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Foreign Aid's Impact on Public Spending

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Summary findings

Using a model of aid fungibility, Feyzioglu, Swaroop, and Zhu examine the relationship between foreign aid and public spending.

Based on a panel of cross-country and time-series data, their results show that roughly 75 cents of every dollar given in net development assistance goes to current spending and 25 cents to capital spending in the recipient countries. But concessionary loans — a component of development assistance — stimulate far more government spending.

Their results also show that aid increases both public and private investment.

To test aid fungibility across public spending categories, they use a newly constructed data series on the net disbursement of concessionary loans. They find that concessionary loans given to the transport and communication sector are fully nonfungible. But loans to the energy sector are converted into fungible monies and part of the funds leak into transport and communications. Loans to agriculture and education are also fungible.

There is no evidence of concessionary funds being diverted for military purposes.

Their results show that total public spending in the health sector has no impact on reducing infant mortality, but concessionary loans to the health sector do. This finding leads Feyzioglu, Swaroop, and Zhu to conclude that linking foreign aid to an agreed-upon public spending program in areas critical to development might be an effective way to transfer resources to developing countries.

This paper — a product of the Public Economics Division, Policy Research Department — is part of a larger effort in the department to analyze aid effectiveness. The study was funded by the Bank's Research Support Budget under the research project "Foreign Aid and the Composition of Public Spending" (RPO 679-76). Copies of the paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Cynthia Bernardo, room N10-055, telephone 202-473-1148, fax 202-522-1154, Internet address prdpe@worldbank.org. May 1996. (42 pages)

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1. Introduction

Roughly $1.4 trillion[1] -- an amount nearly equal to the current GDP of Germany -- has flown from rich to poor countries in foreign aid since 1960. In 1991, net disbursement of Official Development Assistance (ODA)[2] to low- and middle-income countries[3] was over $47 billion or roughly 1.4 percent of their combined GNP (World Bank [1994]). Of this, $16.2 billion went to the Sub-Saharan African countries -- the poorest regional group -- accounting for 9.3 of their GNP. In Mozambique alone, listed as the poorest country in terms of per capita GNP, net disbursement of ODA was close to $1 billion, or nearly 70 percent of its GNP.

To judge the effectiveness of such assistance, one needs to examine its impact, inter alia, on economic growth and poverty alleviation. An extensive literature has studied such effects of foreign aid programs.[4] By providing assistance, donor agencies, among other things, attempt to influence the public-expenditure policies of recipient governments. Governments undertake expenditures to pursue a variety of goals including growth in per-capita income and income redistribution. In order to gain better insights into the relationship between aid and such output indicators, it is therefore important to analyze how aid influences the public sector's budgetary allocation.

The purpose of this paper is to study the relationship between foreign aid and the level -- aggregate as well as sectoral -- of public spending in recipient countries. In particular, the focus is on the relationship between aid -- including aid as a whole as well as sector-specific, earmarked aid --

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[1] in 1988 dollars.

[2] Defined as grants and loans made on concessional financial terms (i.e., having a grant element of at least 25 percent), by all bilateral official agencies and multilateral sources to promote economic development and welfare in developing countries (see OECD, 1994 for details).

[3] A total of 109 countries (42 low-income and 67 middle-income) with a per-capita GNP of up to $8,355.

[4] See White and Luttik [1994] and Obstfeld [1995] for a survey of foreign aid work.

and components of public expenditure, current and capital on the one hand, and education, health, infrastructure and defense on the other hand. The paper also analyzes the impact of foreign aid on some human development indicators.

The link between foreign aid and public spending is not straightforward because some aid may be "fungible." An aid recipient country could render earmarked aid fungible by reducing its own resources from the sector which receives aid and transferring it to other sectors of the budget. Foreign aid induces changes in the recipient country's budgetary allocation, although the magnitude of change depends, among other things, upon the size of the aid relative to the recipient's own resources. Increasingly the donor community is getting concerned that development assistance earmarked for critical social and economic sectors might be used directly or indirectly to fund unproductive military expenditures (see UNDP, 1994, for an analysis of the human development cost of arms imports in developing countries). Given that a significant portion of aid is provided for specific projects or sectors (e.g., projects in agriculture, health, transport etc.), donor agencies would therefore like to know whether aid is indeed effective in increasing *net* expenditures in that sector, or whether specific purpose aid merely *substitutes* for expenditures that governments would otherwise have undertaken. In this context, this paper analyzes how fungible is foreign aid across public expenditure categories.

Section 2 explains the concept of fungibility by means of a graphical analysis. Section 3 develops an analytical framework which links foreign aid with various components of public expenditure. In section 4 we empirically examine the link between foreign aid and public spending. Section 5 presents our concluding remarks.

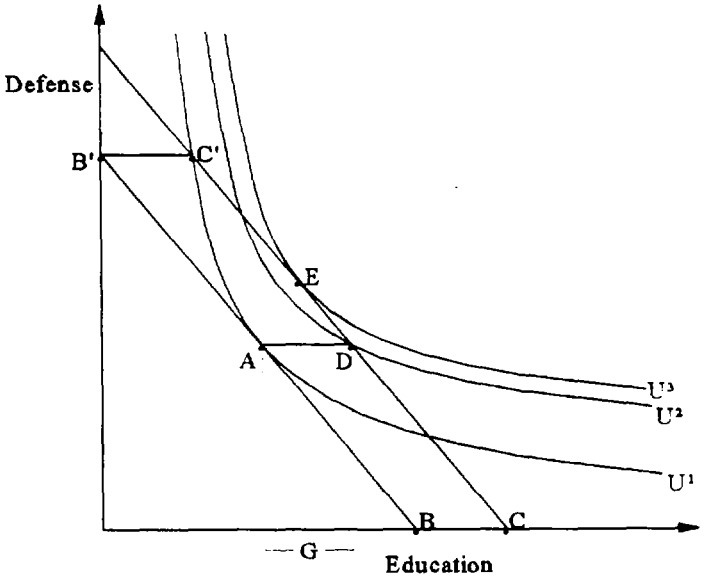

Figure 1

2. Aid fungibility among public spending categories: A graphical analysis

To assess the impact of aid on the recipient country's budgetary allocation one needs to examine the fungibility of aid. Since the concept of fungibility has been used in several ways in the aid literature, it is important to define what we mean by this term. We first postulate a model and then define precisely what it means for aid to be fungible among public spending categories. Suppose there are two public goods -- defense and education -- both normal (non-inferior), that a developing country government buys in the market to provide to its citizens. It pays for these goods by means of domestically generated resources. In addition, foreign donor agencies provide assistance towards the purchase of education. Figure 1 captures this scenario. The budget line BB' represents public spending choices that can be financed by domestic resources. Given the preferences of the recipient country government, point A represents the optimal mix of the two goods in the absence of aid. A

foreign donor agency gives an amount G of earmarked aid to education. Further, suppose the only condition attached to the aid, one that could be easily monitored, is that total education spending in the recipient country has to be *at least* G. (Below we consider aid fungibility at the margin.) For simplicity, we assume that there is no impact of aid on the relative price of the two goods.[5] The post-aid budget line is $B'C'C$.

We now define aid fungibility: Given the pre-aid budget constraint, if the recipient country could treat a portion, ϕ $(0 \leq \phi \leq 1)$, of the earmarked aid as if it were a revenue supplement then aid is said to be fungible. The different degrees of aid fungibility are defined as follows:

Case 1. Aid is fully-fungible if $\phi = 1$ and the post-aid optimal mix of the two goods, chosen by the country, is an interior solution. The latter requires that the country spend at least some of its own resources besides the aid in the targeted sector. $\phi = 1$ implies that the budget constraint shifts outward by the full amount of aid with a kink indicating the aid conditionality, and if the solution is interior, the country moves to a new optimal point associated with a higher level of utility. In Figure 1 this is indicated by a move from point A to point E.

Case 2. Full non-fungibility occurs when $\phi = 0$. In this case the country is not able to manipulate its resources and is forced by the donor agency to spend all the aid money in the targeted sector. Given the preferences of the country, such a move is sub-optimal as shown by amove from point A

[5]To our knowledge, the only paper that models the impact of aid on price changes is the seminal contribution by McGuire [1978]. In his analysis the fungible amount of aid shifts the budget constraint out and the non-fungible amount rotates the budget constraint as the relative price of the non-aided good in terms of the aided good changes.

to point D in Figure 1.

Case 3. Aid is partially-fungible if $0 < \phi < 1$. In this case the country's budget constraint shifts outward by the fungible amount of aid. A kink in the new budget line (not shown in Figure 1) indicates that the education spending chosen by the country plus the non-fungible part of the aid, has to be greater (or equal to) the aid amount. The country then chooses an optimal point (if the solution is interior) on its new budget line and then adds the non-fungible part of the aid to its education spending. Partial fungibility implies that the country is not able to transfer resources from education to defense as much as it would like to. This case would be given by a point that lies between E and D on the post-aid budget line in Figure 1, and would be sub-optimal (though it would be associated with a higher level of utility than the case with full non-fungibility).

Aid fungibility at the margin

In the definition of fungibility given above, we do not treat aid as a marginal dollar after taking into account the recipient's pre-aid spending composition. In reality, however, when targeting aid to particular sectors, donor agencies take some proxy of what the recipient country would have spent in the absence of aid. To ensure that the recipient country spends aid funds in the targeted sector and to preclude any switching of funds at the margin, they often impose carefully chosen conditions. Restricting the switching of funds, at least on paper, seems simple; all what donor agencies need to do is to figure out the pre-aid levels of spending of the recipient country from its previous years' budget documents. Using this as an indicator -- though not perfect -- of what the country would have spent in the absence of aid, donor agencies can compel the recipient country to spend the aid

funds at the margin in the targeted sector. For example, in Figure 1, if the pre-aid composition of education and defense spending is known to be at point A, the recipient country could be asked to spend in addition the aid resources, G, on education. The post-aid composition would then be at point D and aid will be completely non-fungible at the margin. In practice, however, there are at least three reasons why such monitoring is difficult, if not impossible. First, domestic resources in developing countries fluctuate by significant amounts from year to year. Treating past years' composition of spending as the pre-aid composition may not be very meaningful if the change in domestic resources is large relative to foreign aid. In such situations, recipient countries can easily switch aid funds among expenditure categories. Second, when there are several sources of aid in a country and donor coordination is not good, aid monitoring becomes extremely difficult. Finally, not all aid goes through the recipient country's budget. In many developing countries, particularly in Sub-Saharan Africa, a portion of foreign aid bypasses the government budget. In such cases it might be difficult to pinpoint the spending requirement for the government. All in all, monitoring foreign aid is difficult in practice and so aid fungibility is essentially an empirical issue.

3. A Model of Aid Fungibility

Seminal work on modeling aid fungibility has been done by McGuire [1978] who proposed an indirect statistical method to figure out the shape of the post aid budget constraint of the recipient government. In McGuire's model an unknown portion, ϕ, of the grant is taken to be a pure revenue supplement to the recipient and is completely fungible along with the recipient's own fungible resources.[6] The non-fungible portion, $1 - \phi$, of the grant, on the other hand, changes the price of the

[6]McGuire studies the local government response to federal grants for education in the United States.

subsidized good. Using a utility maximization framework, McGuire derives a system of equations that is used to estimate the fungibility parameter, ϕ. One drawback of this model is that the aid recipient is always at an optimal point. In our view, unless the aid is fully-fungible, the recipient is constrained by the aid conditionality and is not at the optimal level.

In this paper, we postulate a variant of the McGuire model which allows the aid recipient to be at a sub-optimal level. In our model, which is close in spirit to the framework adopted by Pack and Pack [1993], the aid recipient government buys S public goods, $\{g_1, g_2,...,g_S\}$, in the market to provide to its citizens. It pays for these goods by the fungible portion of the foreign assistance and all other sources, R -- domestic and foreign -- that it has at its disposal. Following the definition given in section 2, a portion, ϕ ($0 \le \phi \le 1$), of the earmarked aid is fungible if it can be treated as a revenue supplement. Citizens also get to consume goods that the government has to purchase from the non-fungible portion, $1-\phi$, of the foreign aid. We assume that by design all foreign assistance is earmarked by purpose towards the purchase of K ($\le S$) specific public goods[7] and a_k ($k = 1,..., K$) is the amount of aid for good k. Public spending on good k has to be at least a_k. Further, let the representative agent's utility function, defined on these S public goods and a single private good, c_p, be given by:

$$W = U[c_p, g_1, g_1^{NF}, ..., g_K, g_K^{NF}, g_{K+1}, ..., g_S]$$

$$\text{where} \quad g_k^{NF} = \frac{(1-\phi_k)a_k}{p_k} \qquad k = 1,...,K. \tag{1}$$

[7]An assumption not very far from the actual pattern of aid disbursement. Even the policy based lending of institutions such as the World Bank specify a negative list of goods on which the aid may not be spent.

g_k^{NF} is the quantity of the k-th good that the government has to purchase from the non-fungible portion of the aid earmarked for good k and p_s ($s = 1,..., S$) is the price of the s-th public good. We take the fungibility coefficient, $\phi = \{\phi_1, \phi_2,...,\phi_K\}$, as given, rather than deriving it from some game-theoretic framework.[8] Moreover, we assume that aid affects the government's optimal choice of $\{g_1, g_2,...,g_S\}$ only through the fungible portion; public goods purchased from the non-fungible part have no effect on this choice.[9]

The budget constraint faced by the government is:

$$p_1 g_1 + p_2 g_2 + \ldots + p_S g_S = R + \sum_{k=1}^{K} \phi_k a_k \qquad (2)$$

Taking p_s, ϕ_k and a_k as given, the government chooses $\{g_1, g_2,...,g_S\}$ to maximize (1) with respect to (2). To get analytical solutions let the utility function be of the Stone-Geary form:

$$U[c_p, g_1, g_1^{NF}, \ldots, g_K, g_K^{NF}, g_{K+1}, \ldots, g_S] = F(c_p) + H(\sum_{k=1}^{K} g_k^{NF}) + \prod_{s=1}^{S} (g_s - \gamma_s)^{\beta_s} \qquad (3)$$

γ_s's are the subsistence quantities and are positive; and β's satisfy the condition $\Sigma\, \beta = 1$. Maximizing (3) subject to the budget constraint in (2) yields -- if the solution exists and is interior --

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[8]Such a derivation would require specifying some strategic behavior on the part of the government which takes into account the penalty of being "caught" redirecting funds. While this may be a fruitful extension of the research, we do not attempt such an exercise in this paper. Instead, our focus is to econometrically estimate the fungibility coefficient.

[9]Assuming the latter is crucial for the modeling strategy; otherwise the government's optimal choice of $\{g_1, g_2,...,g_S\}$, if it exists and is interior, will imply that the total spending on each of the public goods -- government's optimal choice plus the amount purchased from the non-fungible portion of the aid -- is the same as the mix that the government would have chosen if all of the aid came as a pure revenue supplement. In other words, irrespective of the size of ϕ the government could make the aid fully-fungible as long as its own spending on the aided good is at least as much as the aid. In such a case, our definition of aid fungibility would be meaningless.

the following system of linear expenditure equations:

$$p_s g_s = p_s \gamma_s + \beta_s [R + \sum_{k=1}^{K} \phi_k a_k - \sum_{j=1}^{S} p_j \gamma_j] \qquad s=1,...,S. \tag{4}$$

Empirically, however, one observes the total spending on any particular good rather than spending that is financed by fungible or non-fungible resources. Simple manipulation of (4) leads to:

$$p_s \overline{g_s} = p_s \gamma_s + (1-\phi_s+\beta_s \phi_s) a_s + \beta_s [R + \sum_{k \neq s}^{K} \phi_k a_k - \sum_{j=1}^{S} p_j \gamma_j] \qquad s=1,...,S; \tag{5}$$

$$\textit{where } \overline{g_s} = g_s + g_s^{NF} = g_s + (1-\phi_s) a_s.$$

Since R, the domestic resources of the recipient country, can be written as equal to total government spending net of foreign aid, G^N, equation (5) becomes

$$p_s \overline{g_s} = p_s \gamma_s + (1-\phi_s+\beta_s \phi_s) a_s + \beta_s [G^N + \sum_{k \neq s}^{K} \phi_k a_k - \sum_{j=1}^{S} p_j \gamma_j] \qquad s=1,...,S. \tag{6}$$

Empirical Implication of the Model

Using data, the effect of foreign aid on various components of public spending can be analyzed by estimating equation (6). The parameter γ_s -- the subsistence quantities of various public goods -- can be proxied by social, political and other economic variables. In equation (6) if the estimated coefficient of G^N, is the same as the coefficient of a_s, then aid earmarked for good s is fully-

fungible and $\phi_s = 1$.[10] If the coefficient of a_s is 1 then aid for good s is fully non-fungible and $\phi = 0$. The coefficient of a_s being less than 1 but greater than the coefficient of G^N would indicate partial fungibility of aid, i.e., $0 < \phi_s < 1$. Finally, the coefficient of a_k $(k \neq s)$ indicates how much of aid earmarked for good k is spend on good s.

4. Empirical Analysis

The focus of our empirical analysis is the link between foreign aid and government spending. While the literature on the effectiveness of aid is replete with studies linking foreign aid with consumption, investment (both public and private), taxation and other macro variables, there are very few studies that analyze the impact of foreign aid on different components of government expenditure.[11] As a result, the interesting issues concerning the fungibility of foreign aid among public expenditure categories such as agriculture, health, education, transport and communication etc., have not been researched.[12] For example, while Cashel-Cordo and Craig [1990] claim to have determined whether or not foreign aid changes the composition of government expenditure in a sample of 46 developing countries, the expenditure components in their analysis is limited to defense and non-defense spending. Similarly, in examining the fungibility of U.S. aid among 8 major aid recipient countries, Khilji and Zampelli [1994] look at defense and non-defense expenditures. Time series data in individual countries has been used to analyze the question of aid fungibility across the

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[10]Provided β_s, the coefficient of G^N is not equal to 1 (for any sector s), in which case the concept of fungibility is not very meaningful as it indicates a complete matching of the donor's and the recipient's preferences for that sector.

[11]For a comprehensive review of the foreign aid literature, see Mosley et. al. [1987], White and Luttik [1994] and Obstfeld [1995].

[12]One reason for this has been the difficulty in obtaining aid data by sectors. More on this below.

sectoral classification of expenditures (Gupta [1993], McGuire [1978], Pack and Pack [1990, 1993]). In a study of foreign aid to Indonesia, Pack and Pack [1990] did not find any evidence of fungibility across sectoral expenditures. On the other hand, in their analysis of the Dominican Republic (Pack and Pack [1993]) they found evidence of substantial diversion of foreign aid away from its intended purposes. The individual country evidence while important, does not allow any generalization. The question of the impact of aid on government expenditure in general, and fungibility of aid resources in particular, needs to be addressed in a cross-country time-series framework; this is precisely what this paper does.

4.1 Data and choice of variables

Our empirical analysis uses annual data on developing countries from 1971 through 1990. A panel database was constructed along three dimensions: (1) information on the aid variable; (2) public spending variable; and (3) other control variables.

1. Data on Foreign Aid. We used two different variables for foreign aid. For total aid to a country, we used the series on annual net disbursement of ODA that is put together by the Organization of Economic Co-operation and Development (OECD). For sectoral aid, we would have liked to have data on *disbursement* of ODA over time and across countries. However, such data exist on aid *commitments* only, not on aid *disbursements*. We did not want to use sectoral aid data on commitment for two reasons: First, the mapping between aid commitment and disbursement is far from one-to-one; the disbursement data have a very disparate time profile. The data on aid commitment are very discontinuous with large swings from year to year while the data on aid

disbursement are very smooth. Second, the disbursement data, being predetermined in most part, are much less prone to the simultaneity problem with the government spending data. In the empirical analysis we use the net disbursement of concessionary loans from all sources (bilateral and multilateral) -- a component of ODA -- by sectors, over time and across countries.[13] We put together this series from the World Bank database. Similar information on grants -- the remaining component of ODA -- was not available.

2. Data on Public Spending. Our database on public spending consists of data on the functional classification of public expenditure from two different sources: (a) *Government Finance Statistics* (GFS) -- a database of the International Monetary Fund (IMF); and (b) Database created by Easterly and Rebelo [1993].[14] Among the available data on public spending, GFS's coverage is comprehensive for central government accounts but is quite restricted for the accounts of general (central plus sub-national) government. In addition, GFS data do not include spending by public sector enterprises. The database of Easterly and Rebelo is not as rich and comprehensive as GFS but has information on public investment of the consolidated general government (which includes spending by all levels of government as well as investments by public enterprises).

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[13]Using the available data on ODA commitments, concessionary loans (both disbursement and commitment), and assuming that the relationship between concessionary loan commitment and disbursement is approximately the same as the relationship between ODA commitment and disbursement, we constructed proxy numbers on ODA disbursement by sectors, over time and across countries. This variable, however, was not significant in the regression analysis (more on this below).

[14]As part of this research we also collected public spending data from various issues of *Recent Economic Developments* (RED), a document prepared annually by the IMF for all its member countries. The data reported in RED are said to reflect a more accurate description of public spending in developing countries as it is based on detailed analyses of country budgets by the IMF missions. Our results from the RED data, however, were not very different from the results of the other two sources (see below) and hence, are not reported for space considerations.

3. Data on Control Variables. The database on explanatory variables includes information on per capita real GDP, infant mortality rates. average schooling years in the labor force, school enrollment ratios, military expenditures of neighboring countries, the share of agriculture in national income, and the Gastil index of political rights and civil liberties. (See below for an explanation on the link between these variables and the model.)

The model in section 3 developed links between foreign aid and public spending assuming that the observed mix of public expenditures results from a combination of the government's utility maximizing choice using fungible -- domestic and external -- resources and the purchase of goods from the non-fungible portion of aid. In the empirical analysis we first estimate the impact of aggregate foreign aid on total government spending to examine whether foreign aid is associated with any resource mobilization effort on the part of the recipient country. We then estimate the effect of foreign aid on the government's investment and consumption spending. The impact of earmarked sector-specific aid on components of government spending is estimated next. Finally, we examine the fungibility hypothesis. The key explanatory variable in our analysis is the share of foreign aid (aggregate as well as sector-specific) in GDP. By including a few social, political and other economic variables in our set of explanatory variables we attempt to capture the effect of the variable γ_s -- the minimum quantities of various public goods. Moreover, countries at different levels of development tend to have different sizes of government (Wagner's law). To control for this effect, we include per capita GDP at 1987 constant prices measured in US$ for each sample country.

Could our analysis be subject to a simultaneity problem of the expenditure and foreign aid variables? In deciding the level and composition of foreign aid, donor agencies look at, among other things, the economic, political and social indicators of the recipient country. While the problem of

simultaneity exists in principle in our analysis, we attempt to minimize it by (a) using aid disbursement numbers which in most part are predetermined; and (b) including a few economic, political and social indicators of the recipient country as explanatory variables in the regression analysis. The latter is consistent with the approaches of Boone [1994] and McGuire [1978].

4.2 Regression analysis

The method of least squares is used to estimate sequentially the following three equations.

$$G_{i,t} = \alpha_{0,i} + \alpha_1 Aid_{i,t} + \sum_{c=1}^{C} \alpha_{c+1} Z_{c,i,t-1} + \epsilon_{i,t} \qquad (7)$$

for country i $(i = 1,...,I)$ *at time* t $(t = 1,...,T)$;

$$G^E_{i,t} = \delta_{0,i} + \delta_1 G^N_{i,t} + \delta_2 Aid_{i,t} + \sum_{c=1}^{C} \delta_{c-2} Z_{c,i,t-1} + \nu_{i,t} \qquad (8)$$

where E_1 *and* E_2 *are current and capital expenditures, respectively*;

and for each sector s $(s = 1,...,S)$

$$G_{i,s,t} = \lambda_{0,i,s} + \lambda_{1,s} G^N_{i,t} + \lambda_{2,s} Aid_{i,s,t} + \sum_{k \neq s}^{S} \lambda_{3,k} Aid_{i,k,t} + \sum_{c=1}^{C} \lambda_{c-3,s} Z_{c,i,t} + \eta_{i,s,t} \qquad (9)$$

where $\lambda_{1,s} = \beta_s$; $\lambda_{2,s} = (1 - \phi_s + \beta_s \phi_s)$; *and* $\lambda_{3,k} = \beta_s \phi_k$ *for* $k \neq s$.

Equation (9) is the system of sectoral expenditure equations derived in Section 3 (see equation (6)).

Equations (7) and (8) are derived by applying the Stone-Geary utility function when there is only one aggregate government spending variable and when government spending is divided into current and capital expenditures, respectively. In the latter cases, however, the aid variable is total foreign aid given to a country in a year. The variables in the regressions are:

(a) $G_{i,t}$: Share of total government expenditure (including foreign aid) in GDP for country *i* at time *t*;

(b) $G_{i,t}^{E}$: Share of government expenditure for current or capital purposes (including foreign aid) in GDP for country *i* at time *t*, where *E* is current or capital expenditure;

(c) $Aid_{i,t}$: Share of net disbursement of total foreign aid in GDP for country *i* at time *t*;

(d) $G_{i,s,t}$: Share of government expenditure (including foreign aid) in sector *s* in GDP for country *i* at time *t*;

(e) $G_{i,t}^{N}$: Share of total government expenditure (net of foreign aid) in GDP for country *i* at time *t*;

(f) $Aid_{i,s,t}$: Share of net disbursement of foreign aid to sector *s* in GDP for country *i* at time *t*;

(g) $Z_{i,t-1}$: A vector of other control variables (infant mortality rates , average schooling years in labor force, average ratio of neighbor's military expenditure to GDP, ratio of agriculture output to GDP, Gastil's [1989] index of political and civil liberties);

(h) $\epsilon_{i,t}$, $\nu_{i,t}$ & $\eta_{i,s,t}$: White noise error terms for the three equations.

Table 1 presents the sample statistics of government spending and foreign aid variables. The sample includes 14 low- and middle-income countries and the coverage is from 1971 through 1990 (see the data appendix for the sample selection criteria and the list of countries). On average,

developing countries spend roughly a quarter of their income (GDP) on total public spending; aggregate public investment accounts for 9 percent of the total income. The average net disbursement of ODA to these countries during this period was 4 percent of their combined GDP, with ranges from a negative transfer of one tenth of a percent to an assistance of over 22 percent. The average amount of concessionary loans to these countries was 1.63 percent of GDP -- or roughly 40 percent of ODA. As a ratio to total government spending, the sample averages of the two aid variables were 15.5 and 6.3 percent, respectively.

Table 2 contains the sample statistics of government spending and net disbursement of foreign aid (concessionary loans) by sectors. The six sectors: agriculture, defense, education, energy, health, transport and communication -- together account for over half of the total government spending and nearly 90 percent of all concessionary loans.[15] Roughly 60 percent of all concessionary loans go to two sectors -- energy, and transport and communication.

Table 3 reports the estimates of equations (7) and (8) which are estimated under the null hypothesis that the coefficients, α_{0i} and δ_{0i}, of the country dummy variable are fixed parameters. If, however, the Hausman test rejects the null hypothesis that the appropriate model is fixed effects then the random effects model is estimated.[16] Equation (3.1) shows a positive and statistically significant relationship between the share of total government expenditure in GDP and the share of the net

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[15]As far as we know, there is no "development" assistance to the defense sector.

[16]In the fixed effects model α_{0i}, the country dummy parameter, is a fixed coefficient. In the random effects model these parameters are assumed to be independent random variables with a fixed mean and variance, i.e., $\alpha_{0i} = \alpha_0 + e_i$. Hausman has developed a test which shows that under the null hypothesis the fixed effects model is appropriate and the preferred estimator is least squares with dummy variables. If, however, the fixed effects model is rejected in favor of the random effects model then the preferred estimator is generalized least squares. For details, see Hausman [1978].

disbursement of ODA. The regression shows that a dollar increase in foreign aid leads to an increase of 0.95 cents in total government spending. There is no tax relief effect. Increases in the net disbursement of concessional loans, however, are far more stimulative of total government expenditures; equation (3.2) shows that a dollar increase in concessionary loans leads to a $1.34 increase in government expenditures. The likely reason why concessionary loans have a relatively larger impact on government expenditures than ODA is that a portion of such loans have matching requirements, i.e., for every dollar that a government spends on a specified activity it gets a matching amount in concessionary loans. Among the control variables, the share of agricultural output in GDP -- a measure of level of development in a country -- is the only variable that is statistically significant in both the equations. The negative coefficient suggests that countries that have a bigger share of their GDP from agriculture and are therefore relatively less developed, have relatively smaller government spending. Equation (3.3) -- which includes expenditure shares according to the economic classification -- indicates that roughly three-quarters of ODA is spent on government's current expenditure. This may not be necessarily bad because several components of current expenditure, such as operations and maintenance, may have higher rates of return than capital expenditure.[17] The coefficient of ODA in equation (3.5) shows that the remaining one-quarter of aid (after accounting for current expenditure) goes for capital expenditure. Comparing the coefficients on the aid variable with the coefficients on the variable "total spending net of aid," however, suggests that at the margin more money is spent on current expenditure if the financing is from aid sources.

As noted by Easterly and Rebelo [1993], public investment data reported in GFS for

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[17]In a study of 43 developing countries over 20 years, Devarajan, Swaroop and Zou [1996] show that the only broad public expenditure category that is associated with higher economic growth is the current expenditure.

developing countries could have a bias since they only cover the investment of the Central Government. To correct this problem they have constructed a new measure of public investment which covers all levels of government as well as investments by public enterprises. In order to determine whether or not including such expenditure data qualitatively or quantitatively affect our results, we employ the Easterly and Rebelo measure of public investment. The relationship between foreign aid and public investment of the consolidated general government is also positive and significant as illustrated in equations (4.1) and (4.2) in Table 4.

These regressions show that net concessionary loans are far more stimulative of public investment than ODA. Another interesting feature of these regressions is the size of the coefficients on the aid variable. Only 20 and 32 cents of a dollar in ODA and concessionary loans, respectively, go for public investment purposes. The remaining aid presumably funds either government consumption or private investment and/or consumption. This, however, may not be an unintended outcome of foreign aid for two reasons. First, ODA funds are given to promote development and welfare, and therefore, by design, public investment may not be the sole purpose of such funds.[18] A second reason could be that the standard definition of public investment does not capture the difference between capital-stock-enhancing (physical as well as human capital stock) and consumption expenditures. For example, some researchers consider spending on public education as investment (see Barro, 1991). As for the other variables in the regressions, neighbor's military expenditure and infant mortality rate, both have a positive and statistically significant relationship with public investment.

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[18]Levy [1987] has argued that aid transfers include very heterogenous components (drought-related food transfers, for example) and therefore are likely to have different marginal propensities to consume and invest.

Many previous researchers, most notably Boone [1994], have argued that foreign aid does not increase investment and growth and in most cases aid is spent entirely on consumption.[19] Using data on 96 countries between 1971 and 1990, Boone shows that the marginal propensity to consume from foreign aid is insignificantly different from one, and the marginal propensity to invest (public and private) is zero. Our results, on the other hand, show that foreign aid -- be it ODA or concessionary loans -- has a positive and significant impact on public investment. To check whether the impact of aid on public investment could be crowding out private investment in our sample of countries, we regress both the aid variables on total (public and private) investment. Equations (4.3) and (4.4) show that both ODA and concessionary loans have a positive and statistically significant relationship with total investment. In summary, our results do not support Boone's finding that foreign aid is spent entirely on consumption and not on investment. In our view the main reason why our finding is different from that of Boone is the difference in the sample selection method. Boone uses ten year averaged data and hence, has only two data points (each based on ten or fewer observations) for each country in the sample. We, on the other hand, use annual observations for each country in our sample. While this emphasis on the time dimension reduces the number of countries in our sample, we are able to capture more effectively the impact of annual net disbursement of aid on that period's government budget.

Table 5 has the estimates of equation (9) when GFS data on public spending are used.

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[19]Such a finding, however, is not supported by all studies. For example, in a model of public fiscal behavior in developing countries, Heller [1975] analyzed the impact of an aid variable (total foreign grants to the public sector from all sources) on macro variables including aggregate public investment and consumption spending. Based on a panel data set from eleven African countries (Nigeria, Ghana, Zambia, Kenya, Uganda, Tanzania, Malawi, Liberia, Ethiopia, Tunisia, and Morocco), his findings indicate that foreign aid causes a strong shift away from public consumption and toward investment.

Regressions reported in this table examine the link between the net disbursement of concessionary loans to a particular sector and public spending in that sector. In each of the six regressions -- one each for education, health, energy, agriculture, transport and communication, and defense -- the coefficient on the variable $G^{Net\ of\ loan}$, which is statistically significant in all regressions, indicates how the government distributes an additional dollar that it gets from all resources net of concessionary loans. It is interesting to compare this allocation at the margin with the average allocation (of total government spending) given in Table 2. There are two points worth mentioning: (1) the average and marginal allocations are more or less the same in the defense sector and therefore the share of defense in total spending is fixed; and (2) the transport and communication sector receives a higher marginal allocation than its average indicating that the share of this sector in the composition of public expenditure continues to increase. In the past two decades concessionary loans -- certainly in dollar value if not in numbers -- have mostly funded economic infrastructure. Data from our sample countries confirm this; loans (in dollar value) to two sectors -- transport and communication, and energy -- account for roughly 29 and 31 percent of all concessionary loans (see Table 2). Data on loans also show that most of the variation is in these two sectors (see standard deviations in Table 2).

Sector	Box 1: Estimates of Fungibility Parameter (Φ_k) based on Least Squares Regression					
	Public Spending	ϕ_k (SE[ϕ_k])	Hypothesis Testing on Estimated ϕ_k			
			$\phi_k = 1$	$1 > \phi_k > 0$	$\phi_k = 0$	All
Education	G	-0.60 (1.58)				✓
	G^{PI}	0.52 (0.39)				✓
Health	G	1.33 (1.18)				✓
	G^{PI}	0.35 (0.81)				✓
Energy	G	0.65 (0.09)		✓		
	G^{PI}	-- --				
Agriculture	G	1.08 (0.16)	✓	✓		
	G^{PI}	0.88 (0.10)	✓	✓		
T&C	G	0.09 (0.24)			✓	
	G^{PI}	0.07 (0.24)			✓	

Notes:
(1) 'G' is total central government spending from GFS; G^{PI} is total public investment from Easterly and Rebelo.
(2) 'T&C' is transport and communication.
(3) ✓ indicates that the null hypothesis cannot be rejected at 5% significance level.
(4) '$\phi_i = 1$' tests for full fungibility; '$1 > \phi_i > 0$' tests for partial fungibility; and '$\phi_i = 0$' tests for non-fungibility.
(5) 'All' indicates that we cannot reject any null hypothesis within a reasonable range.

To analyze aid fungibility we need to look at the estimate of ϕ -- the fungibility parameter. Table 5 contains the OLS estimates of equation (9) which does not directly give us the estimates of ϕ_s. We, however, solve for ϕ_s from the other coefficient estimates and present it in Box 1. Our results indicate that loans to the transport and communication sector are fully non-fungible, i.e., a dollar in concessionary loan given to the sector is fully spent in the sector. The coefficient $\phi_{T\&C}$ is 0.09 which is insignificantly different from zero. This can also be seen from Table 5 where equation (5.5) has a positive and statistically significant relationship between loans to the transport and

communication sector and the public spending in that sector; the coefficient on the aid variable is 0.92 which is statistically not different from 1. Moreover, as indicated in Table 5.5, loans to the transport and communication sector appear to have a stimulative impact on public spending in health and energy sectors and a dampening effect on public spending on education. Other estimates of ϕ (see Box 1) indicate that loans to agriculture and energy to the sample countries have been fungible. However, for the education and health sectors we can not reject any of the null hypotheses of interest (i.e., $0 \leq \phi \leq 1$). We believe that based on the available data for these sectors the power of the test is not enough to reject any reasonable hypothesis. In recent years, the donor community has been increasingly concerned that development assistance is being used directly or indirectly to fund military expenditures. Data from our sample countries do not support the hypothesis that foreign aid is diverted for military purposes (see Table 5, equation (5.6)).

Table 6 reports the regression results when the dependent variable is taken to be sectoral public investment. Once again we find that concessionary loans to the transport and communication sector are fully non-fungible. In equation (6.4), the coefficient on the loan variable is positive and statistically not different from 1 indicating that a dollar given to the sector pretty much ends up increasing the public investment in that sector by the same amount (the coefficient $\phi_{T\&C}$, given in Box 1, is 0.07 which continues to be insignificantly different from zero). Moreover, the loan stimulates investment in agriculture and health sectors.[20]

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[20]For space considerations we do not report the regression results based on public spending data from the *Recent Economic Developments*. The results are similar to the ones reported from the other two sources.

4.3 Joint estimation of the sectoral equations

Our model of aid fungibility outlined in Section 3 yields a system of estimable sectoral equations that are nonlinear in the structural parameters (equation (6)). In each of these equations, there are K aid fungibility parameters $\{\phi_k,\ k=1,...,K\}$, where K ($\leq S$) is the number of sectors that receive earmarked aid. The results reported in Table 5 and Table 6 are based on independent least square estimates of each sectoral equation as given in equation (9) which is basically a modified form of equation (6). We now jointly estimate the sectoral equations and impose the cross-equation restriction that the aid fungibility parameter ϕ_k ($k=1,...,K$) is the same across all equations. The system of equations that we estimate is given by

$$G_{i,s,t} = \lambda_{0,s} + \beta_s G^N_{i,t} + (1 - \phi_s + \beta_s\ \phi_s)\ Aid_{i,s,t} + \sum_{k \neq s}^{K} \beta_s \phi_k Aid_{i,k,t} + \sum_{c=1}^{C} \lambda_{c+3,\,s} Z_{c,i,t-1} + Error_{i,s,t} \quad (10)$$

for each sector s ($s = 1,...,S$), *country* i ($i = 1,...,I$), *time* t ($t = 1,...,T$).

To estimate the above system of equations, we use the Generalized Method of Moments (GMM) technique as discussed in Hansen and Singleton [1982].[21] Coefficient estimates and other statistics are reported in Table 7 (using public expenditure data from GFS) and Table 8 (using public expenditure data from Easterly and Rebelo).

To eliminate fixed or random effects, we differenced the foreign aid and government spending variables on the right-hand side in equation (10). The overidentification tests do not indicate any model misspecification problems; the Chi-square tests reported in the tables indicate that the null

[21]For estimation we use a GMM program written in the software Gauss by Hansen, Heaton and Ogaki [1993].

hypothesis of model being misspecified is not rejected. The hypothesis testing on aid fungibility is described in Box 2. The coefficient, $\phi_{T\&C}$ continues to be insignificantly different from zero which indicates that loans to the transport and communication sector are fully non-fungible. This result holds whether we use total central government spending numbers in the transport and communication sector from the GFS or total public investment numbers from Easterly and Rebelo. The results for the agriculture and energy sectors are mixed. Foreign aid to the energy sector is fungible when we use total central government spending data from the GFS; based on public investment data, however, the null hypothesis that ϕ is within a reasonable range (i.e., $0 \leq \phi \leq 1$) is not rejected. For the agriculture sector we find that aid is fungible when public investment numbers are used; for the central government spending data the test suggests that only unreasonable values of ϕ are not rejected. In the social sectors, our results indicate that foreign aid to education is fungible when we use public investment numbers in education.

Sector	Box 2: Jointly Estimated Fungibility Parameters (Φ_K)						
	Public Spending	ϕ_k (SE[ϕ_k])	Hypothesis Testing on Estimated ϕ_k				
			$\phi_k = 1$	$1 > \phi_k > 0$	$\phi_k = 0$	All	Unreasonable
Education	G	-2.99 (2.61)				✓	
	G^{PI}	1.57 (0.41)	✓	✓			
Health	G	-3.96 (1.61)					✓
	G^{PI}	6.67 (2.06)					✓
Energy	G	0.92 (0.06)	✓	✓			
	G^{PI}	45.44 (66.08)				✓	
Agriculture	G	1.90 (0.15)					✓
	G^{PI}	0.99 (0.06)	✓	✓			
T&C	G	-0.20 (0.28)			✓		
	G^{PI}	-0.25 (0.13)			✓		
Other	G	1.68 (0.20)					✓
	G^{PI}	8.57 (9.80)				✓	

Notes:

(1) See Box 1;
(2) 'Other' is public spending not allocated to the specified sectors; 'Unreasonable' indicates that only unreasonable parameter values are not rejected.

4.4 Foreign aid and poverty alleviation

Lack of adequate and consistent data, particularly time-series, on poverty indicators (e.g., income by decile) in most developing countries precludes a systematic analysis of the relationship between foreign aid and poverty alleviation. It is possible, however, to measure the impact of foreign aid on a few human development indicators such as infant mortality rate, school enrollment ratios etc. Equation (9.1) in Table 9 reports the regression of the rate of change in infant mortality on net concessionary loans given to the health sector. The one period lagged value of the concessionary

loan has a negative and significant relationship with infant mortality. The coefficient indicates that if the health sector received concessionary loans equal to one percent of GDP, infant mortality would fall by 31.7 percent. Given the mean value of the loan variable (0.007 perecnt of GDP), this means that doubling the existing amount of concessionary loans to the health sector would reduce infant mortality by 2 percent. In Bangladesh, one of our sample countries, infant mortality in 1992 was 110 per 1000 live birth. A 2 percent reduction in infant mortality would mean 2.2 lives (per 1000 of live births) would be saved; if there are 5 million live births in a year in Bangladesh, the 2 percent reduction would save 11,000 infants. While concessionary loans to the health sector in developing countries have been historically low -- accounting for only .3 percent of all concessionary loans (see Table 2) -- the evidence seems to suggest that the poor are receiving the benefits of these aid programs. The other significant variable in the regression is the real per-capita GDP which has a negative relationship with infant mortality. The sign is what would be expected: rich countries have low infant mortality. The positive but statistically insignificant relationship between infant mortality and public health spending is not necessarily surprising. Together these results indicate that the intra-sectoral allocation of public resources in the health sector is not pro-poor. Boone [1994] reports that foreign aid has no significant impact on improvements in infant mortality. Our analysis also shows that there is no significant impact of aid on infant mortality when we regress the latter on aggregate aid.[22] However, we find that foreign aid given to the health sector in the form of concessionary loans has improved infant mortality. These results have important implications for policy. Perhaps, a more effective way of giving aid to developing countries might be to agree on a public expenditure

[22]Using the aggregate aid variable, ODA, we also found no impact of aid on infant mortality (results not reported in the paper for space considerations).

program in areas that are critical for development.

Our data do not support any significant links between aid to the education sector and primary school enrollment (see equation (9.2) in Table 9). In fact, none of the independent variables is statistically significant. It is possible that either the model is misspecified or the lag structure of the independent variables is not rich enough to decipher any kind of relationship.

5. Conclusion

This purpose of this paper was to examine the relationship between foreign aid and public spending in developing countries. Using a model of aid fungibility, we derived an equation that could be used to estimate the effect of foreign aid on the aggregate as well as various components of public spending. The empirical results showed that a dollar given in official development assistance to developing countries does not lead to a tax relief effect; instead, it causes government spending to increase by a dollar. Of this increase in government spending, roughly three-quarters is spent on current expenditure and the remaining quarter on capital expenditure. One dollar in concessionary loan -- a component of the aggregate development assistance -- however, is far more stimulative of total government spending. Our results also showed that a fraction of development assistance shows up in increased public investment. However, our results do not support previous research findings that foreign aid is spent entirely on consumption and not on total (public and private) investment.

Is it surprising to find that the majority of foreign aid does not go for public investment? We believe the answer is no for at least two reasons: First, increasing public investment may not be the sole purpose of development assistance. In fact, not all of ODA is designed to fund public investment; for example, ODA includes emergency assistance to countries in need. Second, several

components of government consumption, most notably expenditures on basic educaion and health and on operations and maintenance, may have higher rates of return than public investment (Devarajan, Swaroop and Zou, 1996).

In analyzing the impact of foreign aid on different components of public spending, we found that concessionary loans given to the transport and communication sector are fully non-fungible. It could be that restrictions placed by donor agencies on loans are effective due to the lumpiness of investment in the sector and therefore, are easy to monitor. Another possible reason could be that grants in these sectors frequently have a matching requirement. On the other hand, energy sector loans have been converted into fungible monies with a portion of funds leaking into the transport and communication sector. We also find that aid to the agriculture and education sectors are fungible though the evidence on the latter is weak. If these fungibility results stand up to further scrutiny, they have important implications for policy. The widespread focus on project financing by the international donor community could be misleading. The success of a donor-funded project is not just its rate of return; what is more important is how much do these funds crowd-out the recipient government's own spending in that area and what do the government's released funds finance at the margin. In this context, however, we did not find evidence of concessionary funds being diverted for military purposes.

Using available data on human development indicators we found that concessionary loans to the health sector have been helpful in lowering infant mortality. Total public spending in the health sector, on the other hand has no significant impact on infant mortality. This leads us to believe that perhaps, linking foreign aid with an agreed upon public expenditure program in areas that are critical for development might be an effective way of transferring resources to developing countries.

Table 1
Sample statistics of government expenditure and foreign aid as shares of GDP
{in percent (except standard deviation)}

Variable	Mean	Standard deviation	Minimum	Maximum
1. Government expenditure				
Total expenditure (G)	25.7	11.0	11.0	60.1
Current expenditure (Cur.)	22.4	9.5	8.5	49.5
Capital expenditure (Cap.)	6.5	3.2	2.6	18.8
Public investment (PI)	9.0	4.6	2.4	22.9
Total (public & private) investment (I)	14.9	12.7	0.02	45.7
2. Foreign aid				
Official Development Assistance (ODA)	3. 99	4.12	-0.10	22.59
[Ratio to total expenditure]	[15.53]		[-0.91]	[37.59]
Concessionary loan	1.63	1.96	-0.18	13.56
[Ratio to total expenditure]	[6.34]		[-1.64]	[22.56]

Notes:

(a) These numbers are based on 128 observations from a sample of 14 developing countries (for details see the data appendix); current and capital expenditure numbers are based on 89 observations..

(b) Data Sources:
'Total Expenditure' is total consolidated central government expenditure; current and capital are also consolidated central government expenditures (Source: Government Finance Statistics, IMF);
'Public Investment' is total consolidated public investment (Source: Easterly and Rebelo [1993]);
'Public and Private Investment' is gross domestic investment from national accounts (Source: BESD, the World Bank database);
'ODA' is net annual disbursement of official development assistance (Source: OECD, Paris);
'Concessionary Loan' is net disbursement of concessionary loans from all bilateral and multilateral agencies (Source: BESD, The World Bank).

Table 2
Sample statistics of government expenditure and foreign aid
{Mean expressed in percentage (standard deviation in parenthesis)}

Sectors	Total expenditure (G)	Public investment (PI)	Concessionary loan
1. Agriculture			
Share in GDP	1.61 (0.93)	1.11 (0.75)	0.23 (0.38)
Share in G, PI, and loan	6.82 (3.74)	12.95 (8.76)	23.39 (44.28)
2. Defense			
Share in GDP	3.03 (1.88)	n.a.	--
Share in G, PI, and loan	12.08 (5.98)	n.a.	--
3. Education			
Share in GDP	3.85 (1.46)	0.56 (0.41)	0.06 (0.08)
Share in G, PI, and loan	16.24 (6.23)	6.12 (3.06)	5.70 (12.91)
4. Energy			
Share in GDP	0.58 (0.71)	n.a.	0.29 (0.36)
Share in G, PI, and loan	2.37 (2.99)	n.a.	31.24 (114.9)
5. Health			
Share in GDP	1.14 (0.52)	0.31 (0.22)	0.01 (0.02)
Share in G, PI, and loan	4.89 (2.57)	3.79 (2.42)	0.31 (4.35)
6. Transport and Communication (T&C)			
Share in GDP	1.98 (1.56)	2.26 (1.52)	0.32 (0.49)
Share in G, PI, and loan	8.62 (6.01)	24.45 (10.55)	29.06 (50.12)

Notes:

(a) See Table 1 for information on the sample; 'n.a.' indicates not available.

Table 3
Regression results: Government expenditure on foreign aid
{Government expenditure data from GFS}

Equation	(3.1)	(3.2)	(3.3)	(3.4)	(3.5)	(3.6)
Dependent Variable	G/GDP	G/GDP	Cur./GDP	Cur./GDP	Cap./GDP	Cap./GDP
Constant						1.80
						(0.29)
$G^{Net\ of\ aid}$/GDP			0.63	0.65	0.35	0.35
			(15.33)	(14.44)	(9.15)	(8.80)
Share of ODA in GDP	0.95		0.72		0.29	
	(5.82)		(10.59)		(4.65)	
Share of concessionary loan in GDP		1.34		1.22		0.27
		(5.08)		(8.97)		(1.19)
Real per-capita GDP	0.01	0.01	-0.002	-0.004	0.002	0.002
	(1.67)	(1.10)	(-0.43)	(1.05)	(0.59)	(0.80)
Neighbor's military expenditure in GDP [lag(-1)]	0.33	0.43	-0.10	-0.53	0.08	0.04
	(1.04)	(1.26)	(-0.76)	(-0.37)	(0.64)	(0.30)
Average schooling in labor force [lag(-1)]	-1.78	-1.12	3.74	2.92	-3.58	-1.95
	(-1.04)	(-0.61)	(4.19)	(2.90)	(-4.27)	(-2.66)
Infant mortality rate [lag(-1)]	0.09	0.06	0.06	0.01	-0.05	-0.02
	(1.51)	(0.94)	(2.19)	(0.26)	(-1.91)	(-0.89)
Share of agriculture Output in GDP [lag(-1)]	-0.63	-0.53	-0.12	-0.09	0.07	0.15
	(-2.69)	(-2.09)	(-0.94)	(-0.63)	(0.59)	(1.55)
Gastil index of political and civil liberties	0.39	0.32	-0.17	-0.48	0.04	-0.03
	(0.64)	(0.50)	(-0.50)	(-1.35)	(0.12)	(-0.10)
Adjusted R-square	0.87	0.84	0.97	0.97	0.79	0.19
Observations	128	128	89	89	89	89
Model	Fixed	Fixed	Fixed	Fixed	Fixed	Random

Notes:

(a) 'Model' indicates whether the country dummies in the regression represent a Fixed effects or a Random effects model. The test is based on Hausman [1978].

(b) For regressions that represent a Fixed effects model, coefficients of country dummies are not reported.

(c) t-statistics in parentheses.

Table 4
Regression results: Government expenditure on foreign aid
{Public investment data from Easterly and Rebelo, Total investment from National Accounts}

Equation	(4.1)	(4.2)	(4.3)	(4.4)
Dependent Variable	Public Invest./GDP	Public Invest./GDP	Invest./GDP	Invest./GDP
Share of ODA in GDP	0.20		0.81	
	(2.81)		(5.05)	
Share of concessionary loan in GDP		0.32		1.18
		(2.55)		(4.05)
Real per-capita GDP	0.02	0.02	0.03	0.02
	(4.92)	(4.70)	(3.56)	(3.06)
Neighbor's military expenditure in GDP [lag (-1)]	0.51	0.52	0.49	0.55
	(3.69)	(3.73)	(1.57)	(1.69)
Average schooling in labor force [lag(-1)]	-0.36	-0.33	-1.73	-1.40
	(-0.47)	(-0.44)	(-1.02)	(-0.79)
Infant mortality rate [lag (-1)]	0.07	0.06	0.13	0.10
	(2.59)	(2.21)	(2.21)	(1.64)
Share of agriculture output in GDP [lag (-1)]	-0.14	-0.13	-0.38	-0.32
	(-1.37)	(-1.29)	(-1.64)	(-1.33)
Gastil index of political and civil liberties	-0.28	-0.30	0.66	0.59
	(-1.05)	(-1.12)	(1.08)	(0.93)
Adjusted R-square	0.85	0.85	0.66	0.63
Observations	128	128	128	128
Model	Fixed	Fixed	Fixed	Fixed

Notes:

(a) t-statistics in parentheses.

Table 5
Regression results: Sectoral government expenditure and concessionary loan
{Government expenditure data from GFS}

Equation	(5.1)	(5.2)	(5.3)	(5.4)	(5.5)	(5.6)
Dependent Variable	Edu./GDP	Health/GDP	Energy/GDP	Agri./GDP	T&C/GDP	Defense/GDP
Constant	4.12	1.19	-0.63	-2.07	2.08	3.36
	(1.49)	(1.28)	(-0.51)	(-1.20)	(3.44)	(0.89)
G $^{\text{Net of loan}}$/GDP	0.08	0.02	0.01	0.03	0.10	0.11
	(4.94)	(4.32)	(1.99)	(2.75)	(5.57)	(5.10)
Loan $^{\text{Education}}$ /GDP	1.55	0.01	0.16	0.05	0.52	0.71
	(1.08)	(0.03)	(0.27)	(0.05)	(0.31)	(0.38)
Loan $^{\text{Health}}$ /GDP	-3.21	-0.31	3.07	3.45	1.10	5.19
	(-0.73)	(0.23)	(1.61)	(1.29)	(0.21)	(0.91)
Loan $^{\text{Energy}}$ /GDP	-0.71	0.12	0.36	0.21	0.17	0.02
	(-1.21)	(1.84)	(3.82)	(1.59)	(3.75)	(0.07)
Loan $^{\text{Agriculture}}$ /GDP	0.56	0.19	0.09	-0.05	-0.01	0.21
	(2.22)	(2.45)	(0.82)	(-0.32)	(-0.03)	(0.65)
Loan $^{\text{T\&C}}$ /GDP	-0.59	0.14	0.16	0.21	0.92	0.36
	(-3.01)	(2.44)	(1.92)	(1.77)	(3.98)	(1.44)
Loan $^{\text{Other}}$ /GDP	-0.05	0.02	0.01	0.06	0.04	-0.01
	(-1.65)	(2.30)	(0.79)	(3.25)	(1.09)	(-0.35)
Real per-capita GDP	0.0003	-0.0001	0.001	0.0003	-0.0002	0.0002
	(0.26)	(-0.15)	(1.44)	(0.45)	(-0.17)	(0.15)
Neighbor's military	-0.12	0.003	0.02	-0.004	-0.04	0.01
expenditure in GDP [lag (-1)]	(-1.28)	(0.17)	(0.41)	(-0.12)	(-0.67)	(0.16)
Average schooling in	-0.19	-0.08	-0.12	0.46	-1.65	-0.29
labor force [lag (-1)]	(-0.68)	(-0.89)	(-0.99)	(2.55)	(-4.87)	(-0.75)
Infant mortality rate [lag (-1)]	0.01	-0.003	0.002	0.01	-0.03	-0.01
	(1.37)	(-0.91)	(0.53)	(1.60)	(-2.38)	(-1.12)
Share of agriculture	-0.05	0.008	0.02	-0.004	-0.08	-0.03
output in GDP [lag (-1)]	(-1.17)	(0.65)	(1.12)	(-0.18)	(-1.92)	(-0.56)
Gastil index of political	-0.17	-0.06	-0.06	-0.02	-0.07	-0.03
and civil liberties	(-1.56)	(-1.92)	(1.23)	(-0.32)	(-0.57)	(-0.2)
Adjusted R-squared	0.04	0.24	0.18	0.09	0.89	0.34
Observations	128	128	128	128	128	128
Model	Random	Random	Random	Random	Random	Random

*t-statistics in parentheses.

Table 6
Regression Results: Sectoral government expenditure and concessionary loan
{Sectoral public investment data from Easterly and Rebelo}

Equation	(6.1)	(6.2)	(6.3)	(6.4)
Dependent Variable	Education^{PI} /GDP	Health^{PI} /GDP	Agriculture^{PI} /GDP	T&C^{PI} /GDP
Constant	-0.55	0.75	--	0.35
	(-0.82)	(1.47)	--	(0.12)
G $^{Net\ of\ loan}$/GDP	0.01	0.002	-0.01	0.004
	(2.07)	(0.73)	(-1.92)	(0.19)
Loan ^{Education} /GDP	0.49	-0.49	-0.42	2.89
	(1.27)	(-1.93)	(-0.68)	(1.73)
Loan ^{Health} /GDP	-0.56	0.65	4.18	-0.81
	(-0.44)	(0.80)	(2.20)	(-0.15)
Loan ^{Agriculture} /GDP	0.07	0.007	0.11	1.29
	(1.16)	(0.17)	(1.03)	(0.99)
Loan $^{T\&C}$ /GDP	-0.01	0.09	0.31	1.07
	(-0.19)	(2.50)	(3.68)	(4.57)
Loan ^{Other} /GDP	-0.0003	0.003	0.02	0.06
	(-0.03)	(0.48)	(1.81)	(1.69)
Real per-capita GDP	0.0002	0.0001	0.003	0.003
	(0.69)	(0.69)	(5.14)	(2.64)
Neighbor's military expenditure in GDP [lag (-1)]	0.01	0.01	0.02	0.15
	(0.59)	(1.00)	(0.90)	(2.50)
Average schooling in Labor force [lag (-1)]	0.09	-0.06	-0.34	-0.47
	(1.18)	(-1.18)	(-2.55)	(-1.48)
Infant mortality rate [lag (-1)]	0.005	-0.0003	0.01	0.005
	(2.43)	(-0.30)	(1.96)	(0.51)
Share of agriculture output in GDP [lag (-1)]	-0.002	-0.004	0.007	-0.02
	(-0.23)	(-0.624)	(0.063)	(-0.55)
Gastil index of political and civil liberties	-0.03	-0.04	-0.10	0.02
	(-1.01)	(-2.27)	(-2.30)	(0.13)
Adjusted R-squared	0.13	0.64	0.84	0.06
Observations	128	128	128	128
Model	Random	Random	Fixed	Random

* t-statistics in parentheses.

Table 7
Joint estimation of sectoral equations: Sectoral government expenditure and concessionary loan
{Government expenditure data from GFS}

Equation	(7.1)	(7.2)	(7.3)	(7.4)	(7.5)	(7.6)
Dependent variable	Edu./GDP	Health/GDP	Energy/GDP	Agri./GDP	T&C/GDP	Defense/GDP
Constant	-1.73	-0.15	-0.53	0.65	-0.05	-1.04
	(0.78)	(0.18)	(0.32)	(0.38)	(0.65)	(0.72)
Real per-capita GDP	0.0007	0.0001	0.0002	- 0.0003	-0.0001	0.0003
	(0.0003)	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0003)
Infant mortality rate [lag (-1)]	0.0005	0.0001	0.0014	- 0.0018	0.0039	0.0031
	(0.0022)	(0.0005)	(0.0008)	(0.0015)	(0.0022)	(0.0021)
Neighbor's military	0.0587	-0.0013	0.0098	- 0.0192	-0.0135	0.0150
expenditure in GDP [lag (-1)]	(0.0250)	(0.0066)	(0.0103)	(0.0116)	(0.0233)	(0.0229)
Share of agriculture	0.0274	0.0034	0.0059	- 0.0058	-0.0060	0.0159
output in GDP [lag (-1)]	(0.0129)	(0.0036)	(0.0051)	(0.0066)	(0.0129)	(0.0134)
Common to all equations:						
β_j	0.11	0.02	0.01	0.03	0.07	0.09
	(0.03)	(0.01)	(0.01)	(0.01)	(0.02)	(0.02)
ϕ_j	-2.99	-3.96	0.92	1.90	-0.21	- -
	(2.61)	(1.61)	(0.06)	(0.15)	(0.28)	- -
Chi-square	13.4					
Probability	0.99					
Degrees of Freedom	30					
Observations:	104					

*standard error in parentheses.

Table 8
Joint estimation of sectoral equations: Sectoral government expenditure and concessionary loan
{Government expenditure data from Easterly and Rebelo}

Equation	(8.1)	(8.2)	(8.3)	(8.4)
Dependent Variable	Edu./GDP	Health/GDP	Agriculture/GDP	T&C/GDP
Constant	-0.07 (0.13)	-0.01 (0.05)	0.05 (0.11)	-0.02 (0.33)
Real per-capita GDP	0.0001 (0.0006)	-0.0002 (0.0004)	-0.0004 (0.0006)	0.0001 (0.0001)
Infant mortality rate [lag(-1)]	0.0002 (0.0009)	0.0003 (0.0004)	-0.0003 (0.0007)	0.0001 (0.0023)
Neighbor's military Expenditure in GDP [lag(-1)]	0.0039 (0.0071)	-0.0004 (0.0041)	-0.0008 (0.0077)	0.0096 (0.0377)
Common to all equations:				
β_j	0.001 (0.002)	0.0004 (0.001)	0.003 (0.004)	0.017 (0.024)
ϕ_i	1.57 (0.41)	45.44 (66.07)	0.99 (0.06)	-0.25 (0.13)
Chi-square	14.188			
Probability	0.72			
Degrees of Freedom	18			
Observations:	104			

*standard error in parentheses.

Table 9
Regression results: Social indicators on foreign aid

Equation	(9.1)	(9.2)
Dependent Variable	Δ log infant mortality	Δ log primary schooling
Constant	9.78 (1.56)	- 0.28 (-0.03)
Share of health expenditure in GDP	0.12 (0.12)	
Share of health expenditure in GDP [lag (-1)]	0.62 (0.60)	
Share of concessionary loan to health sector in GDP	-16.18 (-1.11)	
Share of concessionary loan to the health sector in GDP [lag (-1)]	-31.66 (-2.25)	
Share of education expenditure in GDP		- 0.15 (-0.27)
Share of education expenditure in GDP [lag (-1)]		0.70 (1.18)
Share of concessionary loan to the education sector in GDP		0.35 (0.04)
Share of concessionary loan to the education sector in GDP [Lag (-1)]		2.71 (0.31)
Real per-capita GDP	-2.11 (-2.75)	- 0.28 (-0.22)
Population growth rate	-0.16 (-0.16)	0.19 (0.12)
Adjusted R-square	0.17	0.02
Observations	111	111
Model	Random	Random

* t-statistics in parentheses.

References

Barro, R. J., 1991, "Economic growth in a cross section of countries," *Quarterly Journal of Economics* 106, 407-44.

Boone, P., 1994, "Politics and the Effectiveness of Foreign Aid," Mimeograph, London School of Economics and Center for Economic Performance, London, UK.

Cashel-Cordo, P. and S. G. Craig, 1990, "The public sector impact of international resource transfers," *Journal of Development Economics* 32, 17-42.

Devarajan, S., V. Swaroop and H. F. Zou, 1996, "The composition of public expenditure and economic growth," *Journal of Monetary Economics*, 37: 000-000.

Easterly, W. and S. Rebelo, 1993, "Fiscal Policy and Economic Growth: An Empirical Investigation," *Journal of Monetary Economics* 32, 417-458.

Gang, I. N. and H. A. Khan, 1991, "Foreign Aid, taxes, and public investment," *Journal of Development Economics* 34, 355-369.

Gastil, R. D., 1989, *Freedom in the World: Political Rights and Civil Liberties 1988-1989*, New York: Freedom House.

Gupta, K. L., 1993, "Intra-sectoral fungibility of foreign aid: An alternative framework," Mimeograph, University of Alberta.

Hansen, L. P. and K. J. Singleton, 1982, "Generalized Instrumental Variables Estimation of Nonlinear rational expectations model," *Econometrica* 50: 1269-86.

Hausman, J. A., 1978, "Specification tests in econometrics," *Econometrica* 46: 1251-72.

Heller, P. S., 1975, "A model of public fiscal behavior in developing countries: Aid, investment, and taxation," *American Economic Review* 65(3): 429-45.

Khilji, N. M. and E. M. Zampelli, 1994, "The fungibility of U. S. military and non-military assistance and the impacts on expenditures of major aid recipients," *Journal of Development Economics* 43, 345-362.

Landau, D., 1994, "The impact of military expenditures on economic growth in less developed countries," *Defense and Peace Economics* 5: 205-20.

Levy, V., 1987, "Anticipated development assistance, temporary relief aid, and consumption behavior of low-income countries," *The Economic Journal* 97: 446-58.

McGuire, M. C., 1978, "A method for estimating the effect of a subsidy on the receiver's resource constraint: With an application to the U. S. Local governments 1964-1971," *Journal of Public Economics* 10: 355-69.

Mosley P., J. Hudson and Sara Horrell, 1987, "Aid, the public sector and the market in less developed countries," *Economic Journal* 97, pp. 616-641.

Obstfeld, M., 1995, "Effects of foreign resource inflows on saving: A methodological overview," Mimeograph, University of California, Berkeley.

OECD, 1994, *Geographical Distribution of Financial Flows to Developing Countries: Disbursements, Commitments, Country Indicators*, Paris, France.

Pack, H. and J. R. Pack, 1993, "Foreign aid and the question of fungibility," *Review of Economics and Statistics*, 258-65.

Pack, H. and J. R. Pack, 1990, "Is foreign aid fungible? The case of Indonesia," *Economic Journal*, 100, 188-194.

Stone, R., 1954, "Linear expenditure systems and demand analysis: An application to the pattern of British demand," *Economic Journal*, 64, 511-27.

UNDP, 1994, *Human Development Report*, New York: Oxford University Press.

White, H. and J. Luttik, 1994, "The countrywide effects of aid," Policy Research Working Paper 1337, The World Bank, Washington, D.C.

World Bank, 1992, "Adjustment lending and mobilization of private and public resources for growth," Policy and Research Series, Country Economics Department, The World Bank.

World Bank, 1994, *World Development Report*, Washington, D.C.

Data Appendix

A panel database (annual data from 1971 through 1990 for developing countries) was constructed for the empirical analysis. Three different sets of expenditure data -- total and sectoral expenditure data at the consolidated central government level from GFS and RED; and total and sectoral public investment data at the consolidated general government level from Easterly and Rebelo [1993] -- and two sets of foreign aid data -- net disbursement of aggregate overseas development assistance from OECD and net disbursement of concessionary loans (overall as well as by sectors) -- were collected and used in the regression analysis.

I. Sample Selection

The sample used in the empirical analysis is based on 128 observations from 14 developing countries (see the country list below).

To collect our sample we started with the database of Easterly and Rebelo [1993] which has a new measure of public investment -- one which incorporates investment by all levels of government as well as investment by public enterprises. Data on public investment in GFS and RED, on the other hand, are incomplete in this sense. To construct a meaningful panel for the statistical analysis, we included a country from the Easterly and Rebelo database in our sample, if at least 35 percent of the annual observations were available on each of the public investment variables used in the regression analysis. From a total of 166 countries, twenty seven were chosen. Four of these 27 countries were dropped because they did not have related GFS expenditure data on the same variables. The objective was to have the same set of countries from all the three different databases. In the final analysis, only 14 of the 23 countries were chosen as only these had the required information on all the relevant variables (including the control variables) in the regression.

II. Countries

The classification -- by regions and by income levels -- is according to the World Bank

Classification of Country Group (World Bank, 1994).

A. Country List

BANGLADESH, COSTA RICA, ECUADOR, EGYPT, HONDURAS, KENYA, MEXICO, MALAWI, MALAYSIA, PERU, SIERRA LEONE, THAILAND, TURKEY, ZAIRE.

B. Country Groups: Regional Classification

2 East Asia countries, 1 South Asia country, 4 sub-Saharan Africa countries, 5 Latin American and Caribbean countries, and 2 EMENA countries.

C. Country Groups: By Income

7 Low-income countries, 5 Lower-middle-income countries, and 2 Upper-middle-income countries.

III. DATA SOURCE

(1) Data on Public Expenditures: Public investment data from Easterly and Rebelo [1993]; Government Finance Statistics (GFS), Various issues of RED's, International Finance Statistics (IFS) -- all from the International Monetary Fund; and National Accounts from the World Bank Economic and Social Database(BESD).

(2) Data on Foreign Aid: From *Geographical Distribution of Financial Flows to Developing Countries: Disbursements, Commitments, Economic Indicators*, Paris, France; International Economics Department, The World Bank, Washington, D.C.

(3) Exchange Rate: International Currency Analysis, Inc., World Currency Yearbook, New York.

(4) Infant Mortality Rate: UN Social Indicators.

(5) Average Schooling Years in the Labor Force: Barro [1994], Nehru [1993].

(6) Military Expenditures of Neighboring Countries: Landau [1994].

(7) Agriculture Output to GDP Ratio: United Nations.

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