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Abstract

Aid has been the principal source of development finance for the majority of developing countries over the past few decades. This has spawned a large literature on the effectiveness of aid, which remains essentially inconclusive. The empirical literature has tended to evaluate the impact of aid by including it as a variable in a regression for the determinants of some economic performance indicator. This paper follows a different strand of the literature and examines the impact of aid on public sector fiscal behaviour. Aid is in general given to the public sector, thus any effect of aid is mediated by that sector. We specifically address this behavioural feature by analysing how aid revenue affects government fiscal behaviour with respect to tax, borrowing and expenditure decisions; unlike previous contributions, aid is endogenous in our model, which has a number of important implications. We estimate an econometric model that differs from previous studies not only in this respect but also by allowing domestic borrowing, in addition to aid and tax revenue, to finance both capital and recurrent expenditure. Structural and reduced form equations are derived and estimated using 1956-95 time series data for Pakistan. Results indicate, contrary to much of the literature, that only half of aid has gone to government consumption, that it has had a slightly positive impact on public investment and negative impact on tax effort.

Outline

I INTRODUCTION

Aid, or foreign development assistance, has been a dominant feature of the relationship between Industrial and Developing countries since the 1960s; aid receipts have been a major source of external finance for the majority of countries in Africa and Asia since they gained independence. The predominant nature of aid has changed considerably, from project finance in the 1960s to adjustment support in the 1980s, but its economic importance to recipients has remained considerable. As late as 1993, aid revenues were on average equivalent to some six per cent of GNP of low income countries (excluding China and India), and almost 12 per cent of GNP for sub-Saharan African countries on average; as virtually all aid goes to the public sector, this translates into aid representing about half of government consumption spending in LDCs on average (*World Development Report 1995*). As aid has been such an important source of development finance, a large literature has emerged on evaluating the effects, especially the macroeconomic impact on savings, investment and growth, of aid.

The underlying economic rationale for aid as a source of development finance can be traced back to the two-gap model of Chenery and Strout (1966): low income countries have insufficient domestic savings to finance the level of investment required to achieve their target growth rates, and/or insufficient foreign exchange earnings to finance required capital imports; these savings and foreign exchange gaps constrain growth. Capital inflows (of which aid is one form) are justified as, if they relax the savings and foreign exchange constraints, they can contribute to increased growth. Following the early work of Griffin (1970), who posited that aid inflows may discourage domestic savings, displace investment and be redirected into consumption rather than investment, and for all these reasons may not increase growth rates, much of the literature on the macroeconomic impact used simple ordinary least squares regressions of aid on savings, investment and/or economic growth. This literature has been comprehensively reviewed and justifiably criticised, on both theoretical and econometric grounds, by White (1992) and others. This notwithstanding, many studies continue to draw inferences on the impact of aid from cross-section regressions of aid on economic indicators; in an oft cited recent study, Boone (1996) claimed that aid increased (government) consumption but had no significant effect on raising investment.

A core deficiency of this 'aid-growth' literature is that it fails to explicitly recognise that aid is given primarily to the government, and that hence any impact of aid on the economy will depend on government behavior, in particular how fiscal decisions on taxation and expenditure are affected by aid revenues. Both possible impacts have been a widespread concern in the donor community, especially that concerning

taxation. A relatively recent development in the literature avoids this criticism by explicitly modelling how the impact of aid is mediated by public sector behavior. Mosley *et al* (1987) and Gang and Khan (1991), picking-up on an earlier paper by Heller (1975), model the public sector fiscal response to foreign aid inflows within a framework where government's maximise their utility by attaining revenue and expenditure targets, and aid influences their ability to attain these targets. Gang and Khan (1991), unlike Mosley *et al* (1987) whose regressions were in the 'aid-growth' tradition, actually estimated the model, using time series data for India, and this work has stimulated a debate on the appropriate basis on which to model public sector behaviour in the presence of aid inflows[1] This paper is a contribution to that literature.

Our major point of departure from the previous literature is that we endogenise aid. Previous contributors have assumed that governments set revenue targets for tax and borrowing, yet treat aid as exogenous aid. A prime interest of previous studies is aid fungibility, which occurs if recipients fail to use aid in the manner intended by donors: the implicit assumption is that donors grant aid for investment purposes and fungibility arises when recipients divert these funds into consumption uses. As discussed in the next section, fungibility is not a requirement of our model, although we can address the associated concerns. In our approach, governments have a target for aid revenue, and this 'expected' revenue is incorporated into their fiscal planning; that is, when determining revenue and expenditure allocations, aid revenue is taken into account. Making aid endogenous does not require the assumption that recipients have control over the aid they are allocated by donors; instead it requires that effective control over the amount of this allocation that is actually spent. Other innovative features of our model, notably that a budget constraint is expressed as an inequality and that domestic borrowing is allowed to finance both capital and recurrent expenditure (in previous studies it is permitted to finance investment only), are detailed in the next section.

The model is presented and discussed, with attention to how it relates to and deviates from the existing literature, in Section II; structural and reduced-form equations are also derived. Details of the data and estimation procedures are provided in Section III. In Section IV the structural equations are estimated using three stage non-linear least squares with 1956-95 time series data for Pakistan, a country chosen as being a major aid recipient which has used borrowing to finance consumption, whose public sector has attracted much attention (Zaman, 1995) and for which a relatively good data set is available. We obtain the coefficients of the reduced-form equations using the estimated coefficients from the structural equations. Concluding comments are in Section V.

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1 See, for example, Binh and McGillivray (1993), Gang and Khan (1993), McGillivray (1994), Khan (1994) and White (1994).

II A FISCAL RESPONSE MODEL WITH ENDOGENOUS AID

A basic task facing public sector decision-makers in all countries is to allocate revenue among various expenditure categories subject to budgetary constraints. In our model we distinguish two categories of public expenditure: recurrent expenditure or government consumption (G) and capital expenditure or public sector investment (I_g). Government revenue is obtained from both domestic and foreign sources in the forms of taxation and other recurrent revenue (T), borrowing from domestic sources (B) and, for developing countries, aid inflows (A). The utility function of public sector decision-makers can be represented as:

$$U = f(I_g, G, T, A, B) \tag{1}$$

Public sector policymakers are assumed act in a rational, utility-maximising manner. They set annual targets for each revenue and expenditure category and attempt to attain these targets. Following Mosley *et al* (1987) and Binh and McGillivray (1993), the utility function in (1) can be represented as a quadratic loss function:

$$U = \alpha_0 - \frac{\alpha_1}{2}(I_g - I_g^*)^2 - \frac{\alpha_2}{2}(G - G^*)^2 - \frac{\alpha_3}{2}(T - T^*)^2 - \frac{\alpha_4}{2}(A - A^*)^2 - \frac{\alpha_5}{2}(B - B^*)^2 \tag{2}$$

where the asterisks denote exogenous target levels of the endogenous variables, $\alpha_i > 0$ for $i = 1, ..., 5$. It is clear from (2) that government maximises its utility if it achieves all targets, the maximum unconstrained value being α_0.[2] Also, as $\alpha_i > 0$ the principle of diminishing marginal utility is ensured for all levels of I_g, G, T and B. Note that this utility function is symmetric, in the sense that utility is reduced in the same proportion whether governments overshoot or undershoot a target. As Binh and McGillivray (1993) point out this may appear restrictive if one believes that governments would be

[2] This is not the case with the functional form used by Heller (1975) and Gang and Khan (1991), which was:

$$U = \alpha_0 + \alpha_1(I_g - I_g^*) - \frac{\alpha_2}{2}(I_g - I_g^*)^2 + \alpha_3(G_c - G_c^*) - \frac{\alpha_4}{2}(G_c - G_c^*)^2 + \alpha_{51}(G_s - G_s^*) - \frac{\alpha_6}{2}(G_s - G_s^*)^2$$
$$- \alpha_7(T - T^*) - \frac{\alpha_8}{2}(T - T^*)^2 - \alpha_9(B - B^*) - \frac{\alpha_{10}}{2}(B - B^*)^2,$$

where G_s and G_c are socioeconomic and civil consumption, respectively, and the other variables are as defined in the text. Binh and McGillivray (1993) show that in the above case the policymaker is better off by overshooting the targets for I_g, G_s and G_c and undershooting those for T and B. In this context, it not only follows that these 'targets' cannot truly be considered as targets, but that the structural equations derived from this function are not consistent with maximising behaviour.

more concerned with undershooting revenue targets than with overshooting. However, obtaining revenue has political costs, whether from public objection to paying taxes or concern with aid dependency, while a revenue shortfall imposes the political costs associated with a budget deficit (and/or the opportunity costs of reduced spending). There is no reason, *a priori*, why a revenue shortfall generates more disutility than a revenue overshoot. A similar argument applies to expenditures, as the opportunity cost of overspending is in raising the revenue. For these reasons, which the government will take into account when setting targets, we consider the symmetric form of (2) to be a reasonable representation of *U(.)*.

The specification in (2) differs from all previous fiscal response models by treating aid as a choice variable for the recipient, and hence endogenous. The general justification for treating aid as exogenous from the perspective of recipients is that its level is determined by donors purely on the basis of supply-side criteria, an issue considered explicitly in research on the determinants of aid allocation (see, for example, McGillivray and Oczkowski, 1992). In practice, however, donors commit a certain amount of aid to recipients each year, and it is ultimately up to recipients to determine how much of that commitment is disbursed (actually spent) in the year. Although the aid commitment is determined by the donor and as such is largely exogenous to the recipient (who can however take some actions to influence commitments), the amount disbursed, and hence allocated among expenditure categories, is subject to a large degree of recipient discretion and ought therefore enter the recipient utility function as an endogenous variable. Recipients can and do exercise choice over the amounts of aid disbursed; examination of aid data reveals that disbursements often differ significantly from commitments (OECD, 1994).

Given this reasoning, A is disbursements while the target A^* can be represented by commitments. Under-spending an aid commitment in any given year is undesirable as it implies an inability to utilise all aid (limited absorptive capacity) and may result in decreased commitments in subsequent years. Overspending is also undesirable as, in practice, if disbursements exceed commitments it means either delayed spending of past commitments (suggesting limited absorptive capacity) or, more often, that emergency aid was granted during the year (thus, it is a proxy for an adverse shock, such as famine). The estimation of other target variables is discussed in Section III.

Unlike previous applications of the Heller model, we aggregate both aid and government spending; this deserves some comment. First, while we have a single variable G, other contributors tended to distinguish developmental (as a measure of spending on human capital) from non-developmental public consumption expenditure;

in a previous application of a variant of the Heller model to Pakistan, Chishti and Hasan (1992) distinguish defence and non-defence government recurrent expenditure.[3] In (2), α_2 can be considered a weighted sum of the utility attached to alternative forms of government spending, and there is aggregation bias in our approach if the utility attached to particular forms of spending (eg. defence) is much higher than that attached to other forms (eg. education). While we could fairly easily disaggregate *G* in the model, resulting in more complicated algebraic terms in the structural equations, this would greatly increase the number of parameters to estimate; as our primary concern here is with the effect of aid on *G*, I_g and *T*, we consider the potential aggregation bias an acceptable price to pay for a more tractable model from which we are able to generate more reliable parameter estimates. Second, previous contributions tended to distinguish aid in grant form from concessional loans; arguably; to the extent that governments prefer grants to loans there is an aggregation problem in (2). In practice, such bias is likely to be minor as aid loans are long-term and present governments are unlikely to be around when repayment is due, hence could treat them as grants. More importantly, as we endogenise aid it is again relevant to consider the tractability of the model, and the limits of the data available for estimation, so we consider it reasonable to assume that governments treat all forms of aid as essentially the same in terms of fiscal response.[4]

What the government now wants to do is maximise *U* subject to the budget constraint that expenditures cannot exceed (all) revenues. If we were to follow previous Heller-type analyses the utility function given by equation (2) would be maximised subject to the following constraints:

$$I_g = (1-\mathrm{r}_1)T + (1-\mathrm{r}_2)A + B \tag{3}$$

$$G = \mathrm{r}_1 T + \mathrm{r}_2 A \tag{4}$$

3 We offer an advance on Chishti and Hasan (1992) as their estimation was hampered by having a time series limited to 17 observations; our series covering almost 40 years offers more reliable parameter estimates.

4 In all economic modelling one abstracts from some complexities so as to highlight the relationship of primary concern. The point to consider is whether the simplifications are excessive such that they distort the relationship as modelled and estimated. Thus, one must distinguish each of *A*, *T* and *B* as alternative sources of revenue, because the nature of the costs associated with raising each are different, but arguments for disaggregating *A*, while not without some merit, are no more convincing than arguments for disaggregating *T* (more visible taxes generate higher political costs; tariffs are more distortionary than sales taxes) or *B*. Regarding spending, the important distinction is between productive (investment) and non-productive (consumption) spending. There is thus an *a priori* case for distinguishing productive recurrent spending (eg. health and education) from pure consumption, although drawing the distinction in practice is difficult; data sources often do not use these classifications, and a researcher must make arbitrary decisions on what is an is not 'developmental'. This is an issue, but we believe the interests of parsimony over-ride the potential concern.

where (1 - ρ_1) represents savings from the recurrent budget and ρ_2 represents the proportion of aid allocated to consumption spending. Equations (3) and (4) are of course a decomposition of the overall public sector budgetary constraint:

$$I_g + G = T + A + B \tag{5}$$

Previous studies maximised (2) subject to (3) and (4). However, there are three significant problems with the constraints written in (3) and (4). The first is the interpretation given by previous studies to ρ_2, which is taken to represent the extent of fungibility of aid. In other words, it is implicitly assumed that donors grant aid for investment purposes only (and that all investment expenditures are captured in I_g)[5] hence any aid allocated to *G* (proportion ρ_2) is an *ex post* measure of fungibility (i.e., $\rho_2 = 0$ *ex ante*). As there are elements of *G* which donors would be willing to support, notably various social sector expenditures, $\rho_2 > 0$ *ex ante* and the estimated value of ρ_2 is a measure of maximum fungibility.

A second problem is that (3) and (4) do not allow for the not uncommon practice in developing countries of financing recurrent expenditure from domestic borrowing. This can easily be overcome by rewriting (3) with $(1-\rho_3)B$ and adding $\rho_3 B$ to the left hand side of (4). The third problem has been identified by White (1994), who points out that this representation over-constrains the model, not necessarily allowing the government to reach α_0 even in the case where aid revenue are sufficient to meet all targets. The problem arises because although total revenue may be sufficient to meet (5), the ρs constrain allocation so that specific expenditure targets in (2) cannot be met.

To avoid this problem White (1994) suggested, albeit with some reservation, the use of a single budget constraint like that written in equation (5). It is obvious that such a constraint will always ensure that the model can attain α_0 when revenues are sufficient to meet each target. Yet one can question whether (5) alone, which implies no constraints on how revenues are allocated thus implicitly aid is completely fungible, is a realistic representation of public sector fiscal behaviour. Public sector fiscal decisions are subject to pressures from a number of quarters: politicians, private pressure groups, various arms of the bureaucracy and donors themselves all seek to influence the allocation of revenues. These pressures, it is reasonable to suggest, inevitably

[5] In fact, although other studies disaggregated *G* into two components, reflecting concerns we have just discussed, these were then summed in (4). Thus, although different types of *G* were considered as being associated with different levels of utility, this distinction was not captured in the constraints governing the allocation of revenues to each type of expenditure. Thus, in terms of how aid is allocated, our approach does not differ from that of other studies.

culminate in forcing outcomes which are sub-optimal in terms of the government's own preferences. This is likely to be the rule rather than the exception and ought therefore be captured explicitly in one's model of public sector fiscal behaviour.

On the basis of this reasoning we replace (3) and (4) with the following:

$$G \leq \rho_1 T + \rho_2 A + \rho_3 B \tag{6}$$

This rationale for the inequality is that there are *external* constraints which limit the manner in which the public sector in developing countries allocates revenues. The actions of donors or domestic interests cause the values of the ρs in (6) to be imposed on those involved in setting targets and allocating revenue, with there being no guarantee that targets can be met even though revenues may satisfy (5). In other words, on the assumption that (6) is binding (the possible value of *G* is 'upper' bound), these external constraints prevent the attainment of α_0 (because at least one expenditure target cannot be met). Our analysis is premised on this assumption. If (6) is not binding the government is not prevented from reaching specific expenditure targets, utility is maximised subject to (5) only and the government can attain α_0 if revenues are sufficient.

In sum, our underlying model is one in which governments set revenue and expenditure targets, they then attempt to raise and allocate the revenues required to meet these targets so as to maximise their utility. Aid, like tax and borrowing, is treated as one of the forms of revenue. If for some reason they fail to raise adequate revenue, for example a fall in commodity prices reduces export tax revenue, then clearly utility is not maximised. Similarly, if their discretion to allocate alternative revenues across different expenditures is constrained, such that (6) is binding, utility will not be maximised (more strictly, in both cases, there is constrained maximisation and α_0 is not attained). To analyse the impact of aid, in our model where governments expect to receive aid, we derive the structural equations from maximising (2) subject to (5) and (6). With (6) assumed to be binding the Lagrangean is:

$$\begin{aligned} L = \alpha_0 &- \frac{\alpha_1}{2}\left(I_g - I_g^*\right)^2 - \frac{\alpha_2}{2}\left(G - G^*\right)^2 - \frac{\alpha_3}{2}\left(T - T^*\right)^2 - \frac{\alpha_4}{2}\left(A - A^*\right)^2 \\ &- \frac{\alpha_5}{2}\left(B - B^*\right)^2 + \lambda_1(I_g + G - T - A - B) + \lambda_2(G - \rho_1 T - \rho_2 A - \rho_3 B) \end{aligned} \tag{7}$$

where λ_1 and λ_2 are Lagrangean multipliers. Partially differentiating yields the following first-order conditions:

$$\frac{\partial L}{\partial I_g} = -\alpha_1(I_g - I_g^*) + \lambda_1 = 0,$$

$$\frac{\partial L}{\partial G} = -\alpha_2 (G - G^*) + \lambda_1 + \lambda_2 = 0,$$

$$\frac{\partial L}{\partial T} = -\alpha_3 (T - T^*) - \lambda_1 - \lambda_2 \rho_1 = 0,$$

$$\frac{\partial L}{\partial A} = -\alpha_4 (A - A^*) - \lambda_1 - \lambda_2 \rho_2 = 0,$$

$$\frac{\partial L}{\partial B} = -\alpha_5 (B - B^*) - \lambda_1 - \lambda_2 \rho_3 = 0,$$

$$\frac{\partial L}{\partial \lambda_1} = I_g + G - T - A - B = 0 \text{ and}$$

$$\frac{\partial L}{\partial \lambda_2} = G - \rho_1 T - \rho_2 A - \rho_3 B = 0.$$

Following Heller (1975), Mosley *et al* (1987), Gang and Khan (1991), Chishti and Hasan (1992) and Khan and Hoshino (1992) we assume *ex ante* that targeted domestic borrowing B^* is equal to zero. This does not of course preclude borrowing *per se*; basically, we assume that governments wish to meet all expenditures from aid and taxes, but failing that they will borrow. Re-arranging the first order conditions to substitute out λ_1 and λ_2 with $B^* = 0$ yields the following system of structural equations:

$$\begin{aligned} I_g = {} & \beta_1 (1 - \rho_1) I_g^* + (1 - \rho_1)(\beta_1 + \beta_2) G^* + (1 - \rho_1)[1 - \rho_1 \beta_2 - \beta_1] T^* \\ & + [(1 - \rho_2) - (1 - \rho_1)(\rho_2 \beta_2 + \beta_1)] A + [(1 - \rho_3) - (1 - \rho_1)(\rho_3 \beta_2 + \beta_1)] B, \end{aligned} \tag{8}$$

$$\begin{aligned} G = {} & \rho_1 \beta_1 I_g^* + \rho_1 (\beta_1 + \beta_2) G^* + \rho_1 [1 - \rho_1 \beta_2 - \beta_1] T^* + [\rho_2 - \rho_1 (\rho_2 \beta_2 + \beta_1)] A \\ & + [\rho_3 - \rho_1 (\rho_{32} \beta_2 + \beta_1)] B, \end{aligned} \tag{9}$$

$$T = \beta_1 I_g^* + (\beta_1 + \beta_2) G^* + [1 - \rho_1 \beta_2 - \beta_1] T^* - [\rho_2 \beta_2 + \beta_1] A - [\rho_3 \beta_2 + \beta_1] B, \tag{10}$$

$$A = \beta_3 I_g^* + (\beta_3 + \beta_4) G^* - [\rho_1 \beta_4 + \beta_3] T + [1 - \rho_2 \beta_4 - \beta_3] A^* - [\rho_3 \beta_4 + \beta_3] B \tag{11}$$

$$B = \beta_5 I_g^* + (\beta_5 + \beta_6) G^* - [\rho_1 \beta_6 + \beta_5] T - [\rho_2 \beta_6 + \beta_5] A \tag{12}$$

where

$$\beta_1 = \frac{1}{\Phi_1} \alpha_1 (1 - \rho_1),\ \beta_2 = \frac{1}{\Phi_1} [\alpha_2 \rho_1 - \alpha_1 (1 - \rho_1)],\ \beta_3 = \frac{1}{\Phi_2} \alpha_1 (1 - \rho_2),$$

$$b_4 = \frac{1}{\Phi_2}[a_2 r_2 - a_1(1-r_2)],\ b_5 = \frac{1}{\Phi_3}a_1(1-r_3),\ b_6 = \frac{1}{\Phi_3}[a_2 r_3 - a_1(1-r_3)]$$

and

$$\Phi_1 = a_1(1-r_1)^2 + a_2 r_1^2 + a_3, \Phi_2 = a_1(1-r_2)^2 + a_2 r_2^2 + a_4 \text{ and } \Phi_3 = \alpha_1(1-\rho_3)^2 + \alpha_2 \rho_3^2 + \alpha_5$$

.

The reduced form equations, obtained from solving the system of structural equations given in (8) to (12), are:

$$I_g = p_1 I_g^* + p_2 G^* + p_3 T^* + p_4 A^*, \quad (13)$$

$$G = p_5 I_g^* + p_6 G^* + p_7 T^* + p_8 A^*, \quad (14)$$

$$T = p_9 I_g^* + p_{10} G^* + p_{11} T^* + p_{12} A^*, \quad (15)$$

$$A = p_{13} I_g^* + p_{14} G^* + p_{15} T^* + p_{16} A^* \quad (16)$$

$$B = p_{17} I_g^* + p_{18} G^* + p_{19} T^* + p_{20} A^* \quad (17)$$

where

$$p_1 = \left(1 - \frac{g_3}{a_1(g_1 g_3 - g_2^2)}\right), p_2 = -\left(\frac{g_3 - g_2}{a_1(g_1 g_3 - g_2^2)}\right), p_3 = \left(\frac{g_3 - r_1 g_2}{a_1(g_1 g_3 - g_2^2)}\right),$$

$$p_4 = \left(\frac{g_3 - r_2 g_2}{a_1(g_1 g_3 - g_2^2)}\right), p_5 = \left(\frac{g_3 - r_3 g_2}{a_1(g_1 g_3 - g_2^2)}\right), p_6 = \left(1 - \frac{(g_3 - g_2) + (g_1 - g_2)}{a_2(g_1 g_3 - g_2^2)}\right),$$

$$p_7 = \left(\frac{(g_3 - g_2) + r_1(g_1 - g_2)}{a_2(g_1 g_3 - g_2^2)}\right), p_8 = \left(\frac{(g_3 - g_2) + r_2(g_1 - g_2)}{a_2(g_1 g_3 - g_2^2)}\right),$$

$$p_9 = \left(\frac{g_3 - r_1 g_2}{a_3(g_1 g_3 - g_2^2)}\right), p_{10} = \left(\frac{(g_3 - r_1 g_2) + (r_1 g_1 - g_2)}{a_3(g_1 g_3 - g_2^2)}\right),$$

$$p_{11} = \left(1 - \frac{(g_3 - r_1 g_2) + r_1(r_1 g_1 - g_2)}{a_3(g_1 g_3 - g_2^2)}\right), p_{12} = -\left(\frac{(g_3 - r_1 g_2) + r_2(r_1 g_1 - g_2)}{a_3(g_1 g_3 - g_2^2)}\right),$$

$$p_{13} = \left(\frac{g_3 - r_2 g_2}{a_4(g_1 g_3 - g_2^2)}\right), p_{14} = \left(\frac{(g_3 - r_2 g_2) + (r_2 g_1 - g_2)}{a_4(g_1 g_3 - g_2^2)}\right),$$

$$p_{15} = -\left(\frac{(g_3 - r_2 g_2) + r_1(r_2 g_1 - g_2)}{a_4(g_1 g_3 - g_2^2)}\right), p_{16} = \left(1 - \frac{(g_3 - r_2 g_2) + r_2(r_2 g_1 - g_2)}{a_4(g_1 g_3 - g_2^2)}\right),$$

$$p_{17} = \left(\frac{g_3 - r_3 g_2}{a_5(g_1 g_3 - g_2^2)}\right),\ p_{18} = \left(\frac{(g_3 - r_3 g_2) + (r_3 g_1 - g_2)}{a_5(g_1 g_3 - g_2^2)}\right),$$

$$p_{19} = -\left(\frac{(g_3 - r_3 g_2) + r_1(r_3 g_1 - g_2)}{a_5(g_1 g_3 - g_2^2)}\right),\ p_{20} = -\left(\frac{(g_3 - r_3 g_2) + r_2(r_3 g_1 - g_2)}{a_5(g_1 g_3 - g_2^2)}\right)$$

and

$$\gamma_1 = \frac{1}{\alpha_1} + \frac{1}{\alpha_2} + \frac{1}{\alpha_3} + \frac{1}{\alpha_4} + \frac{1}{\alpha_5},\ \gamma_2 = \frac{1}{\alpha_2} + \frac{\rho_1}{\alpha_3} + \frac{\rho_2}{\alpha_4} + \frac{\rho_3}{\alpha_5} \text{ and } \gamma_3 = \frac{1}{\alpha_2} + \frac{\rho_1^2}{\alpha_3} + \frac{\rho_2^2}{\alpha_4} + \frac{\rho_3^2}{\alpha_5}$$

III DATA AND ESTIMATION PROCEDURE

The parameters of equations (8) to (12) and (13) to (17) were estimated using Pakistani time series data for the period 1956-95. As mentioned at the outset of this paper, Pakistan is an interesting case study from a number of perspectives. All data were obtained from Ahmed (1997).[6] The exception was data for the target variables, which could not be obtained directly. Estimates of these variables were derived, therefore, from a cointegrating regression of vectors of exogenous regressors on each actual variable. The fitted values obtained from these regressions were taken as approximations of the target values. This is basically the approach used by Gang and Khan (1991) and Khan and Hoshino (1992).[7]Private investment, GDP and the PSBR were regressed on I_g. GDP, primary and secondary school enrolments and the PSBR were regressed on G and imports, GDP and the PSBR were regressed on T. Each regressor was lagged one period in accordance with a naive expectations framework. A constant term was used in each regression. All financial data are expressed in millions of Pakistani rupees at constant 1987 prices.

Equations (8) to (12) were estimated using the non-linear three stage least squares method.[8] This method is appropriate given that the system is simultaneous and that it contains cross-equation restrictions with respect to the ρ and β parameters (via the αs in the latter case). The reduced form parameters of equations (13) to (17) were estimated indirectly by substituting estimates of the structural parameters into these equations.

IV RESULTS

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[6] Ahmed obtains his data from various in-country sources, including Government of Pakistan (1993). Military expenditure, a major and often controversial budgetary item in Pakistan, is included in consumption expenditure as its purpose is the maintenance of the state rather than directly building its productive capacity.

[7] It is acknowledged that this is a problematic means of obtaining the target values, but in the absence of actual values or an established theory of target determination there would appear to be little option but to use this approach. This is an important area for future research.

[8] The computer program used was the PC version of TSP 4.3.

Results of estimating the structural equations are shown in Table 1.[9] Statistically very good results were obtained, with no computational problems experienced, convergence achieved with as few as five iterations and, most importantly, with each of the nine parameters estimated being found to be significantly different from zero at the 99 percent confidence level or greater. Consider first the estimates of the constraint equation parameters. The estimates of ρ_1, ρ_2 and ρ_3 are 0.85, 0.51 and 0.54 respectively. It follows from these estimates that 15 percent of tax and other recurrent revenue has been saved, aid has been allocated almost evenly between consumption and investment and just under half of domestic borrowing has been allocated to investment with the balance going to consumption.

Table 1: Estimates of Structural Equation Parameters

Parameter	Estimate	*t* statistic
ρ_1	0.85*	154.14
ρ_2	0.51*	17.11
ρ_3	0.54*	36.84
β_1	5.81*	14.41
β_2	-5.68*	-11.69
β_3	2.00*	15.48
β_4	-1.95*	-12.88
β_5	2.12*	29.16
β_6	-2.07*	-22.05

*: significantly different from zero at the 99% level or greater.

Estimates of the remaining structural parameters offer a number of insights. Our main concern for the moment is the incremental impact of endogenous changes in the revenue variables, aid especially. These impacts, and the mechanisms through which they operate, are shown in Table 2. Most of these impacts are negative. Perhaps the most pertinent result concerns the impact of aid on taxation. As mentioned, there is a widespread concern that aid may decrease taxation revenue in recipient countries. The actually seems to the case for Pakistan with respect to endogenous changes in aid, with each one rupee change in aid money disbursed resulting in a -2.91 rupee change in taxation. Endogenous changes in aid are also inversely related to changes in

[9] Corrected functional fits for the structural equations were most satisfactory, ranging from 0.85 to 0.98.

consumption and borrowing. The strongest of these impacts is that on consumption: a one rupee change in the amount aid disbursed results in a -1.97 change in consumption.

Table 2: Direct Incremental Impacts of Revenue Variables

Impact Estimate	Mechanism	
Aid (*A*) on Investment (I_g)	$(1-\rho_2)-(1-\rho_1)(\rho_2\beta_2+\beta_1)$	0.05
Aid (*A*) on Consumption (*G*)	$\rho_2-\rho_1(\rho_2\beta_2+\beta_1)$	-1.97
Aid (*A*) on Taxes (*T*)	$-(\rho_2\beta_2+\beta_1)$	-2.91
Aid (*A*) on Borrowing (*B*)	$-(\rho_2\beta_6+\beta_5)$	-1.06
Borrowing (*B*) on Investment (I_g)	$(1-\rho_3)-(1-\rho_1)(\rho_3\beta_2+\beta_1)$	0.05
Borrowing (*B*) on Consumption (*G*)	$\rho_3-\rho_1(\rho_3\beta_2+\beta_1)$	-1.79
Borrowing (*B*) on Taxes (*T*)	$-(\rho_3\beta_2+\beta_1)$	-2.74
Borrowing (*B*) on Aid (*A*)	$-(\rho_3\beta_4+\beta_3)$	-0.95
Taxes (*T*) on Aid (*A*)	$-(\rho_1\beta_4+\beta_3)$	-0.34
Taxes (*T*) on Borrowing (*B*)	$-(\rho_1\beta_6+\beta_5)$	-0.36

We emphasise that the preceding conclusions are based on estimates of the structural equation parameters and as such ignore indirect feedback effects operating through the system. They also refer to the impact of endogenous changes in variables. Of arguable greater policy relevance is the total (direct and indirect) impact of exogenously determined changes in revenues. In the case of aid, these (largely) result from decisions by donors to alter the level of aid commitments to Pakistan. What are the impacts of these decisions? Answers to this question are provided by the reduced form equation parameters shown in Table 3 (recall that in our model that A^* is the level of aid commitments).

Judging from π_4, a one rupee change in aid commitments results in a total change in investment expenditure of 0.05 rupees. To this extent aid thus seems to be pro-investment in Pakistan, albeit only slightly so. Based on our estimates of π_8 and π_{12}, a one rupee change in aid commitments results in a 2.36 rupee decrease in consumption and an even greater decrease in taxation and other recurrent revenue of 3.59 rupees. With respect to this revenue

Table 3: **Estimates of Reduced Form Equation Parameters**

Parameter	Estimate
π_1	0.84
π_2	0.05
π_3	-0.02
π_4	0.05
π_5	7.12
π_6	-1.19
π_7	0.77
π_8	-2.36
π_9	9.40
π_{10}	-1.96
π_{11}	1.23
π_{12}	-3.59
π_{13}	2.19
π_{14}	-0.93
π_{15}	0.46
π_{16}	0.41
π_{17}	-3.63
π_{18}	1.75
π_{19}	-0.93
π_{20}	0.88

one must conclude, therefore, that the *overall* impact of aid on this variable is negative in the Pakistani case, thus confirming the fears of the donor community. An additional concern is that the results for π_4 and π_8 taken together suggest that the total incremental effect of aid on public expenditure is negative. More precisely, each additional rupee of aid committed by donors to Pakistan results in a 2.31 rupee decrease in total public expenditure. Worse still, that this decrease is smaller than that with respect to taxation and other recurrent revenue suggests that the incremental impact of aid on public sector saving is negative. The implication is that aid has worsened a dependence on external forms of finance in so far as the public sector is concerned. This implication become even more serious if one considers our estimate of π_{20}, which indicates each additional rupee of aid results in an 0.88 rupee increase in domestic borrowing. While disconcerting, this result is contrary to what one may (perhaps naively) expect *a priori*. That is, as aid and domestic borrowing are alternative forms of revenue, an increase in one would be expected to lead to a

decrease in the other. Finally, given our estimate of π_{16}, a one rupee change in aid commitments results in a 0.4 rupee change in the amount of aid actually disbursed. This result is precisely what one would expect: the international donor community provides additional aid money for Pakistan to disburse, and this results in an increase in the amount of aid disbursed and *vice versa*.

V CONCLUSION

This paper offers a number of advances to the literature on fiscal response models of aid impact, predicated on the premise that the appropriate way to analyse the impact of aid is to assess how aid, which is granted to the government, affects government fiscal behaviour. The model developed here diverges from previous applications of the Heller (1975) model in a number of respects. First, aid is endogenised in the recognition that developing countries have discretion over the aid money actually allocated among various expenditure items. Second, the model allows for domestic borrowing to finance recurrent consumption expenditure. Third, influences which limit the ability of a government to allocate revenues in the optimal (utility maximising) manner desired are incorporated through the use of an inequality constraint; if this is binding, governments are restricted to constrained utility maximisation. We believe the model, its many simplifications notwithstanding, captures important features of government fiscal behaviour, and is appropriate for analysing the impact of aid.

The model was applied to 1956-95 time series data for Pakistan. One important finding was that about half of aid was allocated to government consumption; while in some respects this may seem high, if one believes that all aid is intended for (physical capital) investment, critics have often claimed that aid is ineffective because virtually all is allocated to consumption. The reduced form parameters provide estimates of the total impact of aid, and despite the finding regarding the allocation of aid it was found that the overall effect of aid on consumption was negative. While aid was found to have slightly positive total incremental impact on investment, its overall incremental impact on public expenditure was found to be negative. This also seems to be the case with the effect of aid on taxation, but to a greater extent. To this extent, a concern of the donor community is justified with respect to Pakistan. These results, combined with that suggesting that the total incremental impact of aid on domestic borrowing is positive, paint a generally rather gloomy picture of the impact of aid on the behaviour of Pakistan's public sector.

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