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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 has the potential to affect budgetary behaviour. Although the (albeit limited) aid-growth literature has addressed the effect of aid on policy, it has tended to neglect the effect of aid on the fiscal behaviour of governments. While fiscal response models have been developed to examine the effects of aid on fiscal aggregates – taxation, expenditure and borrowing – the underlying theory is *ad hoc* and empirical methods used are subject to severe limitations. This paper applies techniques developed in the 'macroeconometrics' literature to estimate the dynamic structural relationship between aid and fiscal aggregates. Using vector autoregressive methods, an impulse response function is estimated to model the effect of aid on fiscal behaviour in Ghana. Results suggest that aid does not have a direct effect on the volume of government spending in Ghana but is treated as a substitute for domestic borrowing. Government spending does rise significantly following aid but this is principally due to an indirect effect arising from higher tax revenue associated with aid inflows. This, aid to Ghana has tended to be associated with reduced domestic borrowing and increased tax effort, combining to increase public spending.

JEL classification: F35, O23, O11, O55

Keywords: Aid, Fiscal Response, Ghana

1. Introduction

The empirical literature on the effect of aid on growth has seen a revival in recent years (Morrissey, 2001, provides a review). 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 (Franco-Rodriguez *et al*, 1998). The FRM approach has a much broader perspective and attempts to analyse the effects of aid on government fiscal behaviour, namely, taxation, spending and borrowing.

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 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 to trace through the dynamic effect

of aid on the components of the budget, rather than estimate the underlying structural form, estimation of the reduced form is sufficient for our purposes. Moreover, 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 (assumed) structural representation. Secondly, where required, assumptions about exogeneity can be tested within the VAR using the data, rather than imposed *a priori*. Furthermore, VAR methods facilitate an investigation of the dynamics of the relationship. While the VAR offers no panacea, it 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 begins with 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, and then presents our results. An Appendix provides greater detail on the econometric methodology used. The results suggest that in Ghana aid has substituted for domestic borrowing rather than discouraging tax effort or inducing a net increase in government spending. The conclusions are in Section 5, 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 – is aid actually spent on the areas intended by donors. General studies of fungibility consider if 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 only real 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 Morrissey (2001) provide a comprehensive review of the literature, and here we only touch upon the most important issues.

Fungibility studies model the actual extent to which aid is used for purposes other than those intended by donors. Feyzioglu *et al*. (1998) and Swaroop *et al.* (2000) are prominent examples of the approach that derives and estimates a simultaneous linear expenditure system from a utility maximising problem, addressing expenditure categories. Pack and Pack (1990, 1993) are the best known studies of general fungibility that do not use an explicit theoretical framework but still estimate a set of simultaneous equations. Such fungibility studies are the only examples of analysis of the impact of aid on government spending behaviour cited as evidence in World Bank (1998). McGillivray and Morrissey (2000, 2001) discuss a number of limitations of these studies.

First, the models, by restricting the possibility of fungibility to certain expenditures, do not allow for the possibility that aid will affect allocations under *all* types of expenditure headings. Second, the data used do not accurately identify how much aid donors intended should be spent on particular headings; measurement error is high and inferences on fungibility are biased. Third, the studies rely heavily on OLS estimation; if the components of total government spending are jointly determined this method yields inefficient estimates. Fourth, the studies treat domestic revenue as a residual and do not explicitly allow for the fact that aid can influence tax effort (and indeed borrowing). More generally, the effect of aid on the dynamics of spending and fiscal behaviour is not specifically incorporated. The fundamental deficiency of the fungibility approach is that it pays insufficient attention to the broader fiscal impacts of aid over time, especially on tax effort and borrowing. It is this wider dimension that FRMs aim to address.

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:

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

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:

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

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

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:

$$GK + GC = R + F + D \quad (4)$$

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 α s constrain allocation so that specific expenditure targets in (1) cannot be met. Furthermore, 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). A solution to the former problem was advanced in Franco-Rodriguez *et al* (1998) who treated aid as endogenous (i.e. *aid is incorporated in the utility function*): governments have a target for, or expectation of, aid revenue, and this influences fiscal behaviour (the levels of the other variables). Thus, aid is incorporated into the loss function (1), which becomes:

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

Aid is endogenous 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.

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. The atheoretical VAR approach used in this paper circumvents this problem. Nevertheless, FRMs have been applied and it is worthwhile to summarise other limitations of the approach.

Fiscal response models are notoriously difficult to estimate and highly sensitive to the quality of the data (the results are often not robust). Studies frequently yield inconsistent estimates of 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 is that there is no accepted theory regarding how to estimate revenue and expenditure targets. Another serious problem is that the behavioural relationship being estimated is assumed fixed over the period. In econometric terms, one would expect structural breaks or changes in the way series co-move. It is not possible to address these problems within the approach to FRMs outlined above. As discussed in section 4 (and in more detail in the Appendix), the VAR approach allows us to address many of these deficiencies.

3. Aid and Fiscal Trends in Ghana

Economic policy from about the mid-1960s to the early 1980s in Ghana was quite similar, at least with respect to 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. However this policy is the reason they lost power in 1971. The decision to adopt and adhere to the 'liberalising' 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. 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 practice conditionality. The unilateral repudiation of foreign loans in the early 1970s lends some support to this argument. The 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 (blackmail as it was perceived) from donors.

Prior to 1983 public expenditures persistently exceeded revenues in Ghana (and domestic sources of revenue were more important both in relation to aid and also to government expenditures than has been the case subsequently). 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 (partly fuelled by aid) had outstripped expenditures, translating into a surplus which was maintained until 1991. Most of the surplus was due to the large inflow of foreign aid (Addison and Osei, 2001).

The importance of aid in shaping policy in Ghana after 1983 cannot be over-emphasised. As argued above, prior to the 1980s aid revenues were relatively small and successive governments had not felt the need to modify policy since the aid was given unconditionally. 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.

Looking at the components of government expenditure one observes that it is government consumption that has accounted for most of this increase – from about $264m in 1983 to about $1.2b in 1998. Over the same period capital expenditures increased but not by as much. This is against the background of increasing aid flows over the latter period. 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).

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.

Figure 1: Tax Revenue and Foreign Aid Flows

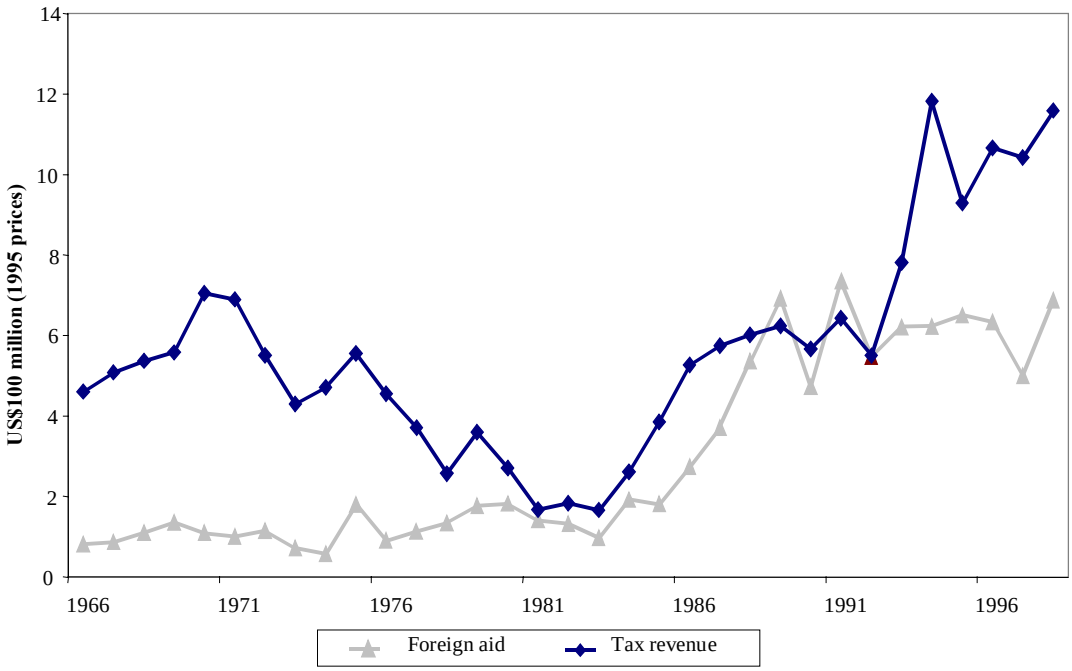


Figure 2: Government Expenditure Trends

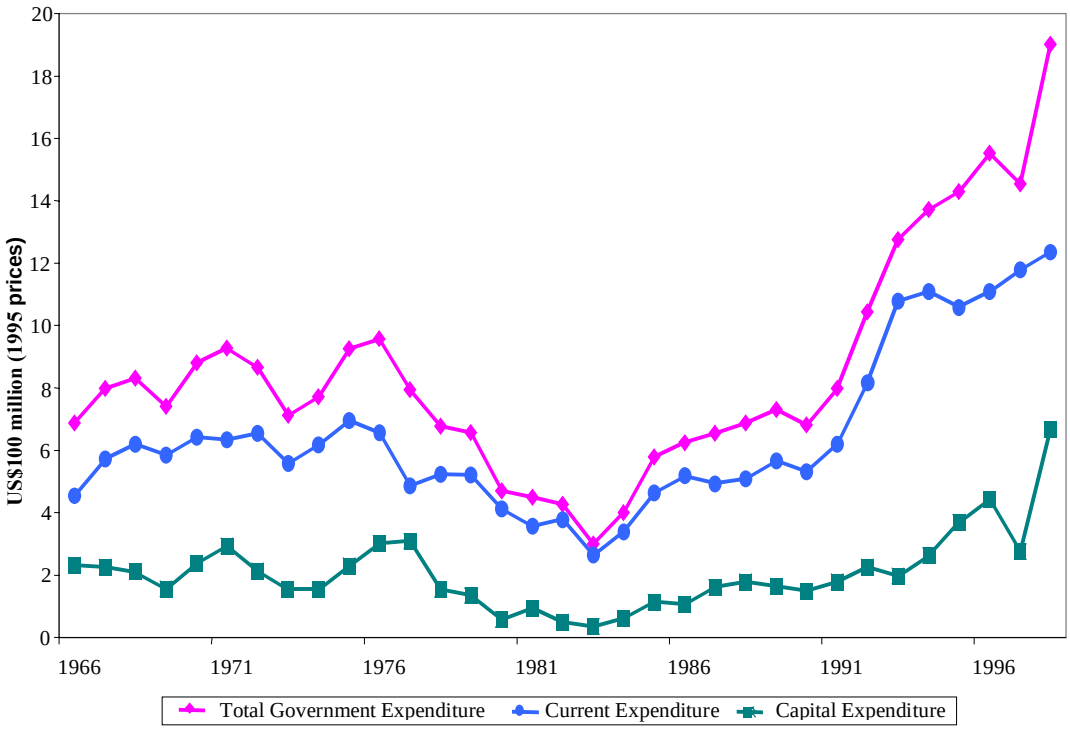


Figure 3: Share of Current Spending and Aid in Total Expenditures

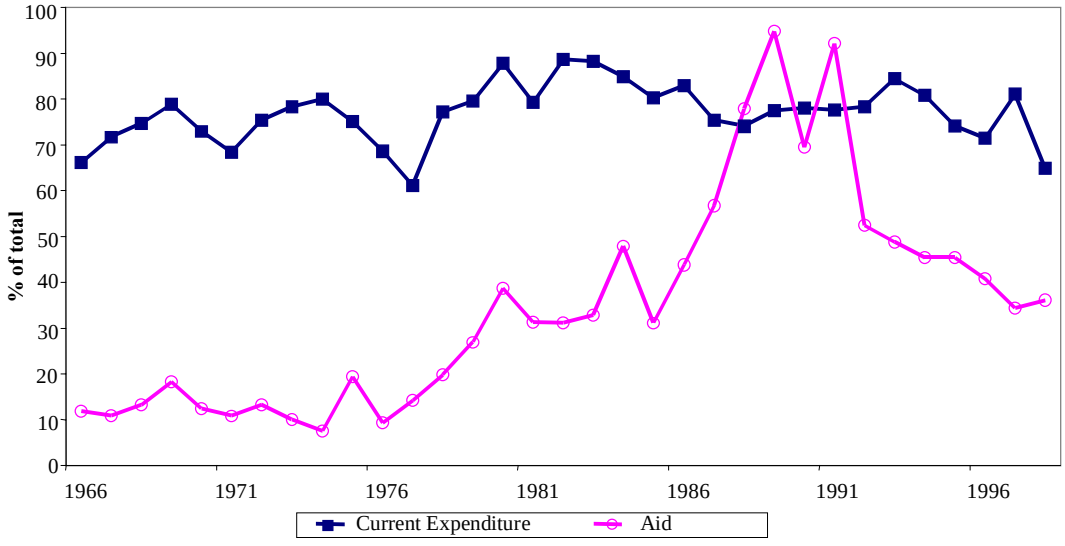
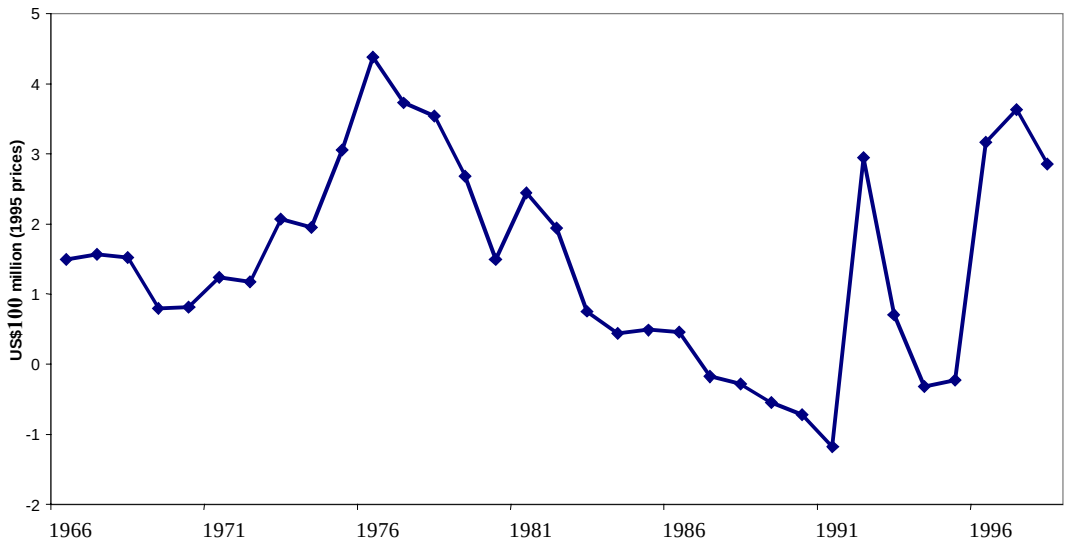


Figure 4: Domestic Borrowing



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, at the least, 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 4). 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. 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 that had been witnessed in the 1970s. This, coupled with a considerable slow-down of aid inflows, resulted in an increase in domestic borrowing in the 1990s that coincides with the election years in Ghana (1992 and 1996). This supports the hypothesis that Ghana's fiscal trends tended to follow a political business cycle (at least

since 1992). Given that the inflow of aid slowed down over the election years one could infer that the increases in government current expenditures over those years were financed from domestic borrowing.

A pattern of fiscal response emerges from this discussion, noting that the principal changes were in the composition of revenues rather than in expenditures. Domestic borrowing increased steadily from the mid-60s to peak around 1977. There were then two phases of decline: by about 1983 borrowing was back to the levels of the mid-60s, but it fell significantly for the remainder of the 1980s. This latter phase of decline (resulting in net repayments) corresponded to the period when both aid and tax revenue were increasing. While tax revenue continued to increase, reaching something of a plateau in the latter half of the 1990s, aid declined significantly during the 1990s. During this period, borrowing was volatile, but was back at a high level by the late 1990s. It is this pattern of fiscal response that we explore in the econometrics of the next section.

4. Econometric Methods and Results

In recent years, vector autoregressive methods have become the 'tool of choice' in much of empirical macro-econometrics (detail on the method is provided in the Appendix). 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 is easily shown to be the reduced form representation of a structural economic model (Hamilton, 1994: 324-340). As such, it provides a useful framework for the investigation of both long-run (cointegration) relationships and short run dynamics (via an equilibrium correction model, the ECM) of the variables in the system. Furthermore, as Ericsson *et al* (1998) demonstrate, providing certain exogeneity conditions are met, the VAR is also a legitimate stage on which to conduct dynamic simulation or so-called *impulse response analysis.* Impulse response functions represent time profiles of the effect of an exogenous shock on the endogenous variables in a dynamic system, allowing for the knock-on and feedback effects between the variables in the system in periods following the shock. Here, we adopt the generalised impulse response function of Pesaran and

Shin (1998) owing to the fact that, unlike the orthogonalised impulse response function, it is unique, i.e. invariant to the ordering of the variables in the VAR. However, as with all impulse response analysis the variable being shocked must be 'strongly exogenous' if the results are to be meaningful in a policy context. As a result, exogeneity testing plays a central role in the empirical analysis.

One additional advantage of impulse response analysis is that, as total derivatives, the coefficients of the impulse response function do not suffer from the *ceteris paribus* limitation that can confound the interpretation of cointegration vectors in the multivariate context (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 the cointegrating vector, which ignore these interactions by construction, may have limited appeal and may give a misleading impression of the '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.

In the current context the VAR comprises the variables of the FRM, namely, government expenditure (G), tax and other revenue (R), aid finance (F) and domestic borrowing (D). Thus, the VAR captures the inherent inter-relationship between the variables in the model, without initially imposing any restrictions on the nature of the relationship. 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 OCED/DAC data. It includes all loans with a grant element of more than 25 per cent and also technical cooperation and assistance.[1]

[1] All data and statistical output are available from the authors upon request.

Cointegration and Exogeneity

As a precursor to the empirical analysis the order of integration of the individual series is evaluated using the Augmented Dickey Fuller (ADF) test. 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 1-4 suggest. Consequently, the variables R_t, F_t, D_t G_t form the equations of a (restricted constant) VAR(k) model. The appropriate lag length (k) of the VAR is determined using standard model selection criteria, namely 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 produces 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. One expects to find at least one cointegrating relationship among this set of variables as some form of 'co-movement' is expected between government expenditure, tax revenue (which is the major component of government revenue) and domestic borrowing. Although we are not estimating an identity (foreign non-aid borrowing and inflation tax finance are omitted), revenues and expenditures as defined must be in long-run equilibrium. The results are reported in Table 2 and confirm the existence of a single long-run relationship at the 5% level. Normalising on government revenue (as this is the most strongly endogenous variable), yields,

$$R_t = -0.0708F_t - 0.9613D_t + 0.8081G_t + 0.4474$$

The estimates suggest that, *ceteris paribus,* aid and borrowing tend to be negatively correlated with tax revenue, whereas government spending has a positive correlation in the long run. The negative correlation between aid and domestic borrowing with tax revenue reflects the fact that all three variables are financing items in the government budget constraint. Therefore a decrease (increase) in one will be compensated for by an increase (decrease) in another, given government expenditure. The possible relationships are explored further below.

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)

Notes: 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.

Table 2: Trace Test for the Number of Cointegrating Vectors (*r*)

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

Note: All computations made in *PCGive*.

Table 3: Demonstrating Strong Exogeneity of Aid

(a) Weak Exogeneity

H_0 **: weak exogeneity**	**χ-squared**	**P-value**
Variable		
Revenue	11.888	0.0006
Aid	0.049	0.8248
Domestic Borrowing	9.0048	0.0019
Government Expenditure	3.0099	0.0828

(b) Granger Non-Causality Tests

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

Note: 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.

As mentioned above, impulse response analysis requires that the variable being shocked is strongly exogenous, which in turn demands that it is both weakly exogenous and is not Granger-caused by any of the variables in the system. Table 3 reports the results from Johansen's (1992) test of weak exogeneity and the exclusion restrictions implied by Granger non-causality. Referring to panel (a) of Table 3 results clearly support the weak exogeneity of aid. The hypothesis that government expenditure is weakly exogenous can only be rejected at the 8% level. This is sufficient to infer that expenditure responds to the level of finance, whether from taxation or other sources (perhaps the nature of government behaviour is that, given expenditure requirements, financing composition is chosen). The results in panel (b) of Table 3 strongly point to aid being a Granger-cause of the fiscal variables but not *vice versa*, in that lagged values of aid are highly significant in the equations for R_t, D_t and G_t, but lagged values of R_t, D_t and G_t are jointly insignificant in the aid equation. In sum, the results of these tests clearly point to the strong exogeneity of aid in the system and with it the legitimacy of impulse response analysis, which is undertaken below.

The Error Correction Model (ECM)

Although the primary focus of this study is the simulation of aid shocks via impulse response analysis, for completeness we report estimates of the error, or equilibrium, correction equations from the VECM (Table 4). While the interpretation of short run coefficients is invariably conjectural, the estimates of Table 4 do shed some light on the role of aid in the budget. The results suggest that in the short run aid induces increased tax effort, reduces domestic borrowing and has no significant effect on total government spending. The coefficient on the ECM terms show that both revenue and spending 'over-adjust' and this may be the reason why the adjustment term for borrowing appears to be insignificant. In other words, if there is a disequilibrium in the government budget in period *t*, then it is consistent for any adjustment in period *t+1* to occur in government spending and either one, or more, of the financing items.

The insignificant effect of aid on government expenditure in the short run may seem inconsistent with what one expects. It can however be explained when one looks at the broader fiscal picture: aid is associated with an increase in tax revenue and a reduction in domestic borrowing. These two effects may off-set each other. This could mean that public expenditure patterns in Ghana are primarily driven by the volume of resources that can be generated, including domestic borrowing and foreign aid. 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 (Table 4). One could therefore argue that the level of government spending is not directly determined by aid inflows: aid merely influences the composition of revenue. As such, it lends support to the use of a fiscal response rather than a fungibility approach in the Ghanaian case. Furthermore, it was noted in Section 3 that in the late 1970s aid inflows were fairly stable, although government spending, tax revenue and domestic borrowing were on the decline. In the 1990s, when donors adopted the so-called 'wait and see policy' around election years of 1991/92 and 1995/96, government expenditure growth did not slow down. Rather domestic borrowing was increased in these years.

Table 4: Equilibrium-Correction Models

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

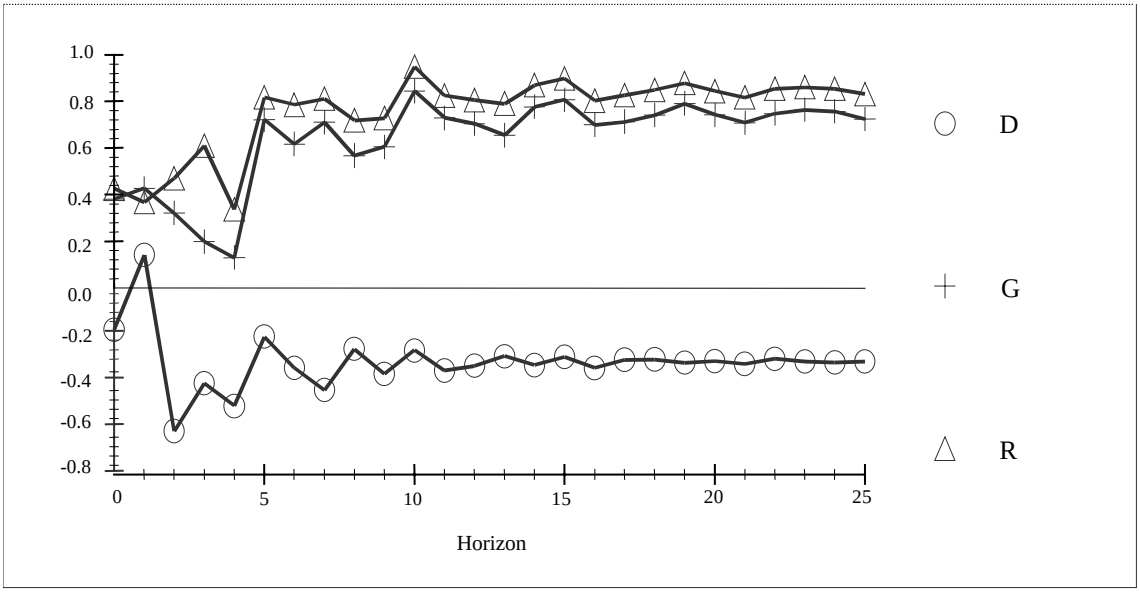
Autocorrelation	F-Version	1.1425 *(0.3445)*
Normality	Chi-squared Version	9.8297 *(0.2772)*

Notes: *, **, *** are respectively the 10, 5 and 1 per cent levels of significance. The chi-squared version of the tests for autocorrelation and normality for the individual equations 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* and are tests on the vector residuals.

Impulse Response Analysis

Since aid has been shown to be strongly exogenous to the fiscal variables in the system, it is possible to conduct an impulse response analysis of the dynamic impacts of an aid shock to the system. This will be instructive as short and long run effects may differ. Aid may have long term development objectives but will still be given with the aim of filling a financing gap in the short to medium term. Therefore an interesting issue, at least from the point of view of this study, concerns the role of aid in influencing short and medium term behaviour of the government. Moreover, the impulse response functions generated will take account of the inter-relations that are likely to exist in this context.

Figure 5: Generalised Impulse Response Functions of a One Standard Error Shock in the Aid Equation



Plots of the generalised impulse response functions for a one standard error shock in aid are shown in Figure 5. According to the estimates, the effect of a shock persists over a relatively long period of time, stabilising after about 10 years. The pattern of the effect is strong: a shock in aid results in an increase in spending and revenue, but a reduction in borrowing. Long run responses in each of these variables are generally of twice the magnitude of the contemporaneous (or impact) effects. As Figure 5 also demonstrates, the magnitudes of the effect on tax revenue and government expenditure are similar suggesting that the net effect of aid is to reduce domestic borrowing. This is consistent

with the ECMs and the discussion in section 3. So, in sum, aid appears to encourage tax effort and reduce borrowing. The combined effect of aid and the increased tax revenue allows expenditure to increase, off-setting the reduced borrowing. Whilst one cannot directly infer that aid itself was used to increase spending, the results do clearly identify the net effect of aid in Ghana, that being increased spending, increased tax revenue and lower borrowing.

Finally, 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. In the model reported here, 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. 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.

5. Conclusions

We have sought to analyse the effect of aid on fiscal behaviour in Ghana using annual data over the period 1966 to 1998. The theoretical basis of the study is fiscal response models, which look at the effect of aid on government fiscal behaviour. Fiscal response models have the advantage that they are broadly focused, as opposed to fungibility studies that examine the effect of aid on categories of government spending. However, the FRMs employed in the literature have suffered from some serious 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.

We find that the variables in the model, namely aid, government expenditure, tax revenue and domestic borrowing, form a long run relationship, such that they are bound together in the long term. In other words, there is a single cointegrating relationship, in which all variables are significant. We test and find that aid is strongly exogenous within the model. This provides an empirical justification for studying the dynamic impact of aid on fiscal behaviour, in particular using impulse response analysis.

Results from the ECMs show that aid induces increased tax effort and reduces domestic borrowing but has no significant effect on total government expenditure in the short run. This suggests that policy makers in Ghana have perceived aid as an alternative to domestic borrowing. These findings are supported by the estimated impulse response function for a 'shock' in aid. The results are tentative, given the limitations of the small sample, but are indicative. A shock in aid leads to a reduction in domestic borrowing, but to increases in both tax revenue and government expenditure. Our analysis demonstrates that the direct effect of aid appears to be to reduce domestic borrowing. Furthermore, there is no evidence that aid has a negative effect on tax revenue: if anything, aid appears to have encouraged tax effort in Ghana.

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, 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 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

Econometric Methodology

Consider a VAR(p) model,

$$\mathbf{x}_t = \mathbf{\Phi}_1 \mathbf{x}_{t-1} + \mathbf{\Phi}_2 \mathbf{x}_{t-2} + \ldots + \mathbf{\Phi}_p \mathbf{x}_{t-p} + \mathbf{\Psi} \mathbf{w}_t + \boldsymbol{\varepsilon}_t \qquad \text{(A1)}$$

where $\mathbf{x}_t$ is a $(m \times 1)$ vector $(1,2,\ldots,i,j,\ldots,m)$ 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, $\mathbf{\Sigma}$. Note that all explanatory variables are pre-determined and thus (A1) can be thought of as the reduced form of some (undefined) structural economic model. While the structural model is assumed to possess a diagonal variance – covariance matrix, (A1) does not since the off-diagonal elements of $\mathbf{\Sigma}$ account for the contemporaneous linkages between the variables in the (simultaneous) structural representation.

Providing the variables are (at most) integrated of order one {I(1)} and cointegrated, equation (A1) also has an equilibrium correction representation that is observationally equivalent but which facilitates estimation and hypothesis testing as all terms are stationary. In this reparameterisation, given by,

$$\Delta \mathbf{x}_t = \boldsymbol{\alpha} \boldsymbol{\beta}' \mathbf{x}_{t-p} + \sum_{i=1}^{p-1} \mathbf{\Gamma}_i \Delta \mathbf{x}_{t-i} + \mathbf{\Psi} \mathbf{w}_t + \boldsymbol{\varepsilon}_t \qquad \text{(A2)}$$

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 (A2) estimate the short-run effect of shocks on $\Delta \mathbf{x}_t$, and thereby allow the short and long run responses to differ.

Impulse response analysis is readily facilitated in the VAR and delivers time profiles of the effect of hypothetical shocks to $\boldsymbol{\varepsilon}_t$ on the level of $\mathbf{x}_t$ taking in to account the knock-on and feedback effects that characterise the variables in a dynamical system such as (A1). The simulated time paths are found by imposing a recursive structure on the

moving average representation of the VAR and represent the time path of variable i with respect to a unit shock to variable j, s periods ago, all other variables at the time of the shock (and earlier) held constant. Given that all variables on the right hand side of the VAR are predetermined, a shock to say x_{jt} must emanate from ε_{jt}, and thus it is convenient to develop the analysis in terms of the disturbances rather than the variables themselves. More generally it is useful for impulse response analysis to express the VAR in its moving average [MA(∞)] representation, i.e.

$$\mathbf{x}_t = \boldsymbol{\varepsilon}_t + \mathbf{A}_1\boldsymbol{\varepsilon}_{t-1} + \mathbf{A}_2\boldsymbol{\varepsilon}_{t-2} + \ldots + \sum_{i=0}^{\infty}\mathbf{A}_i\boldsymbol{\Psi}\mathbf{w}_{t-i} \qquad \text{(A3)}$$

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

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

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,

$$\varphi_j^g(n) = \sigma_{jj}^{-0.5}\mathbf{A}_n\boldsymbol{\Sigma}\mathbf{e}_j \qquad \text{(A4)}$$

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). Providing the shock emanates from a source that is strongly exogenous to the system such a simulation experiment is valid (Ericsson *et al*, 1998) as the evolution of the endogenous variables do not impact on the variable that is being shocked.