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Te Kunenga
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ANALYSIS OF THE AID, FISCAL RESPONSE AND GROWTH RELATIONSHIP IN GHANA: A COINTEGRATING VAR APPROACH

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ABSTRACT

The literature on aid effectiveness is mired in controversy. Aid, purportedly given to supplement the domestic savings and foreign exchange earnings of a recipient country to enable it achieve some higher rate of growth, can lead to perverse results. Because aid is given to governments, the effectiveness of aid will depend crucially on the fiscal response of governments to aid. A preponderance of the available empirical studies are based on cross-country analysis, but cross-country analyses mask the peculiar experiences of individual countries that, for policy purposes, can only gainfully be captured in single-country time series studies. Most of those studies applying time series techniques on individual country data have analysed the relationship between aid and a set of fiscal variables in fiscal response models without explicitly incorporating rate of economic growth. The current study goes beyond the aid-fiscal variables focus of aid effectiveness studies on Ghana to simultaneously explicitly consider the economic growth rate, aid and fiscal variables and also use a larger dataset than those utilised in previous studies. Modern cointegration analytical techniques are employed. The results suggest that over the medium to long term, foreign aid boosts government consumption expenditure and the growth rate of the economy whilst it induces reductions in government investment expenditure and tax effort, displaces domestic borrowing by government and crowds out private investment.

JEL Classification: F35, O40, O55.
Keywords: aid effectiveness; aid, fiscal response and growth; Ghana; cointegration.

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1. INTRODUCTION

The main economic rationale for giving aid seems to be the desire to help the recipient countries attain some higher rates of economic growth, and yet the empirical evidence on the effectiveness of aid in stimulating economic growth is mixed and the theoretical literature continues to be mired in controversy (McGillivray *et al.*, 2005). In part, the controversies are rooted in the different ideological stances and methodological approaches taken by the various researchers. White (1992) identifies critics of aid from both the left and right of the political spectrum. The perception that aid can promote sustainable economic growth is predicated on aid supplementing domestic savings and foreign exchange earnings in a recipient country. Hence, aid is said to be effective if an increase in aid raises savings and export earnings which enable a recipient country to increase investments and, in turn, economic growth. This line of enquiry of aid effectiveness is well known as the two-gap approach pioneered by Chenery and Strout (1966). As outlined by White (1992), one criticism of the two-gap model has been the subject of the savings debate in which the 'radical' position has been that aid supplants domestic savings, thus lessening the impact on growth. And one question to emerge from this analysis is how recipient governments respond to aid inflows.

Theoretically, the efficacy of aid can be diminished if aid produces effects that are similar to Dutch Disease.[3] This view suggests that aid can cause a boom in one sector (the non-tradable sector) at the cost of a recession in another sector (the tradable sector). Consequently, aid may lead to the appreciation of the exchange rate, which in turn erodes the recipient's export earnings. Aid can also be less effective if it is fungible or is used for purposes other than what it was intended for. For example, aid may be used to invest in low-productivity sectors or to increase unproductive government consumption or to fund tax reduction or reduce borrowing. These can reduce domestic savings and investments through upward pressure on prices and interest rates (McGillivray and Morissey, 2000, 2001).

Another issue is the policy conditionality attached to aid. Since the 1980s, aid donors have increasingly attached policy conditionality to most of their aid allocation. To qualify for foreign aid a country must adopt economic policies that are broadly in line with the set of policy prescriptions called the "Washington Consensus".[4] This assumes that a

[3] See IMF (2005, Appendix II) for a detailed discussion of the theoretical and empirical literature of the "Dutch Disease".

[4] Washington Consensus is the name given to the ten policy prescriptions proposed by Williamson (1990) for countries embarking on market economic reform. These are: (1) keep fiscal deficit to minimum, (2) make public expenditure priority toward education, health and infrastructure development, (3) reform tax system by lowering marginal tax rates and broadening the tax base, (4) liberalise interest rate to discourage capital flight and increase savings, (5) adopt a competitive exchange rate to bolster exports, (6) liberalise trade and minimise tariffs for intermediate goods needed to produce exports, (7) encourage foreign direct investment, (8) privatise the state-owned enterprises, (9) deregulate the economy to allow enterprises entry and exit market freely, (10) secure property rights via law and order enforcement in order to encourage saving and accumulating wealth. For more details, see Williamson (1990).

"good" policy environment is a precondition for aid effectiveness, but this view is not shared by all commentators. The leading rival studies in the controversy are those authored by Burnside and Dollar (2000), who argue that good policies are a necessary condition for aid effectiveness, and by Hansen and Tarp (2001), who counter-argue that aid is effective regardless of the policy environment. However, Morrissey (2001) observes that majority of the studies present evidence of aid effectiveness even though there is acceptance in many other studies that a good policy environment improves aid effectiveness. And indeed, aid donors have recently provided aid packages designed to promote institutional reform. Good governance and capacity building are high on the policy dialogue agenda between donors and recipients.

It can be argued that the side effects of aid such as the Dutch Disease and fungibility issues are the consequences of how policies are designed to accommodate aid inflow which, in turn, depend on the institutional capability of recipient countries as well as the policy conditionality. In simulations implemented by Xayavong *et al*. (2005), a stable aid inflow contributes to economic growth even when aid is fungible but policy conditionality leading to unstable aid inflow impairs the effectiveness of aid. Tsikata (1998) highlights the importance of an appropriate macroeconomic policy mix to address the problems of the effect of aid on competitiveness and crowding out of private investment. Morrissey (2002) also suggests that government policies can play an important role in enhancing aid effectiveness through seeking to improve the productivity of investment. Hence the degree to which aid can stimulate economic growth depends critically on the behaviour of the recipient government.

In the aid effectiveness literature the aspect of government behaviour found to be most amenable to modelling is fiscal behaviour. From their comprehensive review of studies on the fiscal impact of aid, McGillivray and Morrissey (2001) have classified those studies into two broad groups: (i) fungibility studies; and (ii) those estimating a fiscal response model (FRM). Whereas fungibility studies attempt to assess the extent to which aid is diverted from its intended purposes, studies estimating fiscal response models go further to capture the impacts of aid on tax effort, domestic borrowing by government and the different categories of government expenditure. On that account, the FRM approach trumps the fungibility approach in analysing fiscal effects of aid even though it is not without its shortcomings. A discussion of these approaches is offered in Section 2.

We rationalise this current study on the basis of three observations made about the growing number of fiscal effects studies. Firstly, the aid-growth nexus has been modelled in single or system growth equations where aid is one of the regressors. Most of the empirical studies are cross-country analyses which mask the peculiar experiences of individual countries that can only properly be captured in single-country time series studies for policy purposes. The point was made by Papanek (1973) and echoed by White (1992) and still there are relatively few individual country studies available. Secondly, as a distinct subset of empirical studies, those estimating FRMs mostly consider the

relationship between aid and fiscal aggregates without explicitly modelling growth. The FRM route to evaluate aid effectiveness would be a bit more enlightening if growth was explicitly incorporated; only a handful of studies do that.[5] Thirdly, in FRM methodologies there is no uniform way to generate the target values required for the constituent variables in the FRM and the 3 SLS estimation techniques employed to solve the FRMs tend not to be robust to changes in data or model specification. As an example of the more recent variety of FRM studies, Osei *et al.* (2003) suggests that those methodological problems can be circumvented by estimating the FRM within a vector autoregression (VAR) modelling framework. The authors applied VAR methods to the 1966-98 data on aid and fiscal aggregates to estimate an FRM for Ghana. The efficacy of that approach has been replicated in a study on Kenya by M'Amanja *et al*. (2005) who explicitly incorporated the growth rate among the variables and thus applied the VAR and vector error correction model (VECM) or multivariate cointegration techniques.

This paper takes a cue from Osei *et al*. (2003) and M'Amanja *et al*. (2005) and contributes to the aid effectiveness literature by examining the link between foreign aid and fiscal behaviour and growth in Ghana using a multivariate cointegration framework. Data used traversed the 1965 to 2004 period. The approach taken allows us to transcend the analysis of the effect of aid on fiscal behaviour in Ghana done by Osei *et al*. (2003) to include the effect on economic growth. In the scheme of things, generalised impulse response functions were generated. We discovered that over the medium term to the long term, foreign aid boosts government consumption expenditure and the growth rate of the economy whilst it induces reductions in government investment expenditure and tax effort, displaces domestic borrowing by government and crowds out private investment.

The paper is divided into six parts. After this introductory section, Section 2 gives an overview of the theoretical underpinnings and empirical specifications of the FRM. Section 3 outlines the multivariate cointegration model – the analytical method of choice. Section 4 explains the sources of the data and provides statistical descriptions of the constructed variables. The analytical results comprising the results of the preliminary tests to establish the order of integration of the individual variables as well as the existence of cointegration among the variables and those of the estimated cointegrating VAR and their interpretations are presented in Section 5. Section 6 concludes the paper.

[5] Gupta and Lensink (1995) and Xayavong (2002) construct fiscal response macroeconometric models with heavy emphasis on the impact of aid on the demand side of the economy. M'Amanja *et al.* (2005) apply multivariate vector autoregressive model to examine the link among fiscal aggregates, aid and growth variables.

2. AID, FISCAL RESPONSE AND ECONOMIC GROWTH: THEORY AND EMPIRICAL MODELLING

As mentioned in Section 1, McGillivray and Morrissey (2001) have divided the studies on fiscal impact of aid into two: fungibility studies and fiscal-response-model studies. Both types of studies develop their empirical frameworks from a utility maximising problem specified appropriately. The quintessential approach in fungibility studies was developed by Pack and Pack (1990, 1993). The fungibility coefficients are obtained from regressions of the various types of government expenditure and taxation on a range of variables, including aid. Aid is said to be fungible if $\Delta IG/\Delta AF < 1$, $\Delta CG/\Delta AF > 0$, and $\Delta TR/\Delta AF < 0$ (where IG is government investment, AF is foreign aid, CG is government consumption, TR is tax revenue, and Δ is the first difference operator). The first condition states that when aid increases, government investment increases less than proportionally, which indicates that aid intended to be used for public investment does not increase public investment to the extent of the value of aid inflow. This suggests that the recipient government is able to avoid donor attempts to target aid, and some of the released resources that are available due to an increase in aid inflow can be used to increase consumption (as implied by the second condition) or to fund tax cuts (as implied by the third condition). The magnitudes of the estimated parameters are the items of major interest in fungibility studies. Other researchers applying similar approaches to that of Pack and Pack (1990, 1993) are, for example, Khilji and Zampelli (1991, 1994), Feyzioglu *et al*. (1998) and Swaroop *et al*. (2000). Because fungibility studies are narrower in focus than the FRMs, and also because the objective of this study is not to estimate or ascertain aid fungibility in Ghana, we shall now turn our attention to the FRM approach.

The FRM was first developed by Heller (1975) and has since been extended by Mosley *et al*. (1987), Gang and Khan (1991) and Franco-Rodriguez *et al*. (1998). The FRM approach models the government as optimising utility by minimising a welfare loss function quadratic in the deviations of fiscal aggregates from their target levels subject to expenditure constraints. The fiscal aggregates would typically include government recurrent and capital expenditures, taxation and other recurrent revenue and borrowing. It must be noted that there is uniformity neither in the choice of numbers and definitions of the fiscal aggregates nor in the specification of the generation of the target levels in the utility function. The empirical framework is in the form of structural or reduced-form equations. Mosley *et al*. (1987) extended Heller's model by incorporating a production function, disaggregating government expenditure into three, and integrating private investment specified as a function of aid. Their analytical framework allowed the linking of growth and private investment to the examination of the relationship between aid and fiscal behaviour. Franco-Rodriguez *et al*. (1998) attained methodological progress by incorporating aid directly in the utility function. For our purposes we shall proffer that the "generic" RFM may be represented with the following set of equations:

$$U = U(CG, IG, TR, AF, BD \mid CG^*, IG^*, TR^*, AF^*, BD^*) \quad (1)$$

$$CG = g(TR, AF, BD) \quad (2)$$

$$X_j^* = X_j^*(\cdot) \text{ for } j = CG, IG, TR, AF, BD \quad (3)$$

$$IP = f(AF) \quad (4)$$

$$Y = \Gamma \cdot Y(KG, KP, L) \quad (5)$$

where CG is government consumption expenditure, IG is government investment expenditure, TR is tax revenue, AF is foreign aid, BD is domestic borrowing by government, the asterisks indicate the target levels of the respective variables, IP is private investment, Y is aggregate output, Γ represents technology or total factor productivity, KG is public capital stock, KP is private capital stock, and L is labour force. Government maximises utility U (equation 1) subject to the budget constraint (equation 2). The target levels $X_j^* = X_j^*(\cdot)$ in equation (3) are subjectively specified. Private investment is expressed as a function of aid (equation 4) and output is expressed as a function of technology, labour and private and public capital (equation 5).

Mosley *et al*. (1987 formalised the three channels through which aid impacts growth. For brevity we report the simplified version of the results as outlined by White (1992) as follows:

$$\text{Maximise: } U = a_0 - (a_1/2)(IG - IG^*)^2 - (a_2/2)(TR - TR^*)^2 \quad (6)$$

$$\text{subject to: } IG = a_3 AF + a_4 TR \quad (7)$$

$$\text{where } IG^* = a_5 IP \quad (8)$$

$$T^* = 0 \quad (9)$$

$$IP = a_7 AF \quad (10)$$

$$\text{and, } Y = Y(KP, KG, L) \quad (11)$$

The variables are as explained before. In White's rendition, other fiscal aggregates are excluded for the sake of simplicity. Equation (6) is the utility function. Equation (7) is the government's budget constraint, assumed to depend only on aid inflows and tax revenue. The tax revenue target is set equal to zero in equation (9). Equation (8) captures the influence of government spending on private investment, as governments can set their spending targets to promote private investment. Equation (10) captures the direct impact of aid on private investment and is the reduced form for IP, where $a_7 < 0$ implies

crowding out. On the supply side, production is driven by the stocks of private and public capital and the labour force (equation (11)).

By maximising the utility function (equation (6)) subject to the budget constraint (equation (7)), the model yields a set of equations that determine the coefficients of the fiscal aggregates. Substituting equations (8) and (9) into the first order conditions yields the reduced form for IG. Taking the total differential of the production function (equation (11)) and substituting the reduced forms for IG and IP into it gives the solution for the impact of aid on growth as follows:

$$\frac{\partial(dY)}{\partial AF} = (\delta_1 a_7) + \left(\delta_2 \frac{1}{1+\mu} a_3\right) + \left(\delta_2 \frac{\mu}{1+\mu} a_5 a_7\right) \quad (12)$$

where $\mu = \frac{a_2}{a_1 (a_4)^2} > 0$.

Equation (12) illustrates that aid affects growth through three channels:

(i) *crowding out* – the first term captures the impact of aid on growth through private investment (a_7) and the marginal productivity of private capital (δ_1);
(ii) *direct impact* – the second term captures the impact of aid on growth through public investment (a_3) and the marginal productivity of public capital (δ_2); and
(iii) *crowding in* – the last term captures the impact of aid on growth through the interactive effect of public and private investment (a_5a_7) and the marginal productivity of public capital (δ_2).

In sum, equation (12) captures the impact of aid on growth through the effect of aid on the private sector and the effect of aid fungibility on the productivities of public and private capitals which, in turn, depend on the soundness of the government's policy management.

As an approach to measure aid effectiveness the empirical estimation of the RFM is beset with problems. As mentioned in Section 1, there is no uniform way to generate the target values of the fiscal aggregates and the 3 SLS estimation techniques employed to solve the FRMs tend not to be robust to changes in data or model specification. The suggestion by Osei *et al.* (2003) to circumvent those methodological problems by estimating the FRM within a vector autoregression (VAR) modelling framework amounts to analysing the relationships among the arguments in the utility function and ignoring growth. Whereas the VAR approach can help ask and find answers to some kinds of questions the omission of growth makes the analysis incomplete. M'Amanja *et al*. (2005) address that drawback by explicitly adding the growth rate among the variables in a VAR framework.

The growth rate can be related to the five arguments in the utility function as follows. Taking the total differential of the production function (equation 5) and dividing both sides of the equation by Y yields the growth equation:

$$\frac{dY}{Y} = \frac{d\Gamma}{Y} + \theta_1 \frac{IG}{Y} + \theta_2 \frac{IP}{Y} + \theta_3 \frac{dL}{Y} \tag{13a}$$

where θ_1, θ_2 and θ_3 are the marginal products of, respectively, public capital, private capital and labour. Following Feder (1982) and Lloyd *et al*. (2001), we assume that the marginal product of labour (θ_3 or $\partial Y/\partial L$) is proportional to its corresponding average product (Y/L). Upon substituting Y/L for θ_3 in equation (13a) we obtain

$$\frac{dY}{Y} = \frac{d\Gamma}{Y} + \theta_1 \frac{IG}{Y} + \theta_2 \frac{IP}{Y} + \frac{dL}{L} \tag{13b}$$

$$\frac{dY}{Y} = \frac{d\Gamma}{Y} + \theta_1 \frac{IG}{Y} + \theta_2 \frac{IP}{Y} + \theta_0 \tag{13c}$$

where θ_0 is used to capture the assumed constant rate of labour supply.

We also assume that the change in total factor productivity is influenced by the level of economic intervention by government, among other things.

$$d\Gamma = \pi_1 CG + \pi_2 TR + \eta \tag{14}$$

where $d\Gamma$ is the change in total factor productivity, CG and TR are as defined before, and η captures other factors affecting productivity that are beyond the control of the government.

Substituting equation (14) into equation (13c) and collecting terms yields the long-run output growth path:

$$\frac{dY}{Y} = \gamma_1 \frac{CG}{Y} + \gamma_2 \frac{IG}{Y} + \gamma_3 \frac{TR}{Y} + \gamma_4 \frac{IP}{Y} + \gamma_0 \tag{15}$$

where $\gamma_0 = \theta_0 + \eta/Y$. Thus incorporating the growth rate in the empirical RFM would require expressing all the arguments as proportions of national output or gross domestic product GDP. This means the set of variables to be analysed is {dY/Y, CG/Y, IG/Y, TR/Y, IP/Y, AF/Y, BD/Y}. The set of seven variables are re-labelled as:

dY/Y = **DYY** the percentage growth rate of GDP;
CG/Y = **CGY** the percentage share of government consumption expenditure in GDP;
IG/Y = **IGY** the percentage share of government investment expenditure in GDP;
TR/Y = **TRY** tax revenue as a percentage of GDP;
IP/Y = **IPY** the percentage share of private investment expenditure in GDP;
AF/Y = **AFY** foreign aid as a percentage of GDP; and
BD/Y = **BDY** domestic borrowing as a percentage of GDP.

Hence, in matrix notation, the set of seven variables to be analysed in a VAR framework is the vector **X** = (DYY CGY IGY TRY IPY AFY BDY)'.

In anticipation of the issue of the number of different ways in which the variables are related in the long run, our theoretical exposition so far suggests to expect two. One of them is the 'output growth path' depicted by equation (15). The other long run relationship reiterates the fiscal impact of aid estimated as the relationship among the five arguments of the utility function in the RFM, namely, CG, IG, TR, AF and BD. In their respective VAR frameworks, both Osei *et al*. (2003) and M'Amanja *et al*. (2005) normalised on domestic borrowing BD. We follow their approach in this study. Thus the long run output growth relationship and aid-fiscal aggregates relationship may be represented, respectively, with equations (16) and (17).

$$DYY = \gamma_{11}CGY + \gamma_{12}IGY + \gamma_{13}TRY + \gamma_{14}IPY + \gamma_{10} \quad (16)$$

$$BDY = \gamma_{21}CGY + \gamma_{22}IGY + \gamma_{23}TRY + \gamma_{24}AFY + \gamma_{20} \quad (17)$$

3. THE ANALYTICAL METHOD: THE MULTIVARIATE COINTEGRATION MODEL

We employ the vector autoregression (VAR) approach which has become quite standard in time series modelling because, compared to the structural approach, it sidesteps the need to provide a dynamic theory specifying the relationships among the jointly determined variables; also it can handle endogenous variables on both sides of the equation as well as a mix of I(1) and I(0) variables in one system. In a VAR system, each variable is regressed on its own lags plus the lags of the other variables. The appropriate lag length (p), which should be specified long enough for the residuals not to be serially correlated, can be determined using standard model selection criteria such as the AIC, SBC and HQC. The VAR model can also be used to test for weak exogeneity and parameter restrictions.

Assume $\mathbf{X_t}$ is a vector of k jointly determined endogenous variables and $\mathbf{W_t}$ is a vector of m exogenous variables. A p^{th} order VAR model of the inter-related time series, VAR(p), can be written as:

$$X_t = \sum_{i=1}^{p} \Phi_i X_{t-i} + \Psi W_t + \varepsilon_t \quad (18)$$

where Φ_i and Ψ are matrices of coefficients to be estimated, and ε_t is a vector of independent and identically distributed disturbances. If the endogenous variables are each I(1) we can write the VAR(p) model as a vector error correction model (VECM):

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \Psi W_t + \varepsilon_t \quad (19)$$

where $\Pi = \sum_{i=1}^{p} \Phi_i - I$, and $\Gamma_i = -\sum_{j=i+1}^{p} \Phi_j$

Granger's Representation Theorem asserts that if the coefficient matrix Π has reduced rank (i.e., rank(Π) = r < k) then there exist k-by-r matrices α and β each with rank r such that Π = αβ' and β'$\mathbf{X_t}$ is I(0). The rank r is the number of cointegrating relations and each column of β is the cointegrating vector (CV). The Johansen maximum likelihood estimation procedure (Johansen, 1988, 1990, 1991, 1995a; Johansen and Juselius, 1990) can be used to estimate the two matrices α and β and test for the number of distinct CVs. Restrictions on the elements of β help to determine which variables are relevant in the long-run relations; economic theory may have to be invoked to decide on the restrictions to impose on each CV (Johansen, 1995b). The elements of α are known as the adjustment parameters in the VECM. Restrictions on the adjustment parameters help to determine which variables are weakly exogenous.

The impulse response functions (IRFs) generated from the VAR model trace out the time paths of the effect of a shock in a nominated variable on each of the other variables in the system. From them we can determine the extent to which an exogenous shock causes short-run and long-run changes in the respective variables. These concepts are amply described in texts such as Enders (1995), Hamilton (1994), Harris (1995) and Johnston and Di Nardo (1997).

4. DATA SOURCES AND DESCRIPTION

The variables required for the model have been described in Section 2. The underlying data on these were obtained from the *World Development Indicators*, 2005. The series start in 1960 but because there were no data on foreign aid prior to 1965, we were forced to utilise the dataset from 1965 to 2004 on all the variables. The underlying data (real GDP or output Y, government consumption CG, government investment IG, tax revenue TR, private investment IP, foreign aid made up of grant aid and loan aid AF and domestic borrowing BD) and the constructed variables (growth rate of output DYY, government consumption as share in output CGY, government investment as share in output IGY, tax revenue as share in output TRY, private investment as share in output IPY, foreign aid as share in output AFY and domestic borrowing as share in output BDY) are reported in Appendix Tables A1 and A2, respectively. Further, the underlying data are plotted in Figure 1 and the constructed variables plotted in Figures 2 and 3.

Figure 1

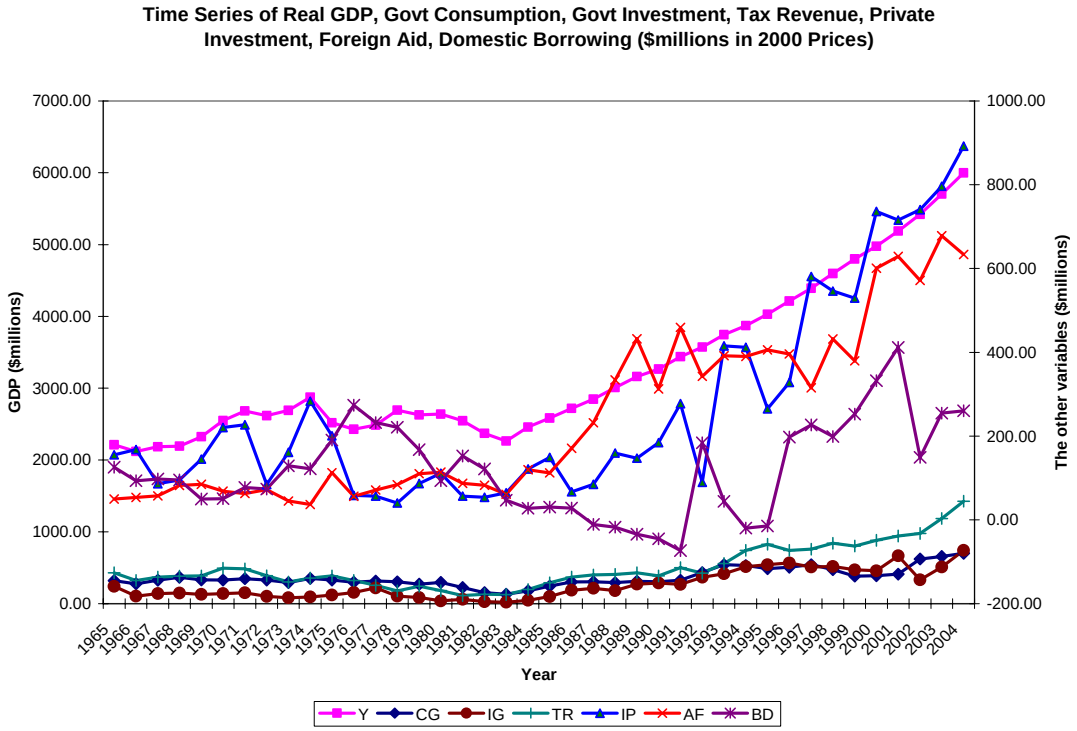


Figure 2

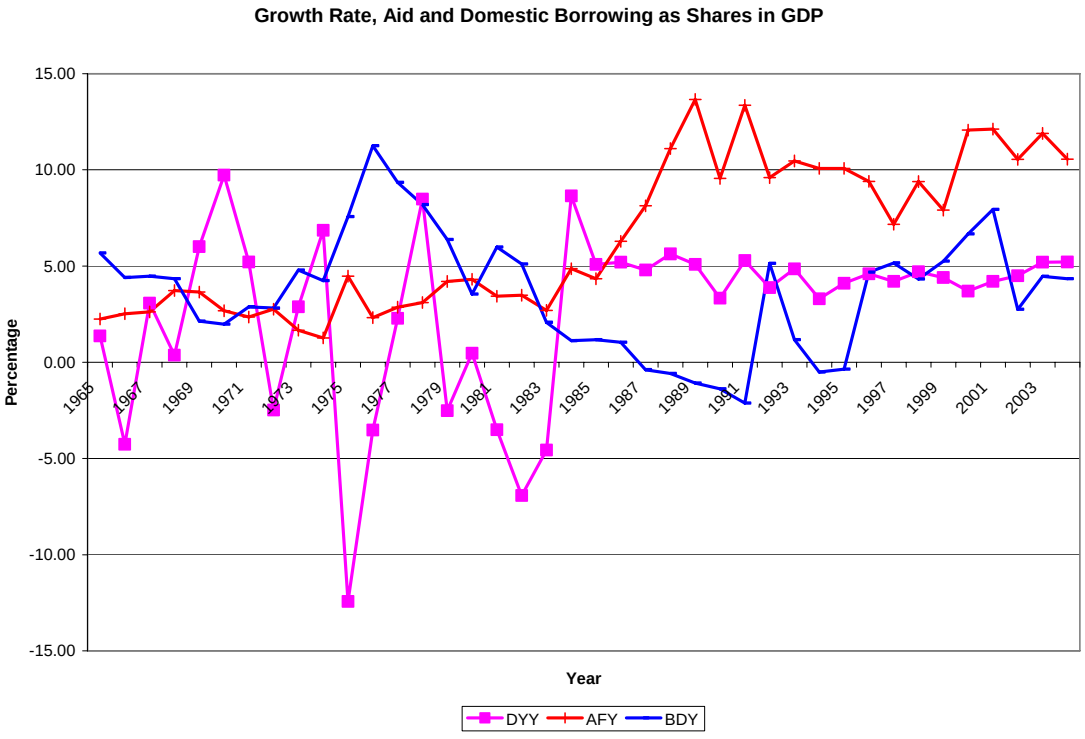
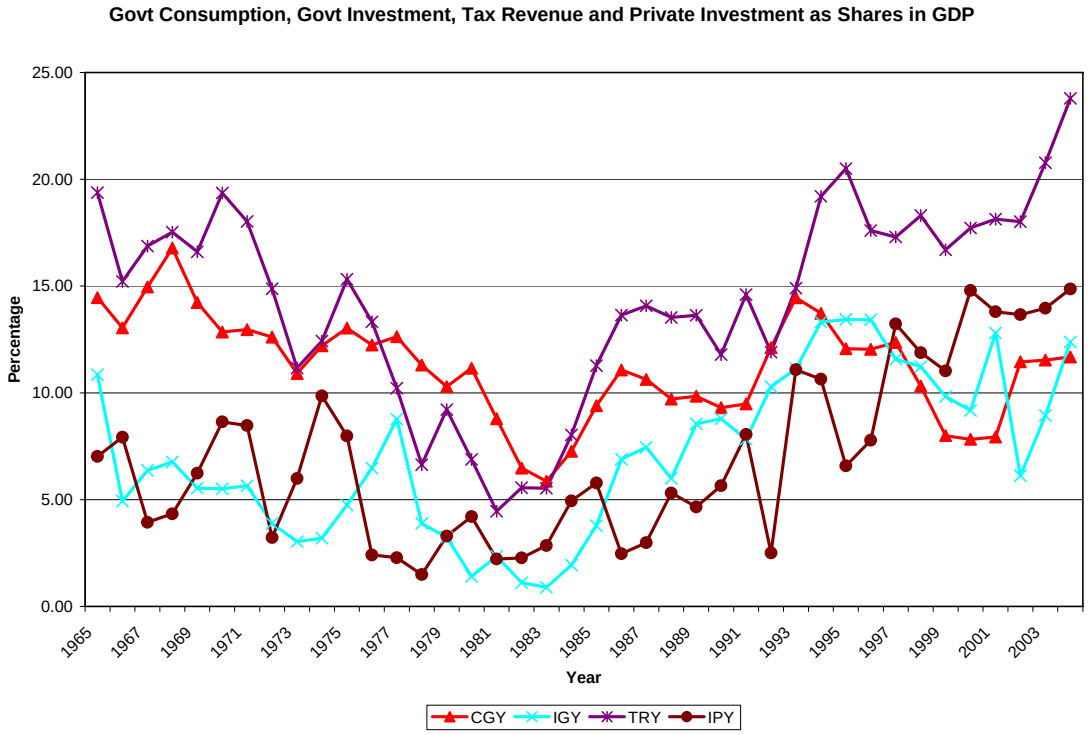


Figure 3



With reference to Figure 1, it can be observed that after sluggish performances reaching low points in the early 1980s, most of the macroeconomic variables experienced an upturn starting from about the mid-1980s; the upturn in domestic borrowing, however, was delayed till about a decade later. Ghana's poor economic performance is generally blamed on corruption, macroeconomic mismanagement, chronic overvaluation of its currency and anti-agricultural bias in economic policies (Lloyd *et al*., 2001). In a fairly comprehensive description of Ghana's economic history, Aryeetey and Fosu (2004) note that the decline set in around the mid-1960s and was only arrested and reversed when Ghana adopted the World Bank's Economic Recovery Program/Structural Adjustment Program (ERP/SAP) starting from 1983/84. As Figure 2 shows, prior to 1985, the growth rate exhibited wide swings and reached the all-time low point of negative 12.43% in 1975 but since 1985 has hovered between 3.3% and 5.63%. It is also worthy of note that during the study period, Ghana experienced no less than five military *coups d'état* that sometimes led to significant changes in policy. Concerning foreign aid, it will be noticed that after remaining under 5% of GDP for the first two decades in the series, the variable has risen to levels between 6% and 14% since 1986.

An examination of the trends in Figures 2 and 3 shows that whereas the plots of the shares in output of government consumption, government investment, tax revenue and private investment are U-shaped, that of domestic borrowing seems approximately cubic.

The summary statistics and bivariate correlations between the variables are presented in Table 1. In Ghana, between 1965 and 2004 real growth rate has averaged 2.66% per annum. The average shares in GDP of the constructed variables are as follows: government consumption, 11.22% per annum; government investment, 7.09% per annum; tax revenue, 14.35% per annum; private investment, 7.01% per annum; foreign aid, 6.47% per annum; and domestic borrowing, 3.65% per annum. The economic growth variable DYY has positive correlation with all the other variables except domestic borrowing BDY with which it also happens to have its strongest correlation: growth and domestic borrowing are strongly inversely related. Foreign aid, AFY is also positively correlated with all the other variables except government consumption CGY. AFY correlates very strongly with government investment IGY and private investment IPY. Domestic borrowing is negatively correlated with all the other variables except with government consumption.

Table 1
Summary Statistics and Bivariate Correlations of the Variables

				Correlation with:						
Variable	Mean	Min	Max	DYY	CGY	IGY	TRY	IPY	AFY	BDY
DYY	2.66	-12.43	9.72	1.000						
CGY	11.22	5.86	16.78	0.053	1.000					
IGY	7.09	0.90	13.44	0.342	0.271	1.000				
TRY	14.35	4.46	23.78	0.315	0.483	0.733	1.000			
IPY	7.01	1.49	14.87	0.297	0.034	0.543	0.709	1.000		
AFY	6.47	1.26	13.66	0.347	-0.235	0.653	0.413	0.517	1.000	
BDY	3.65	-2.13	11.25	-0.376	0.083	-0.058	-0.104	-0.009	-0.393	1.000

5. EMPIRICAL RESULTS

5.1 Pre-Analysis Tests

To preclude spurious regression (Granger and Newbold, 1974) and to ascertain that long-run relationships do exist among the variables, we checked the order of integration of each of the series via the well-known Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests and implemented the Johansen cointegration test. The ADF and PP unit root test results, reported in Table 2, indicate each of the constructed variables is integrated of order one (i.e., each variable is I(1)).

Table 2
Results of the Unit Root Tests

Variables	ADF		PP	
	Levels	1st Differences	Levels	1st Differences
DYY	-3.3995 (-3.5443)	-2.9275 (-2.6174)*	-4.8326 (-3.5298)	-23.508 (-2.9411)
CGY	-2.8798 (-3.5331)	-5.2780 (-2.9434)	-2.2920 (-2.9390)	-4.9010 (-2.9411)
IGY	-3.2768 (-3.5298)	-7.8183 (2.9411)	-3.2811 (-3.5298)	-7.8183 (-2.9411)
TRY	-1.6220 (-3.5298)	-5.6585 (-2.9411)	-1.5475 (-3.5298)	-5.6492 (-2.9411)
IPY	-1.1731 (-3.5366)	-8.3005 (-2.9434)	-2.8449 (-3.5298)	-10.289 (-2.9411)
AFY	-0.8541 (-2.9411)	-9.7495 (-2.9411)	-3.1158 (-3.5298)	-9.6697 (-2.9411)
BDY	-2.4889 (-2.9390)	-6.9504 (-2.9411)	-2.4889 (-2.9390)	-7.2355 (-2.9411)

Notes
Figures in brackets are the corresponding 5% test critical values except where the asterisk (*) indicates the 10% test critical value.

To account for the potential influences of important exogenous factors, two deterministic variables were incorporated in the model: (i) DV8404 – a dummy variable to capture the post-ERP/SAP period, and (ii) COUP to capture the years of military rule. A general-to-specific modelling approach (Charemza and Deadman, 1997) led to the selection of a VAR model of order 2 (i.e., VAR(2)). A variable exclusion/inclusion test recommended to retain the exogenous variables DV8404 and COUP. At the 5% level of significance, the maximal eigenvalue test statistic of the Johansen cointegration test indicates there are two cointegrating relationships whilst the trace test statistic indicates there are three cointegrating relationships among the variables (see Table 3).

Table 3
The Johansen Cointegration Test Results

Eigenvalue	Null hyp	Maximal Eigenvalue (λ_{max})			Trace Test (λ_{trace})		
		Test stat	5% CV	10% CV	Test stat	5% CV	10% CV
0.84924	r = 0	71.8982	48.5700	45.7500	215.0147	140.0200	134.4800
0.74239	r≤ 1	51.5401	42.6700	39.9000	143.1166	109.1800	104.2700
0.59443	r≤ 2	34.2939	37.0700	34.1600	91.5765	82.2300	77.5500
0.50219	r≤ 3	26.5061	31.0000	28.3200	57.2826	58.9300	55.0100
0.49486	r≤ 4	25.9511	24.3500	22.2600	30.7764	39.3300	36.2800
0.10847	r≤ 5	4.3628	18.3300	16.2800	4.8254	23.8300	21.2300
0.01210	r≤ 6	0.4625	11.5400	9.7500	0.4625	11.5400	9.7500

From the theoretical discussion expounded in Section 2 we expected two cointegrating relationships and therefore we decided on two cointegrating vectors. In the subsequent empirical cointegrating VAR model, the first cointegrating vector CV1 reflecting the growth relation (equation (16)) was normalised on DYY and had zero restrictions placed on AFY and BDY. The second cointegrating vector CV2 reflecting the aid-fiscal aggregates relation (equation (17)) was normalised on BDY and had zero restrictions placed on DYY and IPY. In the notation of Granger's Representation Theorem, and with reference to the arrangement of the variables in our vector of endogenous variables X = (DYY CGY IGY TRY IPY AFY BDY)', the β matrix containing the two CVs can be written as:

$$\beta' = \begin{pmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & \beta_{16} & \beta_{17} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} & \beta_{26} & \beta_{27} \end{pmatrix}'$$

And the restrictions on the β elements to reflect the growth relation and fiscal relation can be represented as:

$$\beta' = \begin{pmatrix} 1 & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} & 0 & 0 \\ 0 & \beta_{22} & \beta_{23} & \beta_{24} & 0 & \beta_{26} & 1 \end{pmatrix}'$$

The Microfit 4 software (Pesaran and Pesaran, 1997, 1998) was used for the Johansen cointegration test and to estimate the cointegrating VAR model.

5.2 The Cointegrating (or Long-Run) Relations

Given the foregoing discussions/explanations the empirical model estimated is a restricted VAR(2) with two cointegrating relationships driven by the growth path and fiscal response path. Normalising on growth rate DYY and domestic borrowing BDY the two long-run relationships were estimated to be:

DYY = 6.1904 CGY – 2.5921 IGY – 1.89 TRY + 3.9495 IPY
(1.71) (1.32) (none) (none)

BDY = 0.1910 CGY + 0.2751 IGY – 0.0742 TRY – 0.6133 AFY
(0.39) (0.29) (0.09) (0.21)

The figures in parentheses are standard errors. In the equation for DYY, the long-run parameters suggest that government consumption CGY and private investment IPY

promote growth whilst government investment IGY and taxation TRY detract from growth. The signs of the coefficients are explicable if the variable CGY is understood to encompass government recurrent and development expenditures and the long gestation periods or non-profitability of government investments underlie the negative influence of IGY on growth. The negative coefficient of TRY suggests that taxation in Ghana is distortionary, in the sense that it is not growth-enhancing.

With respect to the equation for BDY, the long-run parameters suggest that government consumption and capital expenditures worsen the budget deficit whilst taxation and foreign aid improve the budget. These results are consistent with the findings by Osei *et al*. (2003).

5.3 The Error Correction Models (or Short-Run Relations)

The vector error correction models (VECMs) are reported in Table 4. The incidental diagnostics do not reveal any serious modelling deficiencies. The negative signs of the coefficients of the error correction terms ECT1(-1) in the equation for ΔDYY and ECT2(-1) in the equation for ΔBDY accord with *a priori* expectations and indicate the model is dynamically stable. Their relative magnitudes, however, suggest that an imbalance in the long-run growth relationship is corrected much faster than that in the fiscal relationship.

An examination of the coefficients of the lagged differences in Table 4 suggests that in the case of the growth relationship, changes in IGY, TRY and AFY from the previous period do not significantly impact the growth rate in the current period whereas those in CGY, IPY and BDY do impact the growth rate significantly and negatively. The upshot is that, in the short run, an increase in the growth rate in one year is likely to be followed by a decrease in the next, and the growth rate is lowered by increases in government consumption, private investment and domestic borrowing. In the case of the fiscal relationship, changes in DYY, CGY, TRY and IPY from the previous period do not significantly impact BDY but those in IGY and AFY do – foreign aid increases and government investment decreases domestic borrowing in the short run. An increase in AFY in one year is likely to be followed by a further increase in the next year.

The coefficients of DV8404 suggest that the ERP/SAP policies boosted the growth rate significantly and discouraged borrowing, albeit insignificantly. The era of structural adjustment also saw increases in the other variables. And from the coefficients of the deterministic variable COUP it can be inferred that the effect of military regimes on changes in all the variables is marginal except in the case of foreign aid which is positive and significant. This latter observation is puzzling in that foreign aid as a proportion of GDP increased relatively more during military regimes than during non-military regimes. Military regimes are characterised by statistically insignificant reductions in the growth rate, government consumption, private investment and domestic borrowing and statistically insignificant increases in government investment and tax effort. Finally, with

reference to the coefficients of the variable Trend, it can be inferred that after accounting for the structural adjustment policies and military coups, the model indicates that the growth rate has been trending downwards and domestic borrowing as a share of GDP has been trending upwards. These results are a cause for concern.

Table 4
The Error Correction Models

Regressor	Dependent Variable						
	ΔDYY	ΔCGY	ΔIGY	ΔTRY	ΔIPY	ΔAFY	ΔBDY
ECT1(-1)	-0.2286 (0.12)*	0.0689 (0.03)**	-0.1366 (.04)***	-0.1117 (0.04)**	0.0417 (0.07)	0.0173 (0.04)	-0.0283 (0.05)
ECT2(-1)	1.4885 (.47)***	0.3569 (0.13)**	-0.0369 (0.16)	0.2225 (0.18)	0.0294 (0.28)	0.1116 (0.17)	-0.6784 (.21)***
ΔDYY(-1)	-0.3725 (0.16)**	0.0059 (0.05)	0.1611 (.06)***	0.1292 (0.06)**	0.0635 (0.10)	-0.0071 (0.06)	0.0690 (0.07)
ΔCGY(-1)	-1.8241 (0.71)**	0.2944 (0.20)	-0.2299 (0.24)	-0.3348 (0.27)	0.0966 (0.42)	-0.0021 (0.26)	0.0567 (0.31)
ΔIGY(-1)	0.8157 (0.50)	-0.2370 (0.14)	-0.5697 (.17)***	-0.1794 (0.19)	0.0879 (0.30)	-0.2104 (0.18)	-0.4740 (0.22)**
ΔTRY(-1)	-0.6605 (0.52)	0.2857 (0.15)*	0.5167 (.17)***	0.2768 (0.20)	-0.4669 (0.31)	0.2047 (0.19)	0.1232 (0.23)
ΔIPY(-1)	-0.6069 (0.32)*	0.0808 (0.09)	-0.1024 (0.11)	0.1800 (0.12)	-0.0794 (0.19)	0.0950 (0.12)	-0.1533 (0.14)
ΔAFY(-1)	-0.4581 (0.52)	-0.2623 (0.15)*	0.1916 (0.18)	-0.5773 (.20)***	-0.3666 (0.31)	-0.6767 (.19)***	0.7288 (.23)***
ΔBDY(-1)	-1.1236 (0.49)**	0.1245 (0.14)	0.5176 (.16)***	0.1201 (0.18)	0.1320 (0.28)	-0.0928 (0.17)	0.4207 (0.21)*
DV8404	23.6415 (5.6)***	2.7333 (1.59)*	3.9897 (1.89)**	5.5486 (2.15)**	1.4944 (3.33)	1.3355 (2.05)	-3.2928 (2.46)
COUP	-3.0316 (2.17)	-0.2309 (0.61)	0.9293 (0.73)	1.2212 (0.83)	-1.0331 (1.29)	1.8130 (0.79)**	-0.4183 (0.95)
Trend	-0.8784 (.26)***	-0.2205 (.07)***	0.0039 (0.09)	-0.0639 (0.10)	-0.0687 (0.15)	-0.0347 (0.09)	0.2200 (0.11)*
Intercept	-9.3822 (6.90)	3.9286 (1.95)*	-7.7289 (2.3)***	-7.4849 (2.6)***	2.8561 (4.08)	-0.5717 (2.52)	-0.3884 (3.02)
Diagnostics							
R^2	0.5290	0.5053	0.6423	0.5981	0.4200	0.4608	0.5019
Adjust'd R^2	0.3030	0.2679	0.4706	0.4051	0.1416	0.2020	0.2628
Serial correlation[a]	$\chi^2_{(1)}$ =4.5 [0.034]	$\chi^2_{(1)}$=7.2 [0.007]	$\chi^2_{(1)}$=.01 [0.927]	$\chi^2_{(1)}$=.04 [0.839]	$\chi^2_{(1)}$ =.38 [0.537]	$\chi^2_{(1)}$=.34 [0.561]	$\chi^2_{(1)}$=1.7 [0.197]
Functional form[b]	$\chi^2_{(1)}$=.91 [0.339]	$\chi^2_{(1)}$=.49 [0.483]	$\chi^2_{(1)}$=4.4 [0.036]	$\chi^2_{(1)}$=6.6 [0.010]	$\chi^2_{(1)}$ =4.8 [0.029]	$\chi^2_{(1)}$=.29 [0.588]	$\chi^2_{(1)}$=8.6 [0.003]
Normality[c]	$\chi^2_{(2)}$=1.8 [0.413]	$\chi^2_{(2)}$=.11 [0.948]	$\chi^2_{(2)}$=.80 [0.672]	$\chi^2_{(2)}$=3.6 [0.166]	$\chi^2_{(2)}$ =1.9 [0.388]	$\chi^2_{(2)}$=.71 [0.413]	$\chi^2_{(2)}$=1.3 [0.522]
Heteroske-dasticity[d]	$\chi^2_{(1)}$=1.9 [0.173]	$\chi^2_{(1)}$=2.2 [0.138]	$\chi^2_{(1)}$=.55 [0.457]	$\chi^2_{(1)}$=.11 [0.743]	$\chi^2_{(1)}$=.004 [0.952]	$\chi^2_{(1)}$ =1.0 [0.307]	$\chi^2_{(1)}$ =1.9 [0.165]

Notes
Δ = First-difference operator. Figures in parentheses below coefficients are standard errors.
*, **, and *** indicate, respectively, statistically significant estimates at the 10%, 5% and 1% levels.
[a] Lagrange multiplier test of residual serial correlation (H_0: no serial correlation).
[b] Ramsey's RESET test using the square of the fitted values (H_0: correct functional form).
[c] Based on a test of skewness and kurtosis of residuals (H_0: normal distribution).
[d] Based on the regression of squared residuals on squared fitted values (H_0: homoskedasticity).
Figures in square brackets below chi-squared test statistics are probability values.

5.4 Analysis of the Dynamic Properties of the Model

This subsection reports the responses of the variables to a shock in a nominated variable. The selection of the variable to be shocked must be buttressed by exogeneity properties, that is, weak, strong or super exogeneity (Ericsson, 1992). A test of weak exogeneity is a test that the two coefficients of the error correcting terms for a particular variable are both equal to zero. Weak exogeneity is required for efficient estimation and testing of parameters. The results of likelihood ratio (LR) tests of weak exogeneity (implemented with EViews 5) for the variables are presented in Table 5 where it will be seen that AFY, CGY, IPY and BDY are deemed weakly exogenous whilst DYY, IGY and TRY are deemed not to be weakly exogenous. Strong exogeneity is the conjunction of weak exogeneity and Granger noncausality; it insures valid conditional forecasting. Super exogeneity is the conjunction of strong exogeneity and invariance, a concept not strictly relevant for our inquiry.

Table 5
Results of the Likelihood Tests of Weak Exogeneity

Variable	Test statistic: $\chi^2_{(2)}$	p-value	Decision
DYY	30.3114	0.000	Not weakly exogenous
CGY	2.0714	0.355	Weakly exogenous
IGY	10.9486	0.004	Not weakly exogenous
TRY	8.5250	0.014	Not weakly exogenous
IPY	4.2063	0.122	Weakly exogenous
AFY	0.7500	0.687	Weakly exogenous
BDY	4.4048	0.111	Weakly exogenous

In addition to the weak exogeneity test, a LR test of Granger noncausality revealed that there is bi-causality between each variable and the corresponding complementary block of variables in the system except between AFY and the set of the other variables. The chi-squared $\chi^2_{(12)}$ test statistic for AFY being noncausal for the others as a cluster of

variables is 33.9142 with a p-value of 0.001; that for the others being jointly noncausal for AFY is 11.9565 with a p-value of 0.449. This means that whereas AFY Granger-causes the other variables taken as a block, the other variables as a block do not jointly Granger-cause AFY. Hence, AFY is characterised by both weak exogeneity and Granger noncausality, implying AFY is strongly exogenous, the only variable to be classified as such. This justifies the generation and interpretation of impulse response functions via innovations in foreign aid AFY.

'Persistence profiles' show the effects of system-wide or variable-specific shocks on the cointegrating (or long-run) relations and how quickly they converge to their respective equilibria. The profiles of the two cointegrating relations (CV1 = the growth path or relation, and CV2 = the fiscal response path or relation) in response to system-wide shocks are shown in Figure 4 where it will be seen that the fiscal response relation takes about two years to reach its equilibrium whereas the growth relation takes up to five years. The generalised impulse responses of the cointegrating relations to one standard error shock in foreign aid are depicted in Figure 5. Whereas the convergence of the fiscal response relation to its long-run equilibrium is smooth and virtually complete by the second year, the growth path is erratic, exhibiting gyrations or wide swings between the first year and fourth year before tapering off and stabilising in the sixth year.

The generalised impulse responses to one standard error shock in the equation for foreign aid by economic growth (DYY) and government consumption (CGY) are plotted in Figure 6; those for private investment (IPY), government investment (IGY), tax revenue (TRY) and domestic borrowing (BDY) are plotted in Figure 7. In Figure 6, it will be seen that following a shock in foreign aid, government consumption immediately falls and remains depressed for the first year before rising past the pre-shock level by the second year and stabilising at a level slightly higher than the pre-stimulus level. The impact effect of aid on growth is negative but this is quickly reversed in the next couple of years and after a slowdown in the third year growth picks up and stabilises at a much higher level from the fourth year onwards.

With reference to Figure 7, it can be seen that the impact effects of aid on tax revenue, private investment and government investment are positive. It takes about a year for domestic borrowing to respond (positively) to the shock in aid but the variable falls drastically in the second year and after a marginal increase in the third year it falls in three consecutive years to stabilise at a level significantly lower than the pre-shock level. This evidence suggests that foreign aid displaces domestic borrowing. After the positive contemporaneous response to an innovation in aid, both tax revenue and private investment fall drastically within the first year. Thereafter, the two variables behave differently. Tax revenue recovers partly over the next four years to stabilise at a level below its pre-shock level. For its part, private investment over-compensates in the second year for the initial reduction but falls again in the next couple of years to stabilise at a level lower than its pre-shock value. These pieces of evidence suggest that foreign aid

crowds out both tax effort and private investment in Ghana. Concerning government investment, following the positive impact effect, the variable rises further in the first year but falls drastically in the third year only to recover partly over the next fours years to stabilise at a level below its pre-shock level.

Figure 4

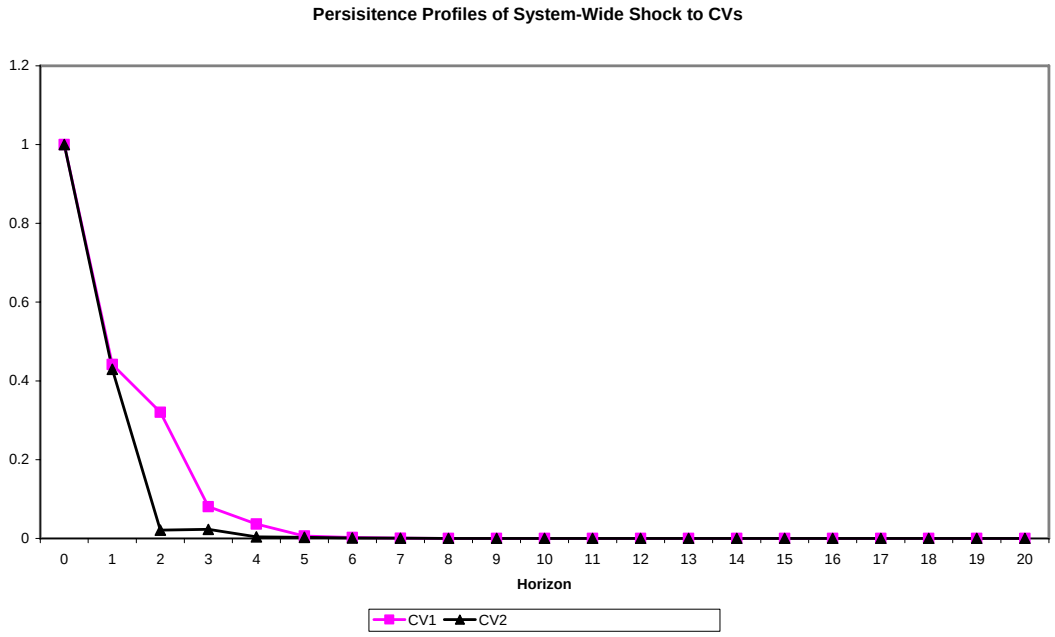


Figure 5

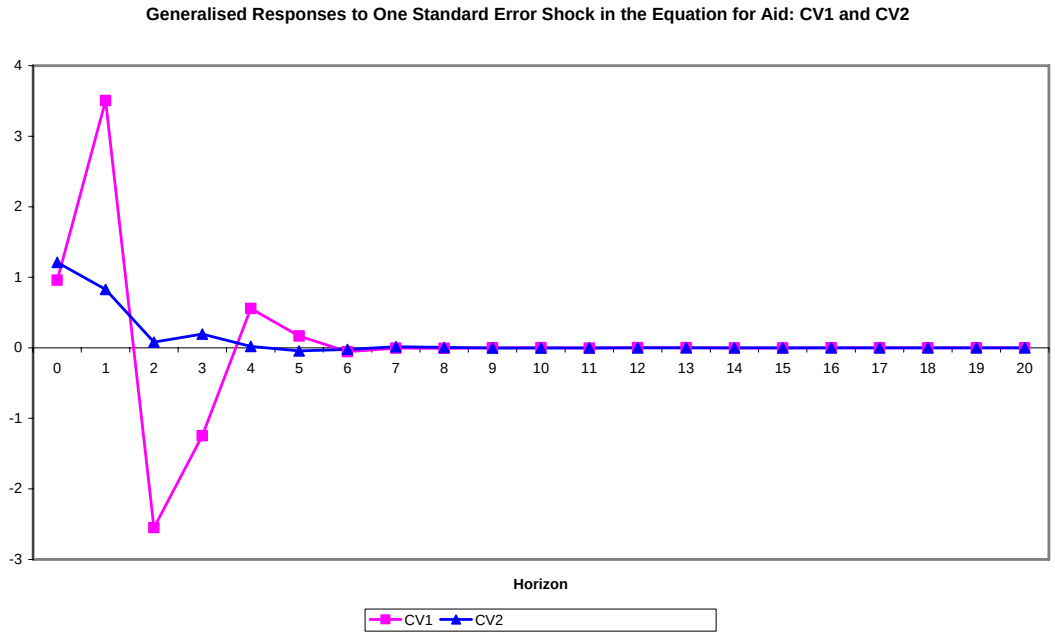


Figure 6

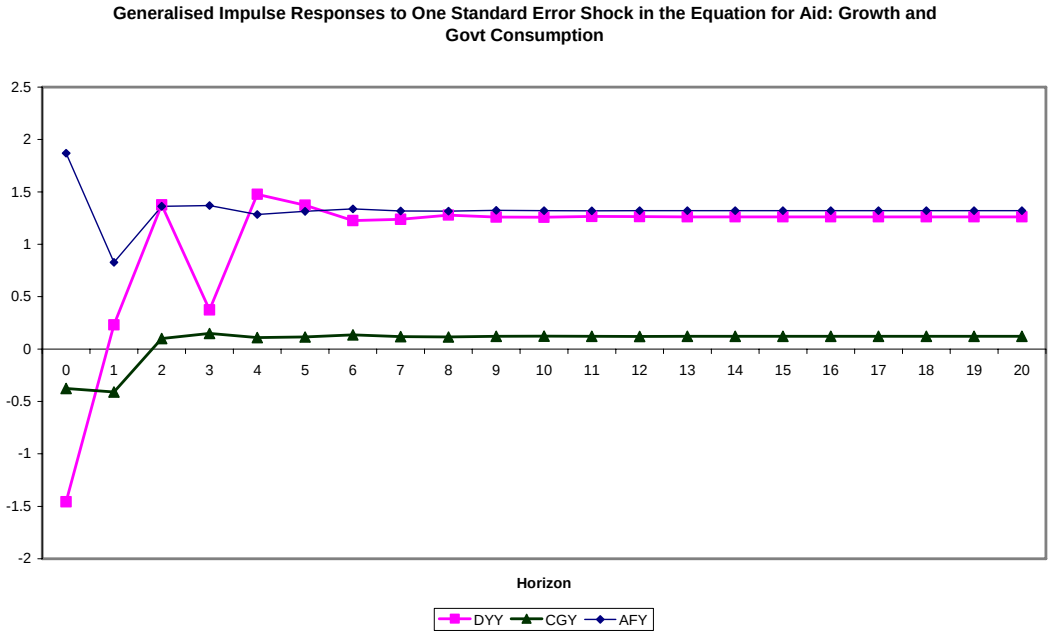
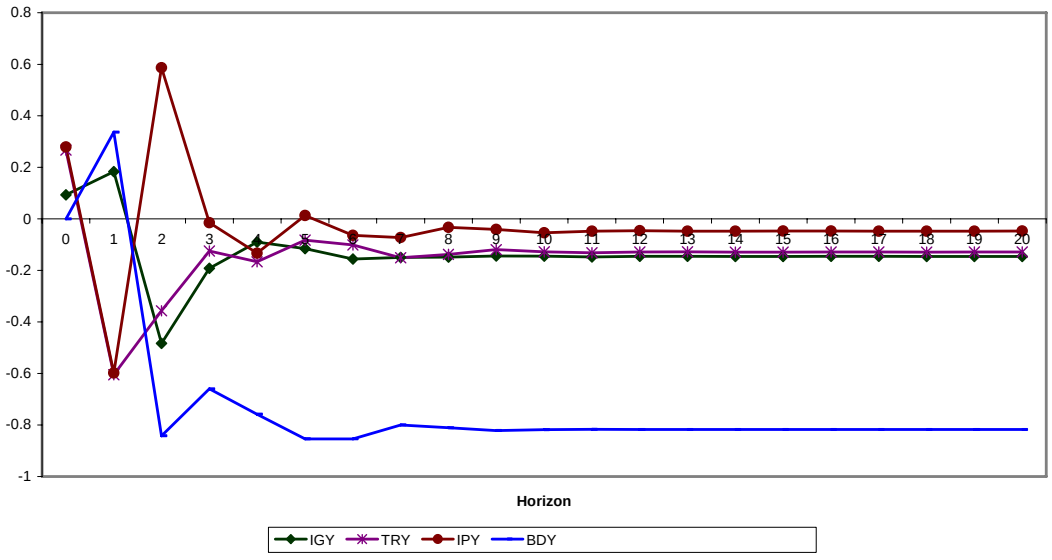


Figure 7



6. SUMMARY AND CONCLUSIONS

This study contributes to the empirical aid effectiveness literature. It does this by setting out to estimate the relationship among foreign aid, fiscal aggregates and economic growth in Ghana using multivariate cointegration techniques on data covering the period from 1965 to 2004. The underlying model is the fiscal response model. Contextually, it extends an earlier study that looked at the relationship between aid and fiscal aggregates and which used a slightly shorter time series dataset and did not account for the influence of the economic recovery program started in 1983/84 and the potential effects of military regimes. The cointegrating VAR model suggested there are two dimensions to the long run relationships: one driven by the growth relation and the other driven by the fiscal relation. We discovered that in the growth relation, government consumption (made up of recurrent and development expenditures) and private investment (expressed as shares of GDP) increase the growth rate, whilst government investment and taxation detract from growth. Taxation in Ghana may be said to be distortionary or not growth-enhancing. With respect to the fiscal relation, we found out that government consumption and capital expenditures worsen the budget deficit whilst taxation and foreign aid improve the fiscal position, as expected. These latter findings are consistent with what an earlier study found. The results of the vector error correction model suggest that the variables behave quite differently in the short run compared to the long run. The period of economic recovery and structural adjustment programs have coincided with a period of relatively high growth rates. Apart from being characterised by markedly larger aid-GDP ratios, years of military rule did not witness significant differences in the other variables.

In connection with the short-run dynamics of the empirical model, we discovered from the generalised impulse responses to one standard error shock in foreign aid that after initial gyrations, the growth rate and government consumption stabilise at levels higher than their respective pre-shock values, and government investment, tax revenue, private investment and domestic borrowing stabilise at levels lower than their respective pre-shock values. These findings suggest that foreign aid boosts government consumption expenditure and the growth rate of the economy whilst it induces reductions in government investment expenditure and tax effort, displaces domestic borrowing and crowds out private investment. The findings about aid's impact on tax effort and government capital expenditure in this study contradict those found by the previous study. Aid's positive influence on the GDP growth rate seems to derive from the incremental effect aid has on government consumption expenditure (which is a component of GDP). It can also be inferred from the long run positive effect of private investment on growth that the crowding out effect of aid on private investment is swamped by the positive joint effect of the other determinants of private investment. The negative effect of aid on private investment in Ghana is slight.

REFERENCES

Aryeetey, E. and Fosu, A. K. (2004) 'Economic Growth in Ghana: 1960-2000', Paper presented at the ISSER-University of Ghana-Cornell University International Conference on "Ghana at the Half Century", July 18-20, 2004, Accra, Ghana.

Burnside, C. and D. Dollar (2000), 'Aid, Policies and Growth', *American Economic Review*, Vol 90, No. 4, pp. 847-868.

Charemza, W. C. and Deadman, D. F. (1997) **New Directions in Econometric Practice: General to Specific Modelling, Cointegration and Vector Autoregression**, 2nd edition, Edward Elgar Publishing Ltd, Cheltenham, UK

Chenery, H. and W. Strout (1966), 'Foreign Assistance and Economic Development', *American Economic Review*, Vol 56, pp. 679-753.

Enders, Walter (1995), **Applied Econometric Times Series**, John Wiley & Sons, Inc., USA.

Ericsson, N. R. (1992) 'Cointegration, Exogeneity and Policy Analysis', *Journal of Policy Modeling*, Vol 14, No. 3, pp. 251-280.

Feder, G. (1982), 'On Exports and Economic Growth', *Journal of Development Economics*, Vol 12, pp. 59-73.

Feyzioglu, T., Vinaya, S. and Min, Z. (1998) 'A Panel Data Analysis of the Fungibility of Foreign Aid', *World Bank Economic Review*, Vol 12, No. 1, pp. 29-58.

Franco-Rodriquez, S., McGillivray, M. and Morrissey, O. (1998) 'Aid and the Public Sector in Pakistan: Evidence with Endogenous Aid', *World Development*, Vol 26, pp. 1241-1250.

Gang, I. and Khan, H. (1991) 'Foreign Aid, Taxes, and Public Investment', *Journal of Development Economics*, Vol 34, pp. 355-369.

Granger, C. W. J. and Newbold, P. (1974), 'Spurious Regressions in Econometrics', *Journal of Econometrics*, Vol 2 pp. 111-120.

Gupta, K. and Lensink, R. (1995) 'Foreign Aid and the Public Sector: A Simulation Approach', Paper presented at the ESRC study group, London, May 1995.

Hamilton, J.D. (1994), **Time Series Analysis**, Princeton University Press.

Hansen, H. and Tarp, F. (2000), 'Aid Effectiveness Disputed', *Journal of International Development*, Vol 12, No. 3, pp. 375-398.

Harris, R. (1995), **Using Cointegration Analysis in Economic Modelling**, Prentice Hall, Essex, England.

Heller, P. (1975) 'A Model of Public Fiscal Behaviour in Developing Countries: Aid, Investment, and Taxation', *American Economic Review*, Vol 65, No. 3, pp. 429-445.

Johansen, S. (1988) 'Statistical Analysis of Cointegration Vectors', *Journal of Economic Dynamics and Control*, Vol 12, No. 3, pp. 231-254.

Johansen, S. (1990), **The Power Function for the Likelihood Ratio Test for Cointegration**, Institute of Mathematical Statistics, University of Copenhagen, Copenhagen.

Johansen, S. (1991), 'Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models', *Econometrica*, Vol 59, No. 6, pp. 1551-1580.

Johansen, S. (1995a), **Likelihood-Based Inference in Cointegrated Vector Auto-Regressive Models**, Oxford University Press, Oxford.

Johansen, S. (1995b), 'Identifying Restrictions of Linear Equations with Applications to Simultaneous Equations and Cointegration', *Journal of Econometrics*, Vol 69, pp. 111-132.

Johansen, S. and Juselius, K. (1990), 'Maximum Likelihood Estimation and Inference on Cointegration With Application to the Demand for Money', *Oxford Bulletin of Economics and Statistics*, Vol 52, No. 2, pp. 169-211.

Johnston, J. and DiNardo, J. (1997), **Econometric Methods**, 4th edn, Singapore: McGraw-Hill.

Khilji, N. and Zampelli, E. (1991) 'The Fungibility of US Assistance to Developing Countries and the Impact on Recipient Expenditures: A Case Study of Pakistan', *World Development*, Vol 19, No. 8, pp. 1095-1105.

Khilji, N. and E. Zampelli (1994) 'The Fungibility of US Military and Non-Military Assistance and the Impacts on Expenditures of Major Aid Recipients', *Journal of Development Economics*, Vol 43, pp. 345–362.

Lloyd, T., Morrissey, O. and Osei, R. (2001) 'Aid, Exports and Growth in Ghana', CREDIT Research Paper No. 01/01, University of Nottingham.

M'Amanja, D., Lloyd, T. and Morrissey, O. (2005) 'Fiscal Aggregates, Aid and Growth in Kenya: A Vector Autoregressive (VAR) Analysis', CREDIT Research Paper No. 05/07, University of Nottingham.

McGillivray, M. and Morrissey, O. (2000) 'Aid Fungibility in Assessing Aid: Red Herring or True Concern?' *Journal of International Development,* Vol 12, No. 3, pp. 413-428.

McGillivray, M. and Morrissey, O. (2001) 'Fiscal Effects of Aid', WIDER Discussion Paper DP 2001/61, United Nations University, WIDER, Helsinki.

McGillivray, M., Feeny, S., Hermes, N. and Lensink, R. (2005) 'It Works; It Doesn't; It Can, But That Depends…', Research Paper No. 2005/54, United Nations University, WIDER, Helsinki.

Morrissey, O. (2001) 'Does Aid Increase Growth?', *Progress in Development Studies*, Vol 1, pp. 37-50.

Morrissey, O. (2002) 'Investment and Competition Policy in the WTO: Issues for Developing Countries', *Development Policy Review*, Vol 20, pp. 63-73.

Mosley, P., Hudson, J. and Horrell, S. (1987) 'Aid, the Public Sector and the Market in Less Developed Countries', *Economic Journal*, Vol 97, pp. 616-641.

Osei, R., Morrissey, O. and Lloyd, T. (2003) 'Modelling the Fiscal Effects of Aid: An Impulse Response Analysis for Ghana', CREDIT Research Paper No. 03/10, University of Nottingham.

Pack, H. and Pack, J. (1990) 'Is Foreign Aid Fungible? The Case of Indonesia', *Economic Journal*, Vol 100, pp. 188-194.

Pack, H. and Pack, J. (1993) 'Foreign Aid and the Question of Fungibility', *Review of Economics and Statistics*, Vol 75, No. 2, pp. 258-265.

Papanek, Gustav (1973) 'Aid, Foreign Private Investment, Savings and Growth in Less Developed Countries', *Journal of Political Economy*, Vol 81, pp. 120-130.

Pesaran, M. H. and Pesaran, B. (1997), **Working with Microfit 4.0: Interactive Econometric Analysis**, Oxford University Press, Oxford.

Pesaran, M. H. and Pesaran, B. (1998), 'Generalised Impulse Response Analysis in Linear Multivariate Models', *Economic Letters*, Vol 58, pp. 17-29.

Swaroop, V., Jha, S. and Rajkumar, A. (2000) 'Fiscal Effects of Foreign Aid in a Federal System of Governance: The Case of India', *Journal of Public Economics*, Vol 77, pp. 307-330.

Tsikata, T. (1998) 'Aid Effectiveness: A Survey of the Recent Empirical Literature', Paper on Policy Analysis and Assessment, IMF, Washington, D.C.

White, H. (1992) 'The Macroeconomic Impact of Development Aid: A Critical Survey', *Journal of Development Studies*, Vol 28, pp. 163-240.

Williamson, J. (1990) 'What Washington Means by Policy Reform', in J. Williamson, ed., **Latin American Adjustment: How Much Has Happened?**, Washington: Institute for International Economics.

Xayavong, V. (2002) 'A Macroeconometric Analysis of Foreign Aid in Economic Growth and Development in Least Developed Countries: The Case Study of Lao People's Democratic Republic', Unpublished PhD dissertation, Massey University, New Zealand.

Xayavong, V., Gounder, R. and Obben, J. (2005) 'Theoretical Analysis of Foreign Aid, Policies and State Institutions', Department of Applied and International Economics Discussion Paper, No. 05/01, Massey University, New Zealand.
http://econ.massey.ac.nz/publications/discuss/dp05-01.pdf

APPENDIX

Table A1

The Underlying Macroeconomic Variables (in constant US $millions, 2000=100)

Year	Y	CG	IG	TR	IP	AF	BD
1965	2213.00	320.00	240.19	428.71	155.49	49.82	125.75
1966	2118.76	276.29	104.62	322.28	167.86	53.47	93.38
1967	2183.92	326.71	139.11	368.54	86.05	57.02	97.72
1968	2191.98	367.81	148.20	384.11	95.11	81.83	95.16
1969	2323.63	330.65	128.84	385.92	145.11	84.65	49.63
1970	2549.57	327.62	140.29	493.55	220.48	68.25	50.56
1971	2682.56	347.66	151.63	483.42	227.15	62.93	77.23
1972	2615.83	329.86	101.54	389.08	84.19	72.12	73.78
1973	2691.28	293.62	81.85	300.56	161.17	44.78	128.95
1974	2875.70	351.12	91.77	357.24	283.50	36.35	122.00
1975	2518.21	328.12	119.67	385.62	200.90	112.67	190.62
1976	2429.31	297.35	157.25	323.78	58.48	56.34	273.38
1977	2484.55	313.80	217.99	253.93	56.80	71.14	232.39
1978	2695.14	304.55	104.62	178.78	40.11	83.82	220.89
1979	2627.36	270.36	85.17	242.05	86.66	110.35	167.57
1980	2639.75	294.60	37.24	181.78	111.11	113.80	93.51
1981	2547.28	223.91	59.89	113.59	56.52	87.39	152.41
1982	2370.92	153.64	26.33	131.75	53.81	82.70	121.25
1983	2262.71	132.60	20.26	125.22	64.59	60.99	47.03
1984	2458.38	178.48	47.59	197.43	121.55	119.46	27.51
1985	2583.56	242.85	97.86	291.39	149.39	112.14	30.45
1986	2717.88	300.87	187.45	370.75	66.94	170.70	28.25
1987	2848.20	302.76	212.22	400.92	84.85	231.56	-10.99
1988	3008.50	292.13	180.27	407.08	159.69	334.11	-17.65
1989	3161.51	311.09	270.34	430.99	147.29	431.96	-34.13
1990	3266.75	304.13	287.15	385.09	184.57	312.25	-45.02
1991	3439.29	326.04	269.05	502.11	277.11	459.38	-73.25
1992	3572.72	432.66	367.70	425.23	89.61	342.63	183.68
1993	3746.00	541.30	416.83	558.15	415.15	391.80	43.92
1994	3869.61	530.91	515.29	742.97	411.87	389.97	-19.85
1995	4028.75	486.27	541.36	825.89	265.19	406.03	-14.39
1996	4214.17	507.39	565.63	741.69	327.77	396.14	197.38
1997	4391.01	542.73	508.44	759.64	580.97	315.11	226.50
1998	4597.41	474.45	516.20	841.33	546.26	431.88	198.80
1999	4799.99	384.00	471.57	801.60	529.22	379.39	252.31
2000	4977.59	389.25	456.64	881.93	736.49	600.43	331.99
2001	5186.64	411.30	663.88	940.57	715.77	628.70	411.71
2002	5420.04	620.59	331.67	976.14	740.42	571.74	149.19
2003	5701.89	657.43	509.53	1184.45	796.20	678.08	254.85
2004	5998.79	700.66	742.70	1426.67	891.97	633.28	260.41

Notes

Y = Real output or GDP. CG = Government consumption. IG = Government investment. TR = Tax revenue. IP = Private investment. AF = Foreign aid. BD = Domestic borrowing.

Source: World Development Indicators, 2005.

Table A2
The Constructed Variables: Growth Rate and the Other Variables as Percentages of the Real GDP

Year	DYY	CGY	IGY	TRY	IPY	AFY	BDY
1965	1.37	14.46	10.85	19.37	7.03	2.25	5.68
1966	-4.26	13.04	4.94	15.21	7.92	2.52	4.41
1967	3.08	14.96	6.37	16.88	3.94	2.61	4.47
1968	0.37	16.78	6.76	17.52	4.34	3.73	4.34
1969	6.01	14.23	5.54	16.61	6.25	3.64	2.14
1970	9.72	12.85	5.50	19.36	8.65	2.68	1.98
1971	5.22	12.96	5.65	18.02	8.47	2.35	2.88
1972	-2.49	12.61	3.88	14.87	3.22	2.76	2.82
1973	2.88	10.91	3.04	11.17	5.99	1.66	4.79
1974	6.85	12.21	3.19	12.42	9.86	1.26	4.24
1975	-12.43	13.03	4.75	15.31	7.98	4.47	7.57
1976	-3.53	12.24	6.47	13.33	2.41	2.32	11.25
1977	2.27	12.63	8.77	10.22	2.29	2.86	9.35
1978	8.48	11.30	3.88	6.63	1.49	3.11	8.20
1979	-2.51	10.29	3.24	9.21	3.30	4.20	6.38
1980	0.47	11.16	1.41	6.89	4.21	4.31	3.54
1981	-3.50	8.79	2.35	4.46	2.22	3.43	5.98
1982	-6.92	6.48	1.11	5.56	2.27	3.49	5.11
1983	-4.56	5.86	0.90	5.53	2.85	2.70	2.08
1984	8.65	7.26	1.94	8.03	4.94	4.86	1.12
1985	5.09	9.40	3.79	11.28	5.78	4.34	1.18
1986	5.20	11.07	6.90	13.64	2.46	6.28	1.04
1987	4.79	10.63	7.45	14.08	2.98	8.13	-0.39
1988	5.63	9.71	5.99	13.53	5.31	11.11	-0.59
1989	5.09	9.84	8.55	13.63	4.66	13.66	-1.08
1990	3.33	9.31	8.79	11.79	5.65	9.56	-1.38
1991	5.28	9.48	7.82	14.60	8.06	13.36	-2.13
1992	3.88	12.11	10.29	11.90	2.51	9.59	5.14
1993	4.85	14.45	11.13	14.90	11.08	10.46	1.17
1994	3.30	13.72	13.32	19.20	10.64	10.08	-0.51
1995	4.11	12.07	13.44	20.50	6.58	10.08	-0.36
1996	4.60	12.04	13.42	17.60	7.78	9.40	4.68
1997	4.20	12.36	11.58	17.30	13.23	7.18	5.16
1998	4.70	10.32	11.23	18.30	11.88	9.39	4.32
1999	4.41	8.00	9.82	16.70	11.03	7.90	5.26
2000	3.70	7.82	9.17	17.72	14.80	12.06	6.67
2001	4.20	7.93	12.80	18.13	13.80	12.12	7.94
2002	4.50	11.45	6.12	18.01	13.66	10.55	2.75
2003	5.20	11.53	8.94	20.77	13.96	11.89	4.47
2004	5.21	11.68	12.38	23.78	14.87	10.56	4.34

Notes

DYY = Growth rate of real output or GDP. CGY = Government consumption as a share in output. IGY = Government investment as a share in output. TRY = Tax revenue as a share in output. IPY = Private investment as a share in output. AFY = Foreign aid as a share in output. BDY = Domestic borrowing as a share in output.

Source: Calculated from data sourced from the World Development Indicators, 2005.

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