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Centre for Research in Economic Development and International Trade, University of Nottingham

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Abstract

An important feature of aid to developing countries is that it is given to the government. As a result, aid should be expected to affect fiscal behaviour. Traditional approaches to modelling fiscal effects are beset by theoretical and empirical problems. This paper applies techniques developed in the 'macroeconometrics' literature to estimate the dynamic linkages between aid and fiscal aggregates. Vector autoregressive methods are applied to 34 years of annual data in Ghana to model the effect of aid on fiscal behaviour. Results suggest that aid to Ghana has been associated with reduced domestic borrowing and increased tax effort, combining to increase public spending. The paper provides evidence that aid has been associated with improved fiscal performance in Ghana, implying that the aid has been used sensibly (at least in fiscal terms).

Outline

1. INTRODUCTION

The empirical literature on the effect of aid on growth has seen a revival in recent years. A deficiency of this aid-growth literature is its failure to explicitly recognise that aid is given primarily to the government and hence any effect on macroeconomic performance will be mediated through government behaviour. The recent literature on the effect of aid on growth recognises this in part, by focusing attention on the interaction between aid and policy. The literature is, however, inconclusive. Burnside and Dollar (2000) argue that aid is only effective (in increasing growth) if accompanied by "good" policies. Hansen and Tarp (2001) find that aid and policy have independent, and positive, effects on growth. Neither study, nor the literature in general, resolves the highly contentious issue of how aid affects policy. We address one specific aspect of this – how aid affects fiscal aggregates. Identifying the fiscal effects of aid is a prerequisite to understanding the macroeconomic effectiveness of aid (McGillivray and Morrissey, 2000).

There is a growing literature on how aid affects the fiscal behaviour of governments (reviewed in McGillivray and Morrissey, 2001). Studies in this area have been classified into two broad groups. First, fungibility studies have sought to analyse effects of aid on the composition of government spending. Aid is said to be fungible if it is given for one purpose (say investment) and used for another (consumption). The second approach, using Fiscal Response Models (FRMs), goes further and argues that aid has complex impacts on government fiscal behaviour that are mediated by impacts on tax effort and borrowing, in addition to effects on the allocation of expenditures.

Although FRMs offer an improvement over fungibility approaches in analysing the impact of aid on government behaviour they have their shortcomings, as we discuss in section 2. In particular, there is the need to presume the existence of, and estimate, targets for government expenditure and revenue. The estimates for the structural equations are very sensitive to the way in which the targets are approximated, and the three-stage non-linear techniques used tend not to be robust to changes in data or model specification. We circumvent these problems by estimating the FRM within a vector autoregression (VAR) modelling framework. VAR methods offer a number of advantages in the current context. First, as our aim is merely to investigate the dynamic effect of aid on the components of the budget, estimation of the reduced form rather than

a complete structural economic model is sufficient for our purposes. Specifically, the 'atheoretical' nature of VAR models means one does not have to maintain the existence of, or estimate, the (unknown) targets, as they are only required for the structural representation. Second, assumptions about exogeneity can be tested within the VAR using the data, rather than imposed *a priori*, and can then be applied to simulate the effect of injections of aid via impulse response analysis. The VAR provides a tractable framework in which a different set of questions to those traditionally posed may be addressed.

In section 2 we outline the limitations of traditional fiscal response models. Fiscal trends in Ghana are discussed in relation to foreign aid flows in Section 3. Section 4 discussing the econometric method, providing a brief outline of the VAR approach and impulse response functions that capture the effect of a shock to one variable (in our case aid) on the other endogenous (fiscal) variables in the system. The results in Section 5 suggest that in Ghana aid has, at least since the 1980s, used aid sensibly: aid has substituted for domestic borrowing rather than discouraging tax effort or inducing a net increase in government spending. The conclusions are in Section 6, where we contend that impulse response functions are an informative and econometrically appropriate method to identify the fiscal effects of aid.

2. FISCAL RESPONSE MODELLING

A number of approaches have been adopted to examine the fiscal effects of aid. The most common of these are studies of fungibility.[1] General studies of fungibility consider whether aid intended for investment is redirected to consumption spending. Other studies are more specific, trying to assess if aid allocated (by donors) to particular categories of expenditure is in fact spent on those categories. The main difference is the degree of specificity in the disaggregation of expenditures. The second approach looks at fiscal response more broadly, specifically incorporating revenue into the utility function (if fungibility studies include revenue, it tends to be as a residual). McGillivray and

1 Fungibility studies model the actual extent to which aid is used for purposes other than those intended by donors, see Feyzioglu *et al*. (1998), Swaroop *et al.* (2000), Pack and Pack (1990, 1993). Such studies are the only examples of the impact of aid on government spending behaviour cited as evidence in World Bank (1998). The approach in these studies suffers from a number of limitations (see McGillivray and Morrissey, 2000, 2001). Specifically, they are narrower in focus than the FRMs considered here.

Morrissey (2001) provide a comprehensive review of the literature, and here we only touch upon the most important issues relating to FRMs.

The traditional approach to modelling the public sector fiscal response to foreign aid inflows is set out in Mosley *et al* (1987) and Gang and Khan (1991), both following Heller (1975). The Heller (1975) approach starts from the observation that public sector decision-makers allocate revenue among various expenditure categories subject to budget constraints. It is usual to distinguish recurrent expenditure or government consumption (*GC*) and capital expenditure or public sector investment (*GK*). Government domestic revenue is obtained from taxation and other recurrent revenue (*R*) and domestic borrowing (*D*). Aid finance (*F*) is treated as exogenous; an external source of revenue that enters the budget constraint, but does not feature in the government's utility function (hence is not incorporated among the targets). Governments maximise utility by attaining their revenue and expenditure targets, the maximum unconstrained value being α_0, represented as a quadratic loss function:

$$U = \alpha_0 - \frac{\alpha_1}{2}(GK - GK^*)^2 - \frac{\alpha_2}{2}(GC - GC^*)^2 - \frac{\alpha_3}{2}(R - R^*)^2 - \frac{\alpha_4}{2}(D - D^*)^2 \qquad (1)$$

The asterisks denote exogenous target levels of the endogenous variables and the α_i parameters are assumed to be positive. In the standard Heller-type analysis the utility function is maximised subject to the following budget constraints:

$$GK = (1 - \rho_1)R + (1 - \rho_2)F + D \qquad (2)$$

$$GC = \rho_1 R + \rho_2 F \qquad (3)$$

In this formulation (1 - ρ_1) represents savings from the recurrent budget and ρ_2 represents the proportion of aid allocated to consumption spending, taken to represent the extent of fungibility of aid. It is implicitly assumed that donors grant aid for investment purposes only (i.e., $\rho_2 = 0$ *ex ante*). As there are elements of *GC* which donors do finance, such as social sector expenditures, $\rho_2 > 0$ *ex ante* and the estimated value of ρ_2 is a measure of maximum fungibility. Equations (2) and (3) are of course a decomposition of the overall public sector budget constraint:

$$GK + GC = R + F + D \tag{4}$$

A technical problem is that this representation over-constrains the model, because it does not necessarily allow the government to reach α_0 even in the case where aid revenues are sufficient to meet all targets. The problem arises because although total revenue may be sufficient to meet (4), the αs constrain allocation so that specific expenditure targets in (1) cannot be met.[2] A solution to the former problem was advanced in Franco-Rodriguez *et al* (1998) who incorporated aid directly into the utility function. In this approach, governments have a target for, or expectation of, aid revenue, and this influences fiscal behaviour (the levels of the other variables). The loss function (1), becomes:

$$U = \alpha_0 - \frac{\alpha_1}{2}(GK - GK^*)^2 - \frac{\alpha_2}{2}(GC - GC^*)^2 - \frac{\alpha_3}{2}(R - R^*)^2 - \frac{\alpha_4}{2}(F - F^*)^2 - \frac{\alpha_5}{2}(D - D^*)^2 \tag{5}$$

Aid is endogenised in this framework in the sense that it enters directly into the utility function in which revenues and expenditures are jointly determined. Governments will have less influence over aid receipts than over other variables (although tax receipts can change for reasons outside the immediate control of government), but this can be reflected in the target (and utility depends on deviation from targets). If (5) is maximised subject to (2) and (3) the over-restriction problem applies; if maximised subject to (4) alone complete fungibility is implicitly assumed. Franco-Rodriguez *et al* (1998) posit that (5) is maximised subject to:

$$GC \leq \rho_1 R + \rho_2 F + \rho_3 D \tag{6}$$

The justification for the inequality is that *external* factors constrain how the public sector allocates revenues. For example, donors may be able to impose values of the ρs in (6), such that targets can not be met even if revenues satisfy (4). If (6) is not binding the government can meet its targets and maximise utility. This addresses the over-restriction problem, but symmetry and other difficulties remain.

2 The symmetric specification imposes the restriction that over- and under-shooting of targets have the same effect on utility. This has stimulated a debate, without adequately resolving the problems (e.g. Binh and McGillivray, 1993; Gang and Khan, 1993, 1994, 1999; White, 1994).

Fiscal response models allow governments to raise revenues and allocate to expenditures according to targets they set themselves. Aid is treated like the other forms of revenue: the government has a target or expected value that is incorporated into fiscal planning or behaviour. The most serious problem with the FRM approach is that the theory is *ad hoc* and does not attempt to explain how the targets or the parameters in the utility function and budget constraints are generated.

Furthermore, fiscal response models are notoriously difficult to estimate and highly sensitive to the quality of the data, and in consequence, results often lack robustness. Studies frequently yield inconsistent estimates of the ρ's and rarely can the underlying α's be recovered (see Franco-Rodriguez, 2000, for a critique along these lines). The major empirical problem however is that there is no accepted means of estimating the revenue and expenditure targets. As discussed in section 4, the simplicity and flexibility of the VAR approach circumvents this problem and readily facilitates policy simulation taking into account the linkages that potentially exist between the components of the budget. Thus, while FRMs provide the theoretical motivation for studying aid as having (inevitable) fiscal effects, existing empirical counterparts have been deficient. We propose the VAR approach as offering an empirical resolution.

3. AID AND FISCAL TRENDS IN GHANA

From about the mid-1960s to the early 1980s in Ghana there were only minor differences in fiscal behaviour under the various governments (Frimpong-Ansah, 1991; Rimmer, 1992). The only exception was the brief period between 1969 and 1971 when the Progress Party government came to power and initiated a relatively more neoclassical (*laissez faire*) approach to development. Aid inflows were unlikely to have been an influence on government behaviour prior to the mid-1980s. In the late 1960s and early 1970s, aid was a little over two per cent of GDP and about 12 per cent of revenue, while donors at that time did not require or enforce conditionality (at least not in terms of fiscal behaviour). The unilateral repudiation of foreign loans in the early 1970s lends some support to this argument. Significant reserves and the importance of cocoa revenue (even if in decline by the early 1970s) gave most of the Ghanaian governments over that period a false sense of economic security. It also meant that they were not very responsive to external pressure from donors. The decision to adopt and adhere to the 'liberalising' Economic Recovery Program /Structural Adjustment Programme

(ERP/SAP) in the 1980s was simply because there were no more 'easy pickings' – the country's reserves had been wiped out and the cocoa sector was on the brink of collapse.

Prior to 1983 public expenditures persistently exceeded revenues in Ghana (and domestic sources of revenue were more important in relation to aid than was the case). This resulted in large fiscal deficits, which peaked at about 11 per cent of GDP in 1976. These deficits were financed mainly by domestic borrowing and printing money. The deficit did narrow after 1983 and by the late 1980s revenues had outstripped expenditures. Most of the surplus was due to the large inflow of foreign aid (Addison and Osei, 2001). The mid-1980s saw a massive inflow of aid into Ghana, peaking in 1991 at almost US$730million in 1995 prices (Figure 1). This compares with the pre-1980s high of under $200m (in 1995 prices). The same period saw government expenditures rising sharply after a steady decline during the 1970s and early 1980s (Figure 2) – increasing from about $310m in 1983 to about $1.9billion in 1998. The period average for the share of aid in total government spending also rose to about 50 per cent over the post 1983 period compared to about 16 per cent prior to 1983. However, structural adjustment aid was not all targeted at capital investment. Much was in the form of budget support: it was a source of revenue that would, in some part, have been allocated to recurrent expenditures. Investment in building schools, for example, is of little use if the government cannot pay teacher's wages. From a fiscal response perspective, what is of more interest is the effect on other revenues and the dynamics of spending.

Looking at the components of government expenditure one observes that it is government consumption that has accounted for most of the increase in public expenditure – from about $264m in 1983 to about $1.2b in 1998. However, the *share* of current government spending in the total only increased slightly over the two periods (pre- and post- 1983), from about 75 to about 77 per cent (Figure 3).

Figure 1 Tax Revenue, Foreign Aid and Domestic Borrowing

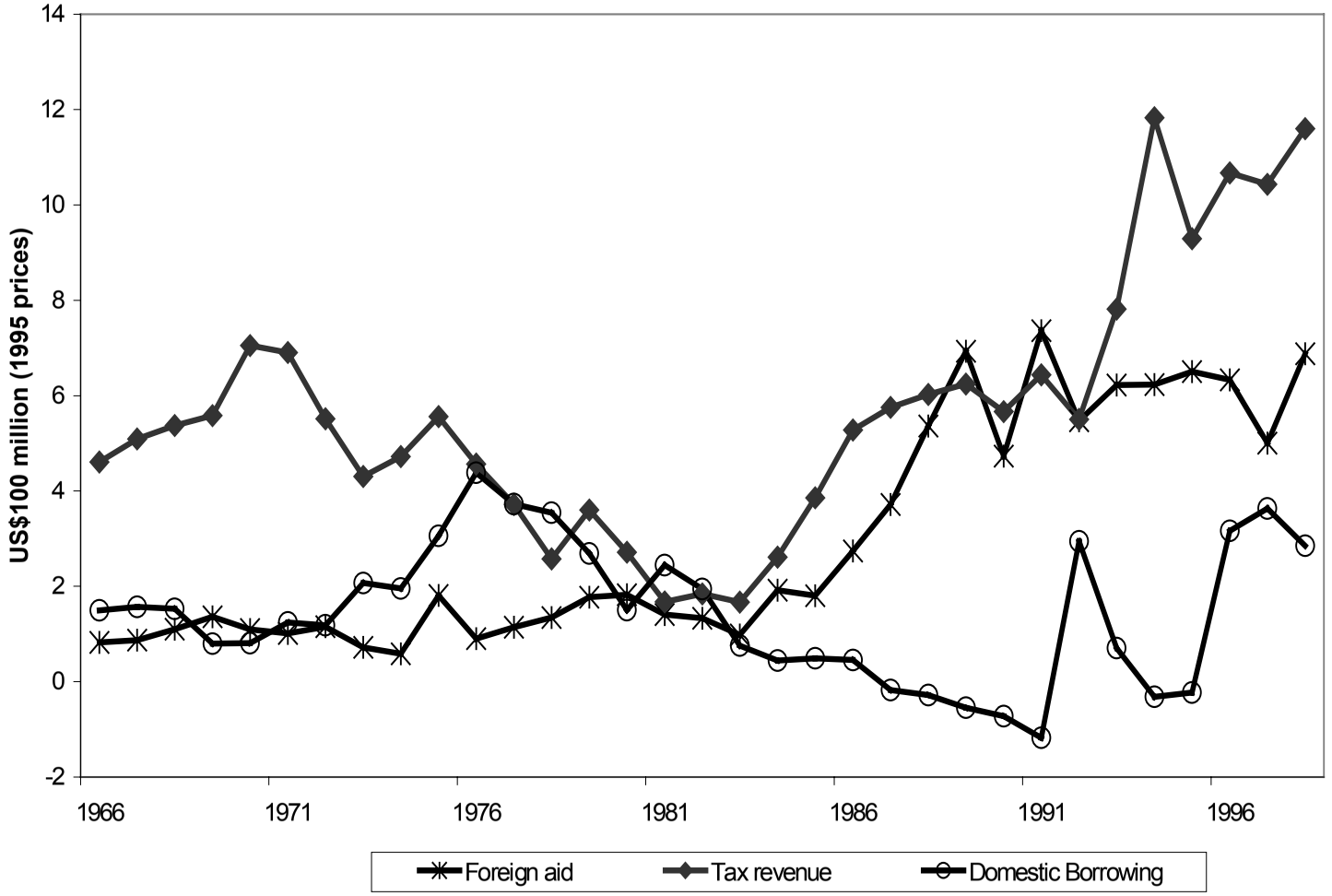


Figure 2 Government Expenditure Trends

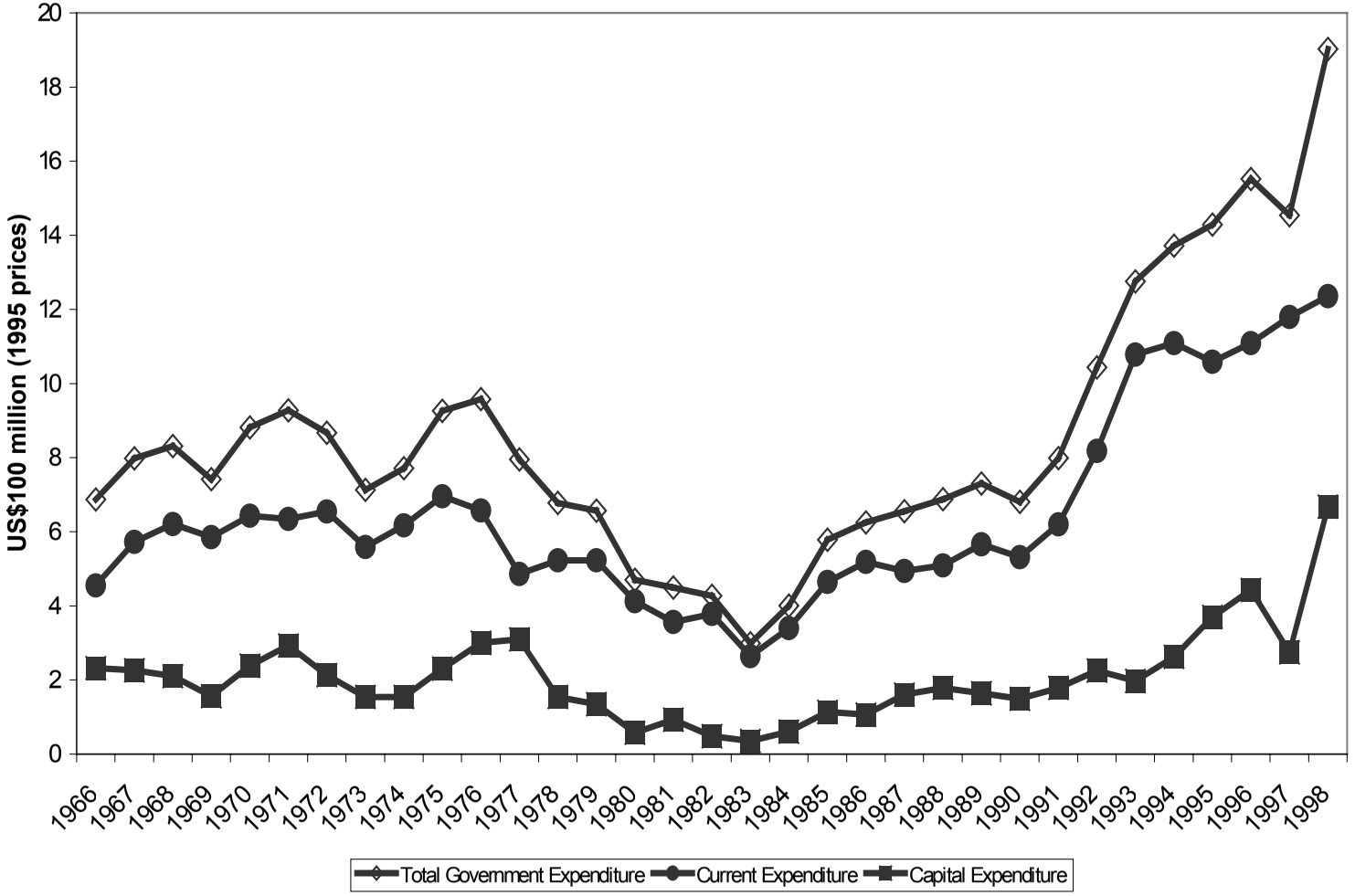
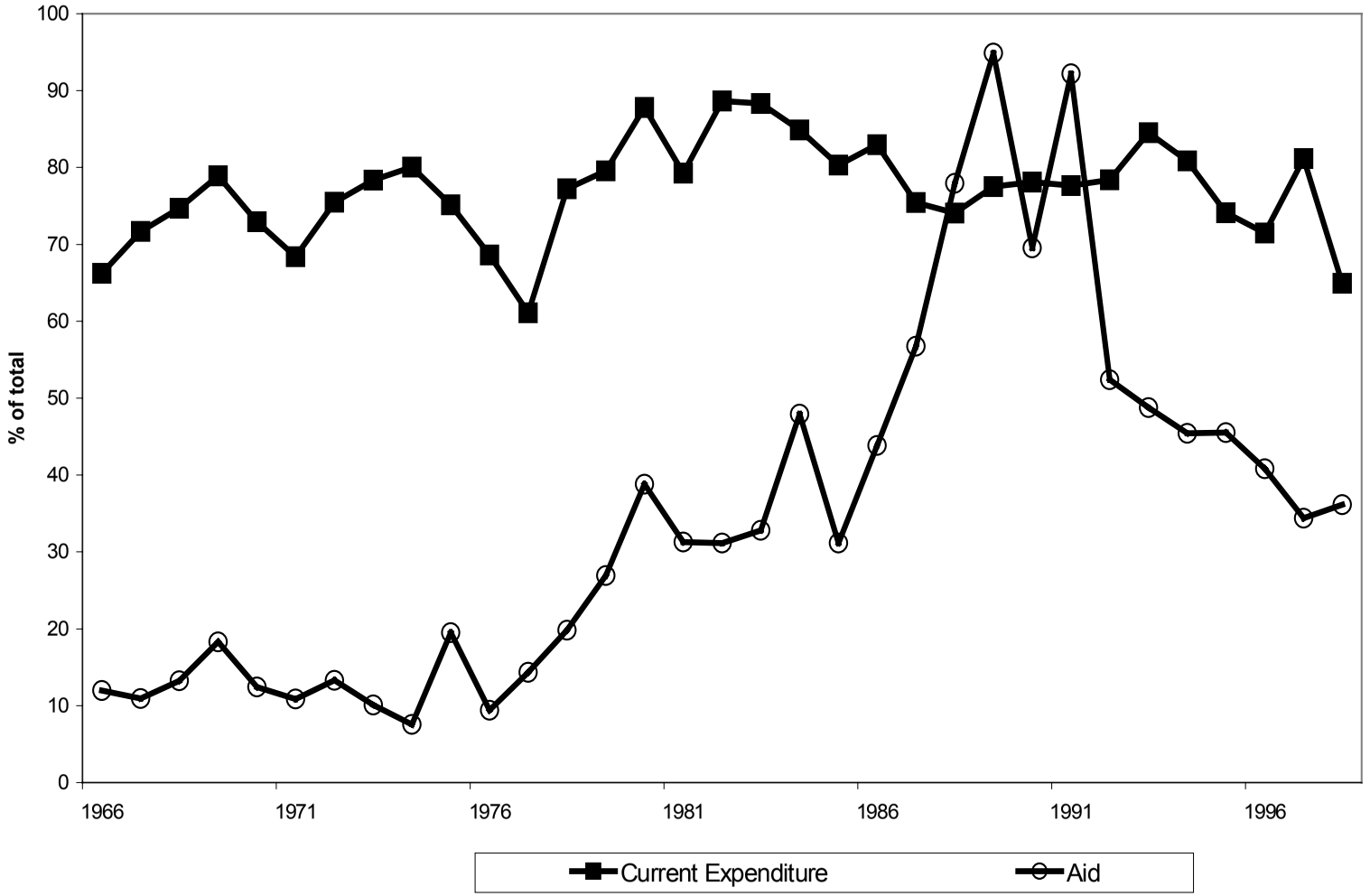


Figure 3 Share of Current Spending and Aid in Total Expenditures



As with the pattern of most macroeconomic variables for Ghana, tax revenue has generally increased in the last two decades following a period of decline in the 1970s and early 1980s. From about $700m in 1970 tax revenues fell to about $160m in 1983 but subsequently increased by more than seven fold, reaching almost $1.2b in 1998 (Figure 1). It is worth noting that the increase in tax revenue coincides with the period over which there was a substantial inflow of aid into Ghana suggesting that aid flows did not discourage tax effort. It is also worth noting that the period of increasing government spending was associated with an increase in aid *and* tax revenues. In other words, whilst one might infer a structural break in the individual series, overall revenues and expenditures *moved together* in the same way (although the composition may have changed).

Domestic borrowing also shows an interesting pattern (Figure 1). From an all-period high of about $440m in 1976 domestic borrowing fell to negative levels in the late 1980s and reached net repayments of $110m by 1991[3]. This was in the period of structural adjustment, when it was not uncommon for the IMF to require net repayment of domestic debt (negative borrowing). The 1990s saw a re-emergence of the large fiscal deficits not seen since the 1970s. The considerable slow-down of aid inflows coupled with a reluctance to reduce spending in the election years of 1992 and 1996 led to substantial increase in domestic borrowing during the 1990s.

4. ECONOMETRIC METHODS

In recent years, vector autoregressive methods have become the 'tool of choice' in much of empirical macro-econometrics. Despite having roots in the analysis of stationary data, their popularity owes much to the theoretical developments in the analysis of non-stationary data which typically characterises many economic time series. In particular, Johansen (1988), Johansen and Juselius (1992), have developed multivariate methods that explicitly use the VAR for the testing and estimation of cointegration (or 'long-run') relationships among non-stationary data. As a medium for analysis, the VAR is tractable and can be interpreted as the reduced form representation of a large class of dynamic structural models (Hamilton, 1994: 326-327). As such, it provides a useful framework for the investigation of both long-run (cointegration) relationships and short run

3 Note that aid inflows reached an all time high of US$ 730million in this period.

dynamics (via an equilibrium correction model, the ECM) of the variables in the system. Furthermore, the VAR facilitates the dynamic simulation of variables within the system following a shock using *impulse response analysis* (Sims 1980, Lütkepohl and Reimers, 1992). In the current context, we use these techniques to evaluate the role played by foreign aid in the national budget of Ghana.

Given the familiarity of VAR methods, we merely sketch the broad outline here.[4] The statistical analysis takes place in a VAR(p) model,

$$\mathbf{x}_t = \mathbf{\Phi}_1 \mathbf{x}_{t-1} + \mathbf{\Phi}_2 \mathbf{x}_{t-2} + \ldots + \mathbf{\Phi}_p \mathbf{x}_{t-p} + \mathbf{\Psi} \mathbf{w}_t + \boldsymbol{\varepsilon}_t \qquad (7)$$

where $\mathbf{x}_t$ is a $(m \times 1)$ vector of jointly determined I(1) variables, $\mathbf{w}_t$ is a $(q \times 1)$ vector of deterministic variables and each $\mathbf{\Phi}_i$ $(i = 1, \ldots, p)$ and $\mathbf{\Psi}$ are $(m \times m)$ and $(m \times q)$ matrices of coefficients to be estimated using a (t = 1, . . .T) sample of data. $\boldsymbol{\varepsilon}_t$ is a $(m \times 1)$ vector of n.i.d. disturbances with zero mean and non-diagonal covariance matrix, $\mathbf{\Sigma}$.

Providing the variables are (at most) integrated of order one {I(1)} and cointegrated, equation (7) also has an equilibrium correction representation that is observationally equivalent but which facilitates estimation and hypothesis testing as all terms are stationary. This reparameterisation is given by

$$\Delta \mathbf{x}_t = \boldsymbol{\alpha} \boldsymbol{\beta}' \mathbf{x}_{t-p} + \sum_{i=1}^{p-1} \mathbf{\Gamma}_i \Delta \mathbf{x}_{t-i} + \mathbf{\Psi} \mathbf{w}_t + \boldsymbol{\varepsilon}_t \qquad (8)$$

Attention focuses on the $(n \times r)$ matrix of cointegrating vectors, $\boldsymbol{\beta}$, that quantify the 'long-run' relationships between the variables in the system and the $(n \times r)$ matrix of equilibrium correction coefficients, $\boldsymbol{\alpha}$, elements of which load deviations from this equilibrium (*i.e.* $\boldsymbol{\beta}' \mathbf{x}_{t-k}$) in to $\Delta \mathbf{x}_t$, for correction. The $\mathbf{\Gamma}_i$ coefficients in (8) estimate the short-run effect of shocks on $\Delta \mathbf{x}_t$, and thereby allow the short and long run responses to differ.

4 See Chapter 5 of Enders (1995) for an induction. Chapter 11 of Hamilton (1994) offers a thorough and rigorous treatment.

However, given the inter-relationships that characterise economic systems, it is often more informative to undertake an impulse response analysis when short- and long-run impacts are of key interest. As total derivatives, the coefficients of the impulse response function do not suffer from the *ceteris paribus* limitation that can confound the interpretation of (8) (Lutkepohl and Reimers, 1992). In cases where variables are inter-related, a shock to one variable may set off a chain reaction of knock-on and feedback effects as it permeates through the system. In such circumstances the partial derivatives of (8), which ignore these interactions by construction, may have limited appeal and may give a misleading impression of the short- and long-run effect of such shocks. By contrast, impulse response analysis estimates the net effect of the direct and indirect effects of a shock, not only in the long run but at all periods following the shock.

Impulse response analysis uses the moving average representation of (7), i.e.

$$\mathbf{x}_t = \boldsymbol{\varepsilon}_t + \mathbf{A}_1\boldsymbol{\varepsilon}_{t-1} + \mathbf{A}_2\boldsymbol{\varepsilon}_{t-2} + \ldots + \sum_{i=0}^{\infty}\mathbf{A}_i\boldsymbol{\Psi}\mathbf{w}_{t-i} \qquad (9)$$

where the $(m \times m)$ coefficient matrices $\mathbf{A}_i$ can be obtained according to

$$\mathbf{A}_i = \boldsymbol{\Phi}_1\mathbf{A}_{i-1} + \boldsymbol{\Phi}_2\mathbf{A}_{i-2} + \ldots + \boldsymbol{\Phi}_p A_{i-p} \quad i = 1,2,\ldots, \qquad (10)$$

with $\mathbf{A}_0 = \mathbf{I}_m$ and $\mathbf{A}_i = \mathbf{0}$ for $i < 0$.

Following Pesaran and Shin (1998), the generalised impulse response is the effect of one standard error shock to the j^{th} equation at time t on $\mathbf{x}_{t+n}$ is given by

$$\varphi_j^g(n) = \sigma_{jj}^{-0.5}\mathbf{A}_n\boldsymbol{\Sigma}\mathbf{e}_j \qquad (11)$$

where $\mathbf{e}_j$ is an $m \times 1$ selection vector that identifies the source of the shock (hence unity is its j^{th} element with zeros elsewhere). This delivers time profiles of the effect of hypothetical shocks to elements of $\boldsymbol{\varepsilon}_t$ on the level of $\mathbf{x}_t$ taking into account the knock-on and feedback effects that characterise the variables in a dynamic system such as (7). Note that the generalised impulse response function accounts for the contemporaneous correlation inherent in the non-diagonality of $\boldsymbol{\Sigma}$ via integrating out their effects according to the observed distribution of the residuals, rather than by traditional orthogonalisation. In so doing, the generalised impulse response function is invariant to

the ordering of the variables in the model, unlike its orthogonalised counterpart. Nevertheless, as with all dynamic simulation, if the effects of a shock are to be economically meaningful, the shock must represent a pure innovation to a particular variable rather than a mixture of correlated errors. Since this requires the causality of the economic structure to be known, impulse responses are prone to misinterpretation (Ericsson, *et al*. 1998: 379). Mindful of this caveat, we offer statistical and economic evidence to support the legitimacy of the impulse response analysis we conduct.

5. DATA AND RESULTS

The empirical analogue of (7) comprises the variables of the fiscal response model, namely, government expenditure (*G*), tax revenue (*R*), aid finance (*F*) and domestic borrowing (*D*). Note that as non-tax components of revenue and external borrowing are omitted, we are not estimating an identity. We also estimate a model in which total government expenditure (*G*) is disaggregated into capital (*GK*) and current spending (*GC*). We use annual data over the period 1966 to 1998 with all the variables measured in constant 1995 prices expressed in US$ (units of 100m). Data on total domestic fiscal variables are obtained from the *International Financial Statistics* of the IMF. Foreign aid is the net disbursement of Official Development Assistance (ODA) to Ghana, derived from OECD/DAC data. It includes all loans with a grant element of more than 25 percent and also technical co-operation and assistance.[5]

As a precursor to the empirical analysis the order of integration of the individual series is evaluated using standard Augmented Dickey Fuller (ADF) tests. Results, reported in Table 1, indicate that all variables are I(1) with no significant drift, as indeed casual inspection of the data in Figures 1-3 suggest. Consequently, the variable sets (R_t, F_t, D_t G_t) and (R_t, F_t, D_t, GK_t, GC_t) form the equations for the aggregate and disaggregate VAR(*k*) models respectively.

5 All data and statistical output are available from the authors upon request.

Table 1 ADF Unit Roots Tests

ADF Model: $\Delta Y_t = \alpha + \beta T + \gamma Y_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Y_{t-i}$					
$Y =$	H_0: $\gamma=0$	H_0: $\beta=\gamma=0$ ϕ_3 – test	H_0: $\beta=\alpha=\gamma=0$ ϕ_2 – test	Lag Length	Inference
D_t	-2.176 *(-3.21)*	2.414 *(5.91)*	1.63 *(4.67)*	0	I (1)
R_t	-2.071 *(-3.21)*	4.274 *(5.91)*	3.037 *(4.67)*	0	I(1)
F_t	-1.823 *(-3.21)*	1.755 *(5.91)*	2.088 *(4.67)*	1	I(1)
G_t	-0.209 *(-3.21)*	4.619 *(5.91)*	3.815 *(4.67)*	0	I(1)
GC_t	-0.877 *(-3.21)*	2.824 *(5.91)*	2.47 *(4.67)*	0	I(1)
GK_t	-0.400 *(-3.21)*	2.956 *(5.91)*	2.205 *(4.67)*	1	I(1)

Note: Numbers in parenthesis are the 10% critical values. Optimal lag length is the largest p for which δ_i is significant at the 10% level. The null hypothesis for a second unit root is rejected for all the I(1) variables at the 10% level.

The appropriate lag length (k) of the VAR is determined using standard model selection criteria (AIC, SBC and HQC). Adoption of a general-to-specific modelling approach points to a VAR of order 2 or 3 as an adequate representation of the data. Given that there are signs of autocorrelation in the residuals from a VAR(2) we opt for a VAR(3) which has residuals that conform to the usual assumptions. Having established an adequate statistical description of the data, we test for the presence of long-run relationships among the variables using the Johansen (1992) *trace statistic* for

cointegration.[6] The results reported in Table 2(a) confirm the presence of a single cointegration vector at the 5 per cent level of significance.

Table 2: Cointegration Test Results

(a) Aggregate Model

Eigenvalues	H_0:	Trace Statistic	P-value
0.7005	$r \leq 0$	69.262	0.001
0.4649	$r \leq 1$	33.098	0.082
0.3080	$r \leq 2$	14.340	0.273
0.1040	$r \leq 3$	3.294	0.538

(b) Disaggregate Model

Eigenvalues	H_0:	Trace Statistic	P-value
0.7255	$r \leq 0$	91.287	0.002
0.5470	$r \leq 1$	52.502	0.068
0.3612	$r \leq 2$	28.746	0.212
0.3233	$r \leq 3$	15.302	0.214
0.1127	$r \leq 4$	3.5883	0.488

Normalising on domestic borrowing the relationship is estimated as

$$D_t = -0.074F_t - 1.040R_t + 0.841G_t + 0.465 \qquad (12)$$

6 Since the limiting distribution of Trace test is a function of the deterministic terms included in the model, we report results for the final model in which the constant is restricted to the long run only, given that the results in Table 1 indicate the absence of drift. Cointegration inference is unchanged using models with unrestricted constants

These long-run estimates suggest that *ceteris paribus,* aid and tax revenue tend to be negatively correlated with domestic borrowing, whereas government spending is positively correlated. As such, (12) seem to represent financing items in the government budget constraint. Note that the coefficient on aid is small suggesting that its long run impact in the budget is minor. Government spending and revenue have coefficients that are nearly equal and opposite in sign, and together these results suggest that, in the long run, domestic borrowing is the main financing item for primary deficits in Ghana. In addition, this supports the view that aid is given to alleviate short and medium term constraints, or to achieve certain development objectives but not to finance persistent budgetary deficits. This does not imply that aid has no long-term impact in the economy as a whole, but merely that as a budgeting item its long run impact is relatively minor.

Equation (12) assumes that all forms of government spending have an equal effect on the other items in the budget. Disaggregating government expenditure into its capital and current components yields consistent results. Table 2(b) indicates the presence of a single long run relation of the form

$$D_t = -0.051F_t - 1.072R_t + 0.723GC_t + 1.197GK_t + 0.61 \qquad (13)$$

Ceteris paribus, both components increase the budget deficit in the long run. A test of coefficient equivalence suggests that the long run budgetary impact of capital spending is greater than that of current government spending.[7] Our normalisation is in a sense *ad hoc* and so one could actually interpret this to be consistent with evidence for *categorical fungibility* – the financing items (and in particular foreign aid) impact more on current spending than on capital spending.[8] The question of whether aid has been *fungible* in Ghana is discussed under results for the impulse response analysis.

The error correction models, which describe the short run behaviour corresponding to (12) and (13), are reported in the Appendix. They reveal that in the short run, there is no *ceteris paribus* impact of aid on government spending, in either the aggregate or

7 The null hypothesis of equivalence can only be rejected at the 5% but not the 10 percent level of significance.
8 This can be seen if a normalisation of equation (13) on GC_t is compared with that on GK_t

disagregated models. In contrast, aid is shown to increase revenue and reduce debt over the short run.

Causality Testing

Insights into the role played by the variables in fiscal response may also be gleaned from the 'causality' tests reported in Tables 3 and 4. Results for both the aggregate and disaggregate models (reported in panel (a) of both tables) indicate that it is only foreign aid that is weakly exogenous to the determination of the long-run fiscal relationship. As such, results indicate that whereas tax revenue, government spending and borrowing adjust to an imbalance in the fiscal situation, aid is taken as given, playing no discernible role in the adjustment process. Furthermore, the results in panel (b) of Tables 3 and 4 clearly point to aid being a Granger-cause of the fiscal variables but not *vice versa.*[9] The combination of weak exogeneity and Granger non-causality suggest that aid is strongly exogenous in fiscal response. The implication here is that aid plays an important determining role in the budget but its level does not reflect budget imbalance. This suggests that aid disbursements have not been influenced by the budget balance over the period. Furthermore, this tends to suggest that shocks to foreign aid are exogenous to the system rather than determined by it and offers statistical support for the legitimacy of an impulse response analysis of aid shocks, to which our attention now turns.

9 See Tables 6 and 7 where the change in aid is shown to follow a simple AR(1) scheme in the VAR.

Table 3: Causality Tests - Aggregate Model

(a) Weak Exogeneity

H_0 **: weak exogeneity**

Variable	**χ-squared**	**P-value**
Revenue	11.888	0.0006
Aid	0.049	0.8248
Domestic Borrowing	3.0099	0.0828
Government Expenditure	9.6048	0.0019

(b) Granger Non-Causality Tests

Direction	**χ-squared**	**P-value**
Aid → Fiscal Variables	69.47	0.0000
Fiscal Variables → Aid	8.27	0.3090

Notes: In panel (b) a large test statistic (small p-value) indicates that the null hypothesis of Granger non-causality is rejected. For example, the null of aid being Granger Non-causal for the fiscal variables is rejected

Table 4 : Causality Tests - Disaggregate Model

(a) Weak Exogeneity

H_0 **: weak exogeneity**

Variable	**χ-squared**	**P-value**
Revenue	9.582	0.002
Aid	0.3087	0.5787
Domestic Borrowing	4.6758	0.0306
Current Expenditure	7.3078	0.0069
Capital Expenditure	1.9103	0.1669

(b) Granger Non-Causality Tests

Direction	**χ-squared**	**P-value**
Aid → Fiscal Variables	72.9916	0.0000
Fiscal Variables → Aid	7.4502	0.4889

Impulse Response Analysis

Plots of the generalised impulse response functions for a one standard shock in aid are shown in Figures 4 and 5 for the aggregate and disaggregated models respectively. Being of one standard error in size, the shock is of typical magnitude for the series and corresponds to some $93 million. In each model, this injection of aid has persistent effects that take around 5 years to stabilise. Foreign aid appears to have pervasive effects throughout the fiscal system, reflecting the linkages between the budget items. Not only does aid result in an increase in the government's spending and revenue base, but it leads to a reduction in borrowing. Estimates suggest that long-run responses in each of the variables to aid shocks are generally of twice the magnitude of the contemporaneous (or impact) effects. For example, as Figure 4 demonstrates, a $93 million injection of aid, induces borrowing to fall immediately by around $20 million, well below its long-run effect of around $36 million. It is also clear that the size of the effects on tax revenue and government expenditure are virtually identical (around $76 million) suggesting that the net effect of aid is to reduce domestic borrowing.

Figure 4. Generalised Impulse Response Functions of a one standard error shock in the Aid Equation: Aggregate Model

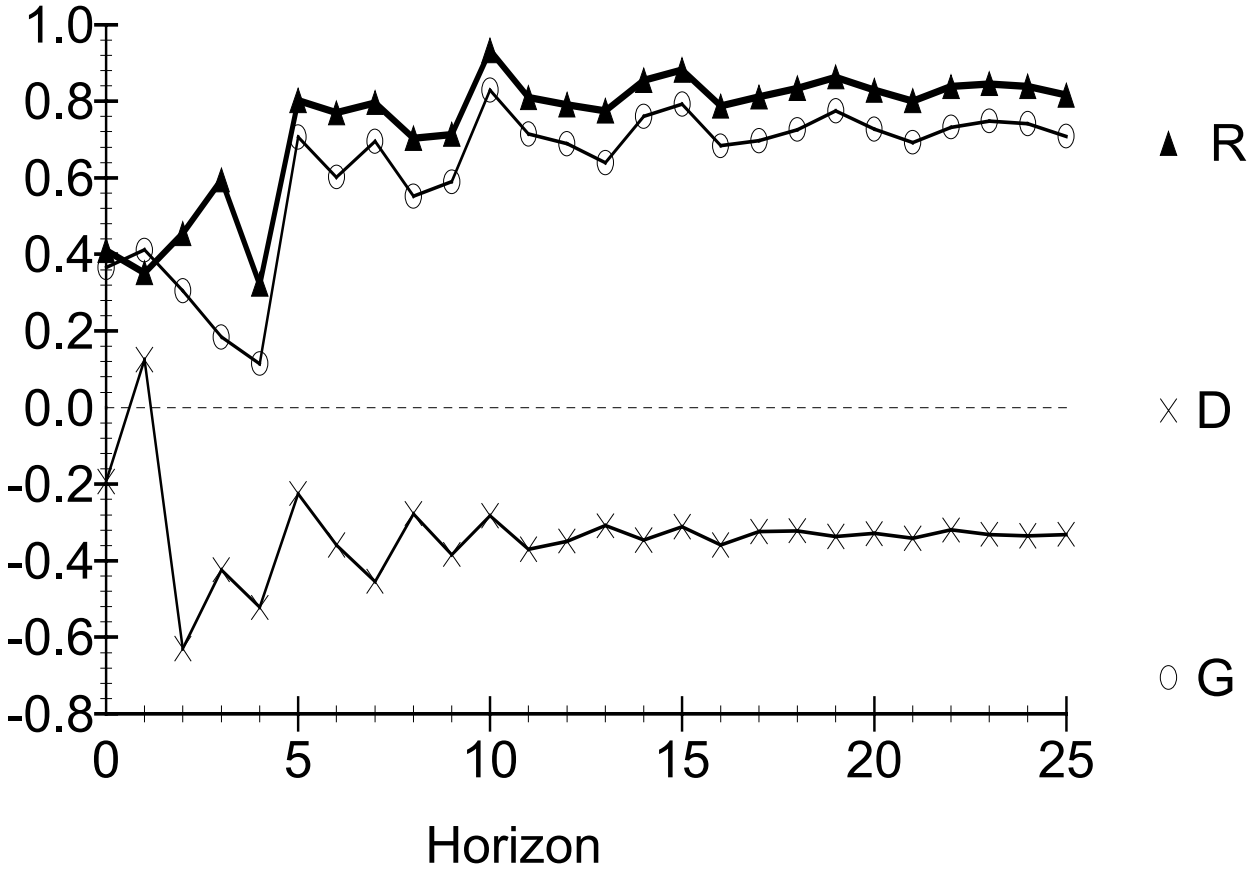


Figure 5. Generalised Impulse Response Functions of a one standard error shock in the Aid Equation: Disaggregate Model

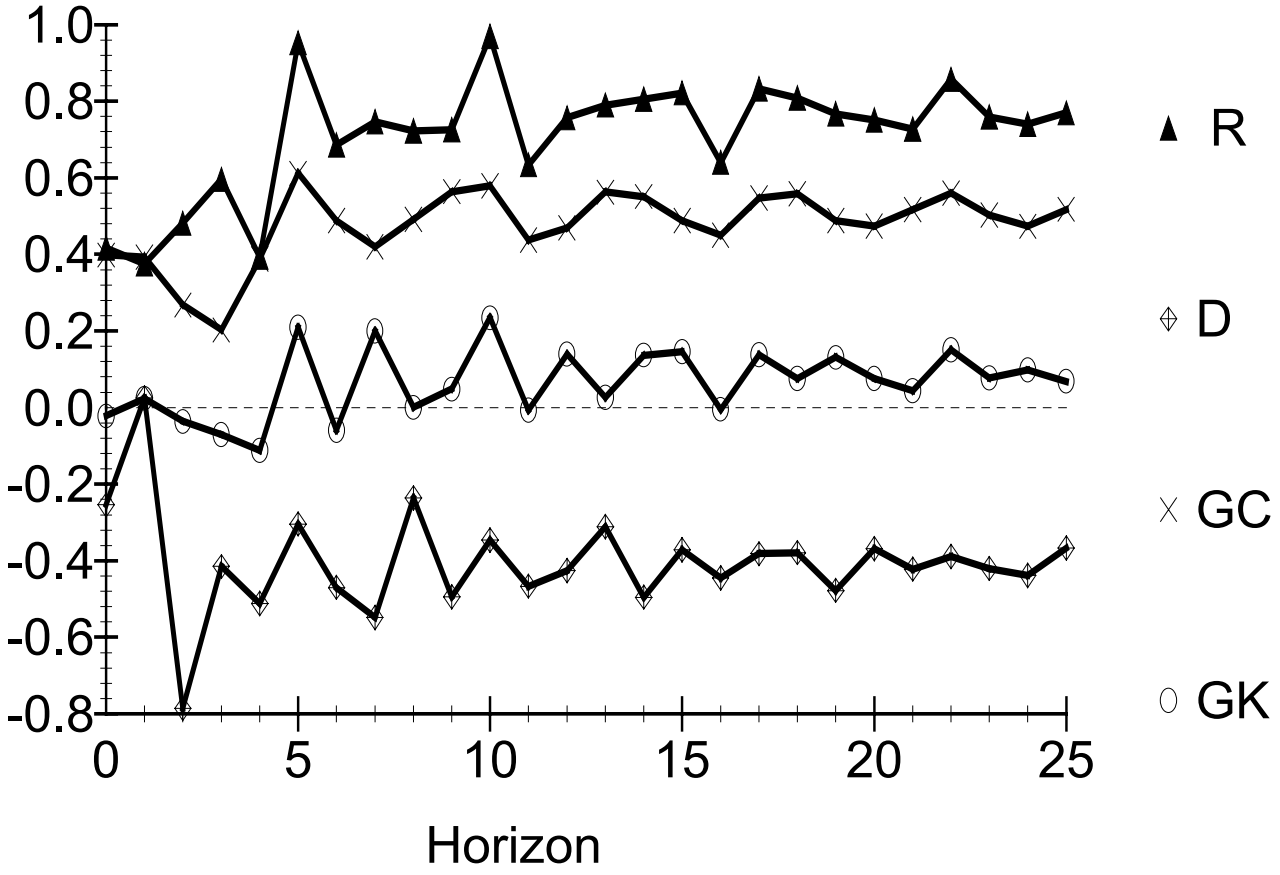


Figure 5 also indicates where the aid was spent, as it decomposes government spending into current and capital categories. Interestingly, aid appears to have a differential effect on the two types of spending. In general, the effects of aid on the government's current spending dwarf those on capital spending in the short, medium and long terms. Estimates from Figure 5 suggests that, in the long run at least, aid contributes around seven times more to current spending (which rises by $56 million) than it does to capital spending (which rises by around $8 million). As such, it casts doubt on the view that most aid was spent on capital projects with development objectives. However, whether this sheds any light on fungibility is uncertain as the proportion of aid intended for current and capital spending is unknown. To the extent that aid to Ghana over the period under study led to an increase in current but not capital spending, one could argue that it has been largely fungible. This conclusion will be valid if one could ascertain that aid was given to support capital spending. The period over which significant aid inflows were recorded for Ghana coincides with the reform period. During these years a significant portion of the aid consisted of 'adjustment lending' that was not necessarily given for capital spending (much would have been intended for budget support). Between 1987 and 1991, 18 per cent of the total net aid was received under the structural adjustment facility (SAF)[10]. Although the evidence is consistent with fungibility, one should be wary of making such an assertion.

An interesting corollary emerges from a comparison of results from the impulse response and error correction models (see Appendix). Specifically, aid does not have statistically significant short-run impacts on government spending in the ECMs, a result that contrasts with the responses in Figures 4 and 5. The ECMs do show however that aid does increase government revenue and reduce domestic borrowing over the short term. Since the parameters of the ECMs are *ceteris paribus*, this suggests that the rise in government spending following an aid shock that is shown in Figures 4 and 5 comes about through the knock-on effects between the other variables in the budget, rather than any direct effect of aid. This serves to underline the importance of the indirect linkages and suggests that in the short to medium run, the direct effect of aid is to reduce borrowing. In other words, aid is perceived as an alternative to domestic borrowing, rather than a source of government finance *per se*. This point is reinforced by the fact

that both domestic borrowing and tax revenue have significant and positive effects on government spending in the short run in the ECMs.

Results therefore suggest that Ghana's expenditure patterns over the period do not appear to be wedded to the rises and falls of aid inflows, as is so often believed to be the case in developing countries. In the Ghanaian case at least, spending plans (presumably based upon the expectation of aid) appear to be implemented irrespective of the receipt of aid itself: borrowing simply adjusting to balance the budget. Importantly, borrowing and aid appear to be substitutes for one another. This is illustrateded by the experience of the election years of 1991/92 and 1995/96. Being reluctant to reign in spending at these key points in Ghana's electoral cycle, the government increased borrowing to counteract the abrupt drops in aid flows.

It is important to acknowledge the caveats that should accompany the results that have been generated in this investigation. VARs are inherently over-parameterised and thus results tend to be sensitive to model specification, sample size and lag length, particularly in small samples. For instance in the aggregate model which comprises three lags in four endogenous variables, 16 parameters are initially estimated with 33 observations. While we have been mindful of the limitations, estimating a wide range of variants of the model shown here, the principal tenet of this study remains unaltered. The cointegration, ECM and impulse response approaches all yield consistent results. Caveats notwithstanding, the conclusions reached suggest that aid does not directly effect government spending in Ghana. Rather, it is considered a 'cheaper' source of financing than domestic borrowing.

6. CONCLUSIONS

In this paper, we have sought to analyse the effect of aid on fiscal behaviour in Ghana using annual data over the period 1966 to 1998. Fiscal response models, which look at the effect of aid on government fiscal behaviour, represent the theoretical basis of the study. Unlike fungibility studies that examine the effect of aid on categories of government spending, the fiscal response approach benefits from a broader focus. However, the FRMs employed in the existing literature have suffered from some serious

10 Calculated from the OECD-DAC data.

problems, notably the need to estimate target values and an inability to incorporate dynamics.

This paper contributes to the empirical literature on two fronts. First, we analyse the effect of aid on fiscal behaviour within a cointegrating VAR framework. The 'atheoretical' nature of VAR modelling means we avoid one major problem that has beset previous empirical work, namely the presumption and estimation of fiscal targets. Moreover, by circumventing the issue of targets we avoid one of the principal causes of model sensitivity, that being the way in which the targets are approximated (Franco-Rodriguez, 2000; McGillivray and Morrissey, 2001). A second advantage of using the VAR modelling approach is that one is able to better capture some of the dynamics within these models, which as the results here indicate can differ considerably, highlighting the distinction between the short and long run effects. Tests suggest that aid is strongly exogenous within both aggregate and disaggregate models. This provides an empirical justification for studying the dynamic impact of aid on fiscal behaviour, in particular using impulse response analysis. The main findings in this paper are summarised as follows.

First the variables in the model, namely aid, total government expenditure (or its components), tax revenue and domestic borrowing, form a long-run relationship. Tax revenue and government spending have almost identical magnitudes with aid having a relatively insignificant effect in the long-run. This suggests that domestic borrowing has been the main long-term financing item for primary deficits in Ghana, and that aid is given to alleviate short- to medium-term constraints.

Second, results show that aid to Ghana over the period led to an increase in current but not capital spending, suggesting that aid has been largely fungible. This assertion is true only if aid was given mainly to finance capital spending. The evidence for this is not very strong as a significant part of foreign aid to Ghana over the period studied was received under the structural adjustment facility and could have been intended for current expenditures and general budget support.

Third, impulse response analysis shows that injections of aid have a pervasive impact on the budget, inducing higher spending, increased tax effort and reduced domestic

borrowing. As improved fiscal management and reducing domestic borrowing are common policy conditions attached to aid, this suggests that aid was associated with beneficial policy responses. Our analysis does not show that aid caused the desirable policy response, but the link from aid to good fiscal policy is a reasonable inference. The picture that emerges indicates that policy makers in Ghana perceived aid as an alternative to domestic borrowing and thus spending was not directly influenced by the year-on-year fluctuations in aid inflows. In other words, the absence/presence of aid did not directly alter public expenditure patterns but rather affected government borrowing from the domestic economy.

The recent literature on aid and growth gives considerable attention to the relationship between aid and policy, and there is dispute over how aid and policy interact. Our study addresses one aspect of this for Ghana, the effect of aid on government fiscal behaviour. The results are illuminating. It appears that aid has been used as a substitute for domestic borrowing. It also appears that aid has been associated with increased tax effort. In general, both would be interpreted as 'good' policy responses. It is not possible to distinguish the aid as financing from aid as policy conditions, i.e. one cannot infer that good policy (say reducing borrowing) meant that aid was better used, nor that aid promoted good policy. It is simply the case that, in fiscal terms, the aid appears to have been utilised sensibly. The good policy responses were made possible by the availability of aid finance. One can also observe an increase in government spending, mostly current although the evidence that this is attributable directly (rather than indirectly) to aid is weak. To observe from the absence of a direct effect, as the fungibility approach would do, that aid did not increase government spending, in particular capital spending as intended (implying a 'bad' policy response) would be misleading. Any induced government expenditure effect of aid is matched by an increase in tax revenue so that the net effect of aid is to reduce domestic borrowing. A corollary of the results found here is that in order to gain a proper understanding of aid effectiveness it is necessary to allow for the effects of aid on the fiscal behaviour of governments. This requires some type of fiscal response model, and we contend that impulse response analysis is the most promising candidate currently available.

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Appendix: Error Correction Models

a) Aggregate Model

Variable	ΔR_t	ΔG_t	ΔD_t	ΔF_t
ΔR_{t-1}	1.360**	2.544***	0.525	0.312
ΔR_{t-2}	0.731**	1.941***	0.715**	0.393
ΔF_{t-1}	0.011	0.249	0.526**	-0.457*
ΔF_{t-2}	0.633**	0.206	-0.694**	0.385
ΔG_{t-1}	-1.055*	-2.146***	-0.685	-0.172
ΔG_{t-2}	-1.155***	-1.984***	-0.489	-0.335
ΔD_{t-1}	1.241**	2.407***	0.932	-0.077
ΔD_{t-2}	1.458***	1.842***	0.116	0.395
$EcmAM_{t-1}$	-3.474***	-3.948***	-0.1510	-0.181
R-Bar-Squared	0.5232	0.4643	0.5043	0.2263
Autocorrelation	0.2689	0.3270	1.562	3.0124*
Normality	1.116	0.6559	1.484	3.139

Vector Diagnostic tests

Autocorrelation	F-Version	1.1425 (0.3445)
Normality	Chi-squared Version	9.8297 (0.2772)

Notes: *, **, *** are respectively the 10, 5 and 1 per cent levels of significance. The chi-squared version of the tests for autocorrelation and normality are reported. All the results except for the 'vector diagnostics test' are obtained from *Microfit 4.0*. The vector diagnostic tests are obtained from *PcGive 10*.

b) Disaggregate Model

Variable	***ΔR_t***	***ΔCU_t***	***ΔCA_t***	***ΔD_t***	***ΔF_t***
ΔR_{t-1}	1.6825**	1.8040***	1.0029**	1.1077	0.5822
ΔR_{t-2}	0.9862**	0.9833***	1.2160***	1.0096**	0.5127
ΔF_{t-1}	-0.1068	0.1467	-0.0040	0.5314**	-0.4676*
ΔF_{t-2}	0.5134*	0.1108	-0.0818	-0.5596*	0.4426
ΔCU_{t-1}	-0.8517	-1.3256**	-0.5108	-1.2175*	-0.3819
ΔCU_{t-2}	-1.2170**	-1.0786**	-0.8472***	-0.8313*	-0.5322
$\Delta CA2_{t-1}$	-1.9369**	-1.9212***	-1.2190**	-0.9550	-0.3907
$\Delta CA2_{t-2}$	-1.3764**	-1.1887**	-1.1570***	-0.8484	-0.3499
ΔD_{t-1}	1.4051**	1.8086***	0.7770**	1.2788**	0.0783
ΔD_{t-2}	1.4202***	0.9304**	0.8294***	0.5297	0.5196
$EcmDM_{t-1}$	-2.4699***	-2.1817***	-0.5534	-1.4873*	-0.3781
R-Bar-Squared	0.5027	0.2319	0.7070	0.5087	0.1605
Autocorrelation	1.2109	1.4062	0.8912	1.8157	4.0089**
Normality	0.7113	1.1651	0.8868	1.7489	3.6073

Vector Diagnostic tests

Autocorrelation	F-Version	1.1754
Normality	Chi-squared Version	12.011

Notes: Same as in appendix (a).

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