866
Norway$^+$	–	−0.238439**	0.011889**	0.997403**	0.003460
Sweden	–	−0.557968	0.010451	1.013746**	0.031561
Switzerland	–	−0.279854**	0.003454	1.009097**	0.020048
United Kingdom	–	1.002212**	0.047574**	0.897570**	−0.059967
United States	0.585847	−0.114037	0.400260	0.490449**	−0.220747

$^+$ Denotes countries that have less than 32 years of observations.
* Statistical significance at the 10% two-tailed levels of significance.
** Statistical significance at the 5% two-tailed level of significance.

6.6 Asia

The donor nations exhibit less evidence of Nash-Cournot behavior for bilateral giving to Asia, than for the other regional breakdowns thus far. Five donors—Australia, Italy, the Netherlands, the United Kingdom, and the United States—abide by Nash-Cournot behavior. Austria ($\varphi_{i2} = 0.4646$, $\varphi_{i2} = 1.2812$, and $R^2 = 0.75$) and Switzerland ($\varphi_{i1} = 0.3561$, $\varphi_{i2} = 1.0598$, and $R^2 = 0.67$) adhere to the third bureaucratic type of behavior. Eight donors do not subscribe to the three allocation processes tested.

In Table 7, the parameter estimates for the Nash-Cournot joint-product model are listed. Nine full-income coefficients are significant at the 10% level or better. Only one of these significant coefficients is negative, so that income normality for donations is the general rule. For Asia, the spillin coefficient is positive and significant for all sample donors, thus strongly supporting the presence of jointly derived donor-specific benefits. Only four of the donors view bilateral donations as complementary. This is the case for one of the nearest donors—Australia—but is not true for Japan. The latter displays a good deal of free riding, given the large absolute value of its reaction path's slope. Of the donors with former colonies in Asia, only the United Kingdom indicates donation complementarity. Two of the largest contributors—Germany and the United Kingdom—display complementarity. Except for Japan and the United States, the degree of aid free riding is rather modest.

6.7 Europe

Finally, we turn to the bilateral aid commitments to the transition countries in Eastern Europe. In evaluating the results, one must remember that Europe receives the smallest share of bilateral donations, which grew in size only after the fall of the

Table 7 Estimates of the Nash-Cournot joint-product model for bilateral commitments to Asia

Country	$\hat{\rho}^N$	$\hat{\beta}_0$ (intercept)	$\hat{\beta}_1$ (fullincome)	$\hat{\beta}_2$ (spillin)	$\frac{\partial q}{\partial \bar{Q}} = \frac{\hat{\beta}_2}{\bar{Q}/\mathcal{Q}} - 1$
Australia	–	0.023431	0.011592*	0.986721**	0.005629
Austria	0.236509	−0.189217	0.008663	1.001306**	0.006936
Belgium	0.310972	0.075764*	0.007781**	0.986869**	−0.008707
Canada	–	1.779592**	−0.029299*	0.959185**	−0.006470
Denmark	–	0.159369	0.016090**	0.976047**	−0.013862
France	0.296435	0.070994	0.030410*	0.961199**	−0.004803
Germany	0.569372	0.088262	−0.001085	0.997881**	0.128862
Italy	0.518192	−0.029241	0.012690	0.988160**	−0.001293
Japan	0.249453	1.520961	0.337426**	0.513850**	−0.183573
Netherlands	0.572512	0.099990	0.049938**	0.935257**	−0.030017
Norway	–	0.114466*	0.013908**	0.980347**	−0.011118
Sweden	0.435443	0.434908**	0.023082	0.942330**	−0.037385
Switzerland	–	0.041905	0.012518**	0.984630**	−0.007982
United Kingdom	0.379578	0.610367	−0.030683	0.996125**	0.047487
United States	0.531336	5.895389**	−0.038017	0.517556**	−0.295802

* Statistical significance at the 10% two-tailed levels of significance.
** Statistical significance at the 5% two-tailed level of significance.

communist regimes. Only Germany, Italy, and the United Kingdom abide by Nash-Cournot behavior. The other donors do not act cooperatively or bureaucratically. In Table 8, we list the parameter estimates for the Nash-Cournot model for bilateral commitments to Europe. Denmark is excluded because of insufficient observations. Only four of the ten positive full-income coefficients are significant. As for the other regions, all of the spillin coefficients are positive and significant, indicative of joint products. In the right-hand column of Table 8, 11 donors display donation complementarity. Spatial propinquity is the primary determinant of this complementarity.

Table 8 Estimates of the Nash-Cournot joint-product model for bilateral commitments to Europe

Country	ρ^N	β_0 (intercept)	β_1 (fullincome)	β_2 (spillin)	$\frac{\partial q}{\partial \bar{Q}} = \frac{\widehat{\beta_2}}{\bar{Q}/\mathcal{Q}} - 1$
Australia$^+$	–	−0.072033	0.001345	1.001791**	0.002768
Austria	–	−1.726414**	0.057080**	1.014337**	0.049230
Belgium	–	0.103261*	−0.000695	0.996246**	0.003022
Canada$^+$	–	0.093504	−0.016241	1.017029**	0.029706
France	–	0.384102	0.003679	0.979063**	0.027793
Germany	–	−1.896122	0.492588*	0.441901**	−0.304817
Italy	–	−0.430180	0.049170	0.959414**	0.024865
Japan	–	−0.596453	0.131942**	0.852994**	−0.062724
Netherlands$^+$	–	−1.282367**	0.016446	1.042058**	0.071290
Norway$^+$	–	−0.907950**	0.029061**	1.008993**	0.025392
Sweden$^+$	–	−0.823518*	0.033596	0.998290**	0.011696
Switzerland$^+$	–	−0.527881*	−0.006839	1.034310**	0.047493
United Kingdom	–	1.244521	−0.065136	1.028234**	0.076455
United States	–	1.602615	0.193595	0.661990**	−0.100419

$^+$ Denotes countries have less than 32 years of observations.
* Statistical significance at the 10% two-tailed level of significance.
** Statistical significance at the 5% two-tailed level of significance.

Except for Germany, all European donors view contributions are complements. Two (i.e., Japan and the United States) of the three non-European countries treat other countries' donations as substitutes for their contributions. In fact, the three largest contributors to Europe—Germany, the United States, and Japan—view their donations as substitutes for contributions of others. This contrasts with other regions.

7 Concluding Remarks

This is the first study to test for the underlying allocation process for foreign aid commitments in its myriad forms, when these commitments are viewed as yielding public benefits. To accomplish this task, we theoretically derive reduced-form equations for noncooperative Nash-Cournot and cooperative Lindahl behavior in a setting where aid may provide purely public altruistic benefits to all potential donors along with donor-specific benefits. For countries that do not abide by either of these behaviors, we test alternative forms of bureaucratic-based decisions, where past action or income determines today's allocations.

Despite a half century of foreign aid activity, we uncover *no evidence of cooperative behavior* among donors. This finding is valid for total aid commitments, multilateral contributions, bilateral giving, and regional breakdowns of bilateral donations. The noncooperation result for multilateral contributions is surprising because aid is channeled into common pools, thereby partly inhibiting donor-specific benefits. Apparently, large donors are still able to capture such benefits through the power that they exercise in these multilateral institutions, which agrees with Dreher and Sturm (2006), Neumayer (2003), and Thacker (1999). Another general finding here is that all forms of aid, including the regional breakdowns for bilateral giving, display joint products and are not purely public. These empirical results imply that multilateral institutions must do more to coordinate giving if the Millennium Development Goals are to be met. The lack of coordination is clear when we compare the apparent motives for multilateral and bilateral giving—i.e., there is little difference in the pursuit of donor-specific benefits. Political and strategic aspects of multilateral support should ideally be curbed (resisted) if cooperation is to be fostered.

There is also ample evidence that many donors view the contributions of other donors as complementary to their contributions. Complementarity has three drivers: past colonial ties (especially for Africa and America), spatial propinquity (especially for Europe), and the overall generosity of the donors (especially for multilateral donations and Africa). Complementarity attenuates free riding by donors because they can only obtain their donor-specific benefits through their own generosity. Thus, the lack of cooperation is somewhat offset by this complementarity. If, in the future, foreign aid is to be effectively directed to less-developed nations then donors must better coordinate their foreign aid commitments, not just in total but also on a regional basis.

Acknowledgments Mascarenhas is an Assistant Professor; Sandler is the Vibhooti Shukla Professor of Economics and Political Economy. The authors have benefited from the comments of three anonymous referees.

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