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Aid, Exports and Growth in Ghana

by

Tim Lloyd, Oliver Morrissey and Robert Osei

**Centre for Research in Economic Development and International Trade,
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Abstract

A number of recent cross-country studies have revitalised the debate on the effectiveness of aid. While there is mounting evidence that aid does contribute to growth, there is some dispute as to whether good policy is a necessary condition for aid effectiveness. This paper is a contribution to the literature, providing a time series study of Ghana. We provide a simple model in which aid contributes to growth through financing government spending (especially public investment). Policy is incorporated via interactive dummies for the period from 1983 (adjustment and post-adjustment). We model growth in private consumption. Exports, aid and public investment all are positively related to long-run growth. In the pre-1983 period, exports and public investment had a negative impact on short-run growth whilst aid had no significant impact. Results for the post-1983 period suggest that policy reform enhanced the effectiveness of exports, public investment and aid, all of which had a significant positive impact on short-run growth. The results emphasise that aid played an important role in promoting this policy reform.

Outline

I. INTRODUCTION

The principal economic rationale for aid is to increase growth rates in recipient countries. This has been the driving economic objective of aid for decades, formally established in the 'two-gap' model of Chenery and Strout (1966). In this approach, investment is the cornerstone of growth and, at least initially, this requires imported capital goods. However, low-income countries typically face two fundamental constraints, or financing gaps. First, domestic savings rates are insufficient to provide the resources to meet desired levels of investment. Second, export earnings are not adequate to finance all the desired capital good imports. Consequently, such countries are constrained in their ability to achieve a target growth rate. Capital inflows, including aid, can 'fill' these gaps and contribute to achieving target growth rates. In this approach, the contribution of aid is to finance investment, including imports of capital goods. Export growth is also important, as it generates the foreign exchange to finance imports.

Early empirical work on the impact of aid on growth was based on these two-gap models, often concentrating on the impact of aid on investment or savings rather than on growth *per se* (these studies are reviewed in White, 1992; Hansen and Tarp, 2000a). Recent studies of aid effectiveness have been based on some variant of neo-classical or endogenous growth models and assess the impact of aid on growth controlling for other variables, especially indicators of economic policy. One prominent view is that the correlation between aid and growth is, at best, weak (Burnside and Dollar, 1997). Aid only appears to be effective in countries with appropriate economic policies, i.e. 'aid works in a good policy environment' (World Bank, 1998: 2). From this perspective, good policy is a necessary condition for aid effectiveness. This view has been challenged, and there is evidence that good policy is not *necessary* for aid effectiveness (Hansen and Tarp, 2000b). It may still be the case that the effectiveness of aid is enhanced by good policy.

The recent literature, and certainly the studies at the centre of the debate on aid effectiveness (Burnside and Dollar, 1997; Hansen and Tarp, 2000b), is based on cross country regressions. Approximating cross section evidence to what is inherently a time series phenomenon is a valuable exercise that allows one to attempt to draw general conclusions. However, to enhance our understanding of aid effectiveness, it is desirable

to conduct studies of the impact of aid on growth in specific countries. Ideally, when there is evidence from many country studies, the results can be compared with those for cross-section studies. This paper offers a study of one country, Ghana, over the period 1970-97 (the longest period for which data on all variables were available).

Building on the work of Feder (1982) and Ram (1986) we formulate a simple model in which aid impacts on growth via its effect on government spending. This allows us to incorporate the fact that almost all aid is delivered through the government and is mostly intended to finance public investment (see Franco-Rodriguez *et al*, 1998). Hansen and Tarp (2000b) and Lensink and Morrissey (2000) provide empirical support for the proposition that aid impacts on growth via investment. The model is described in Section 2. Section 3 provides a description of the data and the trends over time in Ghana. Section 4 outlines the econometric technique and Section 5 discusses the results. The conclusions are in Section 6.

II. PUBLIC EXPENDITURE, EXPORTS AND GROWTH: A MODEL

The model developed here has its roots in the models formalised by Feder (1982) and Ram (1986). The economy comprises two sectors; one producing for an export market (sector *X*) and the other producing for the domestic market (sector *D*). The production functions for the two sectors are given by:

$$D = D\,(K_D, L_D, G, X) \tag{1}$$

$$X = X\,(K_X, L_X, G) \tag{2}$$

Where

$K = K_D + K_X$ is the allocation of capital between sectors

$L = L_D + L_X$ is the allocation of labour between sectors

Production in sectors *D* and *X* is undertaken by the private sector so that the sum of output from the two sectors is gross private output.[1] Sector output is a function of the factors allocated to it and there are two sources of externality. The first, following Feder

1 If the government does not undertake direct production of final foods then one could think of the sum of sectors *X* and *D* output as gross output for the economy.

(1982), is the beneficial effects of exports on the non-export sector, so that the output of *D* is dependent on the amount of exports produced. This externality, which is assumed to be positive (but need not be so), can be thought of as coming from increased productivity in the economy as a whole if export sectors are more competitive (i.e. spillovers from exports to average productivity).

The second source of externality, in line with Ram (1986), is from the public sector. Following Barro (1990) we assume that expenditure on public services (*G*), rather than public capital, generates the externality for the private sector. This simplifies the analysis as we do not model the public sector. We treat the government sector as exogenous; it does not own capital or undertake production, but provides services to the production sectors. As in the case of exports, this externality is also assumed to be positive, but may not be so.

We assume, again following Feder (1982), a constant marginal productivity differential between the two sectors that is equal for all factors (as this greatly simplifies the formalisation). Defining marginal factor productivity as $S_F = \partial S/\partial F$ for factors $F = K, L, G$ and sectors $S = D, X$, we have:

$$\frac{X_K}{D_K} = \frac{X_L}{D_L} = \frac{X_G}{D_G} = 1 + \delta \tag{3}$$

where $\delta > 0$ by assumption (strictly, the only requirement is that it is non-zero).

Totally differentiating equation (2) gives:

$$dX = X_K dK_X + X_L dL_X + X_G dG \tag{4}$$

Substituting equation (3) into (4) gives:

$$dX = (1+\delta)D_K dK_X + (1+\delta)D_L dL_X + D_G(1+\delta)dG \tag{5}$$

Using the definitions of K and L above we get $dK = dK_X + dK_D$ and $dL = dL_X + dL_D$. Substituting into equation (5) yields:

$$dX = (1+\delta)D_K dK + (1+\delta)D_L dL + (1+\delta)D_G dG - (1+\delta)D_K dK_D - (1+\delta)D_L dL_D \quad (6)$$

This can be simplified and re-written as:

$$D_K dK_D + D_L dL_D = D_K dK + D_L dL + D_G dG - \frac{dX}{1+\delta} \quad (7)$$

Differentiating equation (1) gives:

$$dD = D_K dK_D + D_L dL_D + D_X dX + D_G dG \quad (8)$$

On substituting equation (7) into (8) and simplifying:

$$dD = D_K dK + D_L dL + 2D_G dG + \left(D_X - \frac{1}{1+\delta} \right) dX \quad (9)$$

Define gross private output in the economy as Q so that:

$$Q = X + D \Rightarrow dQ = dX + dD \quad (10)$$

Substituting equation (9) into (10) yields:

$$dQ = D_K dK + D_L dL + 2D_G dG + \left(D_X + \frac{\delta}{1+\delta} \right) dX \quad (11)$$

In (11) we have an equation for the change in gross private output. As we have assumed a government sector that does not directly undertake production of final goods, the sum of output of sectors D and X can be thought of as gross domestic output. Even if we assume that the sum of D and X constitutes output from the private sector only, an analogous equation for gross output of the whole economy would not be very different. The variables in the model would be the same, although the parameter on dG would be $(2D_G + 1)$. This implies that government expenditure has two effects on gross domestic output, a direct ‘injection effect’ and an indirect externality effect.

The growth equation corresponding to (11) is:

$$\frac{dQ}{Q} = D_K \frac{dK}{Q} + D_L \frac{dL}{Q} + \left(D_X + \frac{\delta}{1+\delta} \right) \frac{dX}{Q} + 2D_G \frac{dG}{Q} \tag{12}$$

Again following Feder (1982), we assume that the marginal product of labour in the private sector is proportional to its corresponding average product, i.e. $D_L = \phi (Q/L)$. Substitute into (12) and let $dK = I$ (private investment):

$$\frac{dQ}{Q} = \lambda_1 \frac{I}{Q} + \lambda_2 \frac{dL}{L} + \lambda_3 \frac{dX}{Q} + \lambda_4 \frac{dG}{Q} \tag{13}$$

where the λ's correspond to the parameters in (12), except $\lambda_2 = \phi$.

Foreign aid is not explicitly introduced into the model as it is not in itself an argument in the growth equation. Assuming that the impact of aid on growth is via government expenditure, especially investment (other mechanisms exist but this is implicit in most models), we can use a variant of (13) which has aid rather than government expenditure as an argument:

$$\frac{dQ}{Q} = \beta_1 \frac{I}{Q} + \beta_2 \frac{dL}{L} + \beta_3 \frac{dX}{Q} + \beta_4 \frac{dA}{Q} \tag{14}$$

Our empirical analysis in Section 4 is based on estimating directly long-run and short-run variants of equations (13) and (14). Before discussing the empirical analysis, it will be helpful to briefly consider the nature of the data and the economic performance of Ghana during the period under investigation.

III. ECONOMIC PERFORMANCE IN GHANA

'It may seem harsh to say so, but, just as Ghana pioneered political independence from colonial masters in Africa, so also has she pioneered a set of self-destructive economic policies which many more recently decolonised African countries have also followed'

(Toye, 1991: 151). From being a relatively affluent African country in the early 1960s, and still ranking as middle-income by the late 1960s, Ghana made the undesirable transition to a low-income country in the 1970s. Corruption, macroeconomic mismanagement, chronic overvaluation of the cedi and anti-agricultural bias were all at the root of poor economic performance. Things were even worse in the 1970s. Between 1970 and 1983 real GDP at market prices fell by some 11% (per capita incomes fell by even more), and did not recover to the 1970 level until 1985 (Toye, 1991: 166). Ghana was a chronic case of economic failure.

Under the auspices of a World Bank adjustment programme in 1983, Ghana reversed its economic decline of the 1970s, by the mid-80s had established macroeconomic stability and by the late 1980s was one of the best performers in sub-Saharan Africa. Between 1983 and 1987 real per capita income rose by some 12% (Toye, 1991: 166). Ghana has been described as a frontrunner in adjustment 'during the adjustment period Ghana has prospered, despite a massive decline in the international prices of gold and cocoa. Moreover, structural reform will enable Ghana to respond more buoyantly to the external and policy shocks it will inevitably experience' (Leechor, 1994: 169).

One aspect of Ghana's improved performance in the late 1980s was due to agricultural policy reform. Although, as indicated above, world cocoa prices declined, real producer prices for cocoa exports more than doubled between 1983 and 1986 (Toye, 1991: 168). Aid also played an important role, both by injecting funds and 'encouraging' policy reform. 'Donors have played a major role in both shaping the adjustment program and financing the attendant costs' (Leechor, 1994: 172).

Given this history, it is appropriate that our study of growth in Ghana concentrates on the contributions of aid and exports. However, for a number of reasons, we do not focus on growth of national income but rather on growth of private consumption. In effect, we take private consumption as our proxy for income. One reason is econometric. As aid and exports are both components of national income, there is a possible identity problem in estimating any long-run relationship in levels.[2] This problem does not apply to private

2 Ignoring this potential problem, we did estimate the long-run and short-run models for GDP growth. The results are reported in Appendix B. The basic results are similar to those reported here using private consumption.

consumption. The second reason is more conceptual, as concern in economic development is really more about what is happening to private incomes and consumption levels rather than the overall size of the economy. Our ultimate concern is with how exports and aid impact on the growth of consumption in the private sector. This is in line with the recent literature on the relationship between growth and poverty, which focuses on growth in private consumption per capita (e.g. Ravallion and Chen, 1997). Our variables are not measured in per capita terms as annual data on population is not accurate.

As Figure 1 shows, private consumption shows no discernible trend over the 1970s and early 1980s but after 1983 it seems to have increased steadily. The only distinct feature in the pre-1983 period is the high value in 1974, which coincides with the very significant increase in agricultural output recorded that year. The cumulative effect of inappropriate policies of successive governments combined with the second oil price shock to place the economy on the brink of collapse by the end of the 1970s. With the onset of prolonged drought in the early 1980s the economy as a whole, and private consumption, deteriorated and by 1982 reached its nadir. Economic recovery started after 1983, a year that marks the inception of the World Bank supervised Economic Recovery Programme/ Structural Adjustment Programme (ERP/SAP).

Exports exhibited a steady decline over the pre-1983 period and an increase thereafter (Figure 1). This is not a reflection of movements in the country's terms of trade. The decline in exports in the pre-1983 period was primarily because cocoa, the major export earner over most of the period, was discriminated against. This discrimination, through the tax system, price and marketing controls and the over-valuation of the currency, meant that changes in world prices were not passed through to farmers. Consequently, the decline in exports over this period may not have affected private consumption. In the post-1983 period, however, there has been a liberalisation of the foreign exchange, trade,

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This supports our choice of using private consumption as the dependent variable as the results carry through to determinants of GDP growth.

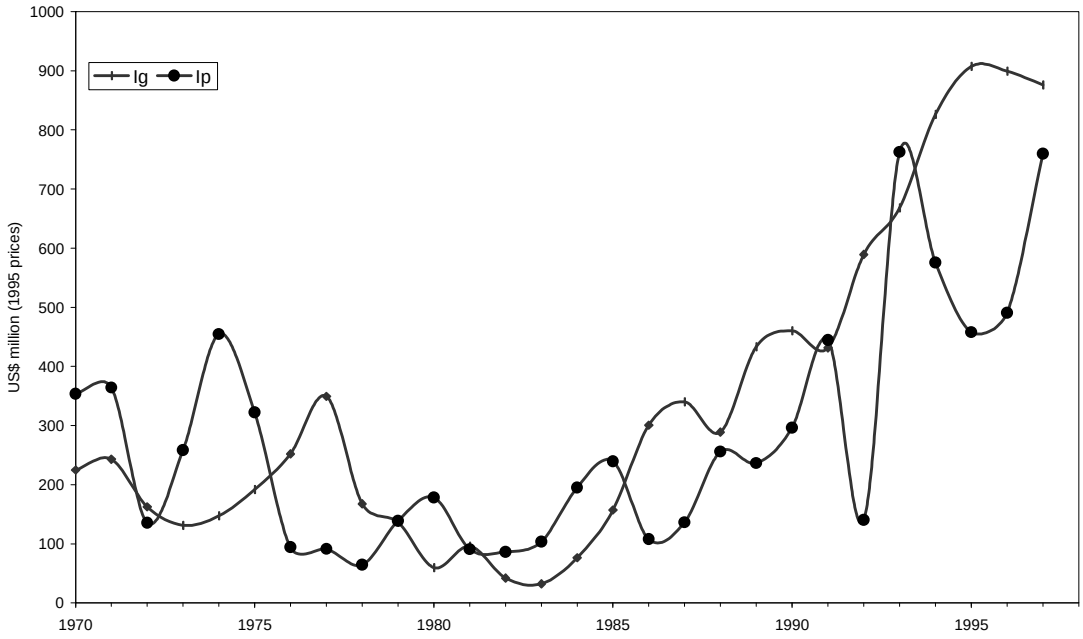
and agricultural marketing regimes; the government made a conscious effort to improve the ‘pass-through’ of export proceeds to producers, primarily farmers. This may help explain why private consumption and exports appear to move together in the later period.

Figure 1: Private Consumption and Exports

Private investment, illustrated in Figure 2, shows no particular pattern although there seems to be a general upward trend after the early 1980s. The somewhat erratic movement in private investment in Ghana is not too surprising given the absence of any consistent or coherent policy to encourage private sector participation in capital formation, especially over the 1970s. Even after 1983, although the adjustment programme was intended to promote the private sector, confidence in the sector was never fully restored and this is reflected in the lacklustre response of private investment.

Government investment (Figure 2) was volatile prior to 1983 but there has been a general upward trend since then, notably in 1983-86. Aid flows follow a similar, albeit less pronounced, pattern (to be expected as aid is the major source of funds for public investment). The trough around 1973 corresponds to the unilateral repudiation of external debt in 1972 that resulted in a decline in aid flows and consequently government investment. Both these variables increased after negotiations were re-opened after 1973. With the inception of the ERP/SAP the government implemented policies agreed with the World Bank and aid flows have risen steadily.

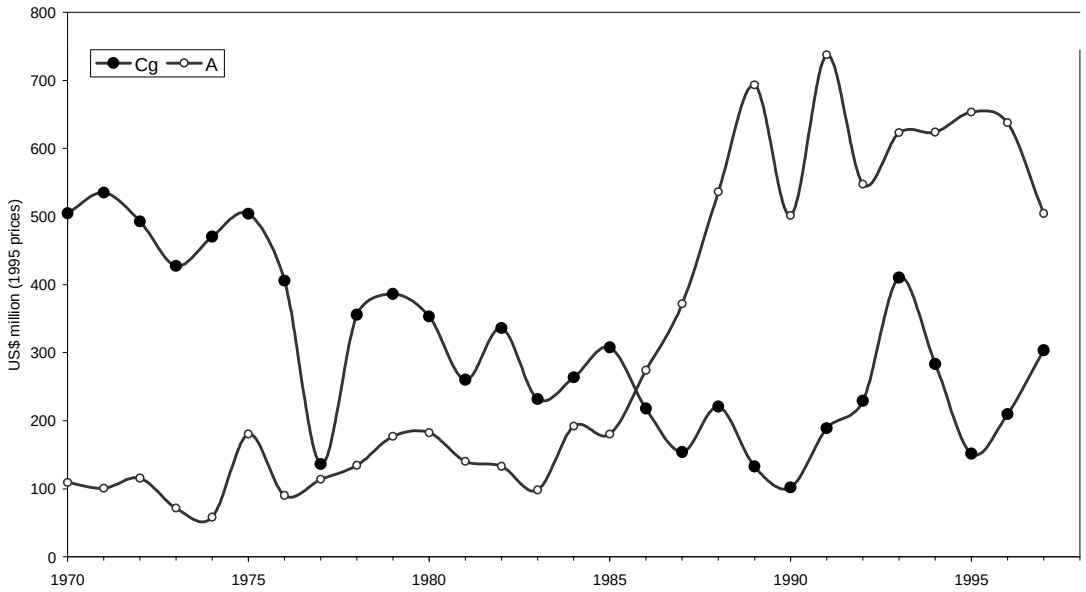
Figure 2: Government Investment and Private Investment



As Figure 3 indicates, government consumption was in decline until 1990, suggesting that Ghana did adhere to IMF/World Bank directives throughout this period. The break from trend observed in 1990 may reflect the need to build institutions for a successful transition to democratic rule in 1992. Funded by government borrowing, it exacerbated growing debt repayments which by 1997 constituted over 30% of total government expenditure. Debt repayment is generally held to be the major factor in reversing the downward trend in government consumption spending witnessed in the 1980s. A distinct feature over the pre-1983 period is the very significant fall in 1977. This may have been a result of the panic created in the government by the senior bishops of the Catholic church who warned of an impending military insurrection (Frimpong-Ansah, 1991: 110). On the other hand, it may simply reflect measurement error.[3]

3 This period coincides with the 'Union government' (UNIGOV) campaign of 1976-1978; given the size of the public sector and the pressures of wage demands at the time, it is difficult to reconcile how current government expenditures could have fallen by so much. As our measure is estimated as total government spending (from IMF) minus government investment (from World Bank), any actual fall could be compounded by measurement errors.

Figure 3: Government Consumption and Aid



IV. ECONOMETRIC METHOD

Being static in nature, the model in Section 2 takes no account of the dynamic behaviour of participants, or, more importantly, the time series properties of the data used to estimate the relationships posited. Given the non-stationarity that is characteristic of time series data, pre-testing for units roots and cointegration analysis form necessary parts of the empirical analysis of economic growth – an inherently dynamic phenomenon. In so far as the data will allow, we adopt a general-to-specific empirical approach, whereby simplifying restrictions are tested against a general, albeit over-parameterised, statistical model (e.g. Banerjee *et al,* 1993). In recognition of the trade-off between efficiency and consistency, a degree of pragmatism is required in a practical setting when implementing this general-to-specific method, especially given the small sample that we have at our disposal. As a result, we couch the empirical analysis in a single equation autoregressive distributive lag (ADL) model.[4] The ADL model is particularly attractive when conducting cointegration analysis in small samples since it avoids the finite sample bias that beleaguers static estimators, yet is more efficient than VAR methods (Inder, 1993;

4 Estimates using vector autoregressive (VAR) methods are reported in Appendix A. Despite the paucity of data they are consistent with our inferences here on cointegration and assumptions concerning exogeneity.

Banerjee *et al.,* 1993). Where the variables cointegrate, the single equation ADL estimator delivers super-consistent estimates of the long-run parameters and asymptotically valid *t*-ratios, even in the presence of endogenous explanatory variables (Inder, 1993; 68).

The adopted procedure (see Johnston and DiNardo, 1997) involves estimation of a general dynamic equation or ADL model of the form

$$A(L)y_t = m + B_i(L)x_{i,t} + \varepsilon_t \tag{15}$$

where $i = 1,2,\ldots,k$, ε_t is a white noise residual term, and $A(L)y_t$ and $B_i(L)x_{i,t}$ are polynomials in L of order $(p, q_1, q_2, \ldots, q_k)$ respectively such that

$$A(L) = (1 - a_1L - a_2L^2 - \ldots - a_pL^p) \tag{16a}$$

$$B_i(L) = (a_0 + a_{i,1}L + a_{i,2}L^2 + \ldots + a_{i,q}L^{q_i}) \tag{16b}$$

and L is the lag operator such that $L^p y_t = y_{t-p}$. The implied long-run solution from (16) is obtained by setting L to 1 in the lag polynomials yielding,

$$y_t = c + D_i(1)x_{i,t} \tag{17}$$

where $c = A(1)^{-1}m$, and $D_i(1) = A(1)^{-1}B_i(1)$ is the ratio of the coefficient sums.

Given our interest in growth, one meaningful re-parameterisation of (16) is the error correction model (Davidson *et al*. 1978). As this requires that the variables cointegrate we pay special attention to this property in the empirical analysis.

V. RESULTS AND DISCUSSION

To estimate the empirical relationships posited in Section 2 we employ annual data that cover the period 1970 to 1997 (as described in Section 3). All variables are in constant (1995 = 100) US dollars and are expressed as natural logs. They are summarised as:

Cp_t Private consumption; the market value of all goods and services.

Cg_t Government consumption, total government expenditure net of government investment.

X_t Exports (goods and market services).

A_t Foreign aid (total net disbursement from all donors).

Ig_t Central Government (fixed capital) investment.

Ip_t Private investment (gross domestic investment minus government investment).

The data are reported in Appendix A, Table A3, and plotted in Figures 1, 2 and 3 (above). Private consumption is measured as the market value of all goods and services, including durable products purchased or received as income in kind by households and non-profit institutions. It excludes purchases of dwellings but includes imputed rent for owner-occupied dwellings. Exports is the value of all goods and other market services provided to the world, and includes the value of merchandise, freight, insurance, travel, and other non-factor services. Both private consumption and exports are obtained from *World Development Indicators 2000*. The total labour force, from the same source, is defined as the number of economically active people in the economy.[5] Foreign aid is defined as the total net disbursement of aid from all donors to Ghana, from *Geographical Distribution of Financial Flows* (OECD-DAC). Government investment and private investment data were obtained from the Global Development Network database of the World Bank. Government investment is defined as central government outlays on additions to fixed assets plus net changes in the government's level of inventories. Private investment is obtained by deducting government investment from gross domestic investment. Current government consumption is the total government expenditure (IMF *International Financial Statistics*) net of government investment.

As an *entre* to the empirical analysis, the order of integration is determined using the Augmented Dickey Fuller test. Results, reported in Table 1, indicate that our measures of private consumption (Cp_t), government investment (Ig_t), foreign aid (A_t) and exports (X_t) are I(1). The measures of government consumption (Cg_t), private investment (Ip_t), and the labour force are better approximated as I(0): Cg_t being mean-stationary;

5 A plot of the labour force variable shows that the series is simply linear interpolations to link population Census years (1960, 1970 and 1984). We omit this variable, both because it is a poor measure and because it can be captured using a linear trend as a proxy.

Ip_t and L_t being trend-stationary. The latter result is consistent with the fact that the labour force variable is interpolated from decennial data. The result for Ip_t and Cg_t appears odd, but may simply reflect the quality of the data and sample size. One major shortcoming of the ADF test is its inability to clearly distinguish between deterministic and stochastic trends, particularly in samples of the size available here. Fortunately, the stationarity or otherwise of these two variables makes little difference to the results in this instance. [6]

Table 1. ADF Unit Roots Tests on the Series

ADF Model: $\Delta Y_t = a + bT + gY_{t-1} + \sum_{i=1}^{p} d_i \Delta Y_{t-i}$					
	H_0: $\gamma=0$	H_0: $\beta=\gamma=0$ ϕ_3 – test	H_0:$\beta=\alpha=\gamma=0$ ϕ_2 – test	Lag Length	Inference
Cp_t	-1.382 *(-3.228)*	2.358 *(5.91)*	2.722 *(4.67)*	0	I (1)
Ig_t	-1.740 *(-3.228)*	1.867 *(5.91)*	1.427 *(4.67)*	0	I(1)
Ip_t	-3.625 *(-3.254)*	---	---	5	I(0)
A_t	-1.868 *(-3.237)*	1.752 *(5.91)*	1.578 *(4.67)*	2	I(1)
Cg_t	-3.447 *(-3.228)*	---	---	0	I(0)
X_t	-1.476 *(-3.228)*	3.418 *(5.91)*	2.346 *(4.12)*	0	I(1)
lab_t	-5.507 *(-3.242)*	---	---	3	I(0)

Note: Numbers in parenthesis are the 10% critical values. Optimal lag length is the largest p for which d_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.

6 We used the Perron method to test for structural breaks in the series but this did not change the conclusions reached using ADF tests. The properties of the non-stationary series remain the same. Also Ip_t, Cg_t, and lab_t are still stationary at the 5% level of significance.

Having established the order of integration of the series, the data are applied to estimate (16) empirically. As discussed in Section 2, whether it is aid or government investment that is used in the estimation is largely an empirical issue and thus two variants are estimated reflecting this choice. In addition, the models are augmented by a trend term to take account of autonomous technological improvements and effects of human capital growth during the period[7].

Table 2. Long-Run Estimates and Cointegration Tests

Dependent variable: Private Consumption (Cp_t)

Variable	***Model (a)***	***Model (b)***
Constant	6.661 *(0.38)*	6.221 *(0.20)*
Exports (X_t)	0.193 *(0.05)*	0.258 *(0.03)*
Trend	0.014 *(0.002)*	0.012 *(0.003)*
Government Investment (Ig_t)	0.043 *(0.029)*	-------
Foreign Aid (A_t)	------	0.051 *(0.034)*
t-value for ECM Test	-4.684**	-5.161**
t-value for Adapted EG Test	-6.745**	-6.202**

Notes: Standard errors in parentheses. The ECM Test is the Banerjee, Dolado and Mestre (1998) test for cointegration. The Adapted EG Test is a unit root test on the residuals from the solved long run equation. ** indicates rejection of the null hypothesis of no cointegration at the 5% level. All estimation is undertaken in PCGive and PCFiml 9.0, Hendry and Doornik (1996).

Lag length is determined by the SBC which indicates that a second order polynomial ($p = q_i = 2 \forall i$) captures the dynamics in both models adequately, such that the residuals

7 If labour force movements in Ghana is truly linear as our data suggests then this will also be captured by the trend term.

($\hat{e}_t$) conform to empirical white noise. Solving the models for the long-run or steady state solution (17) yields the estimates reported in Table 2. [8]

The results suggest that the long-run export elasticity and trend are similar in both variants of the model, with an export elasticity of around 0.2 and an estimated rate of autonomous growth slightly in excess of 1% per year. The aid and government investment elasticities indicate small but statistically significant impacts (albeit at 10%) in the long run. These relatively low long run elasticities comes as little or no surprise, since it is widely held that much of the money designated as government investment (and aid for that matter) ended up in private accounts, especially over the pre-1983 era. Even when investment spending was actually undertaken, it was in unproductive ventures such as the state owned enterprises (SOE). Arguably, government investment and aid spending have been more productive after 1983. This hypothesis is tested within the error correction models. However, both tests for cointegration strongly reject the null of no cointegration, supporting the inclusion of these variables in the long-run determination of growth. [9] Furthermore, exclusion tests also suggest the individual importance of these variables. Specifically, the null of no cointegration is not rejected at the 5% level if any variable is excluded.

Reparameterising (16) as an error correction model and conducting a step-wise reduction yields the final parsimonious forms, reported in Table 3 and illustrated in Figure 4. The overall fit of the two models ($\overline{R}^2 = 0.82$) is similar, implying that for the purpose of prediction at least, there is little to choose between the two specifications and, diagnostic checking indicates the statistical adequacy of both models.

Ex post rationalisation of dynamics is invariably conjectural, so comment is confined to a few general points. First, both models detect a positive influence of lagged consumption on future growth. Second, expansion of exports and government investment are inimical to growth (in private consumption) in the short-run. This may reflect short-run resource

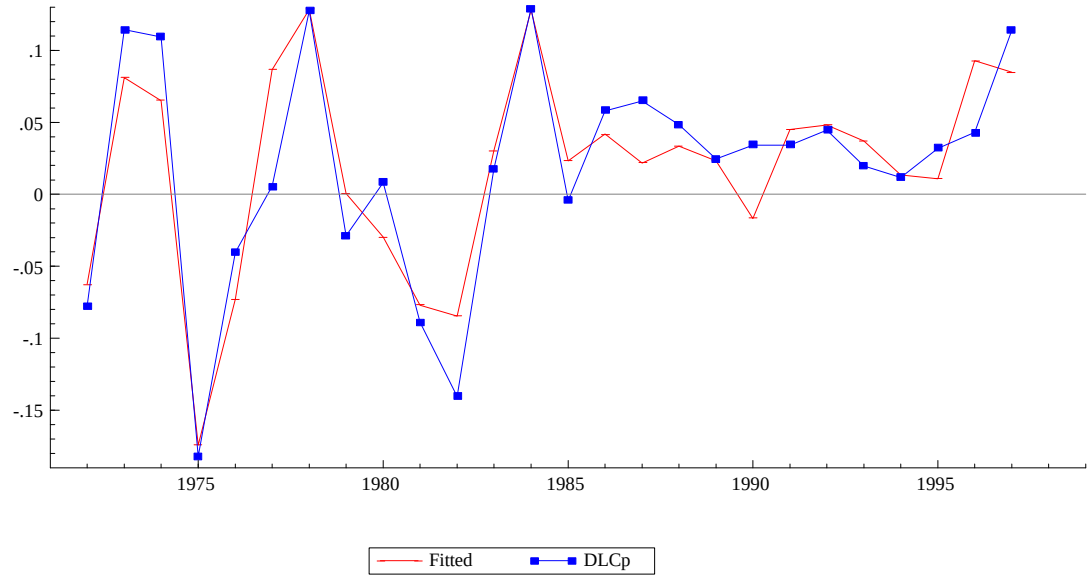
8 The labour force variable added little to the models with coefficients switching around zero in alternative specifications. Accordingly, it has been excluded to improve efficiency of the parameters that remain.

9 Estimation of VAR(2) models of (a) and (b) yield almost identical estimates of the parameters reported in Table 2. Hypothesis testing is confounded by the small sample size but the similarity of the long run parameter estimates indicate that simultaneous equation bias is not a problem.

competition and the fact that government fixed investment is usually in projects with long-term gestation.

Figure 4.Private Consumption Growth: Actual and Fitted Values from the Error Correction Models.

Model (a)



Model (b)

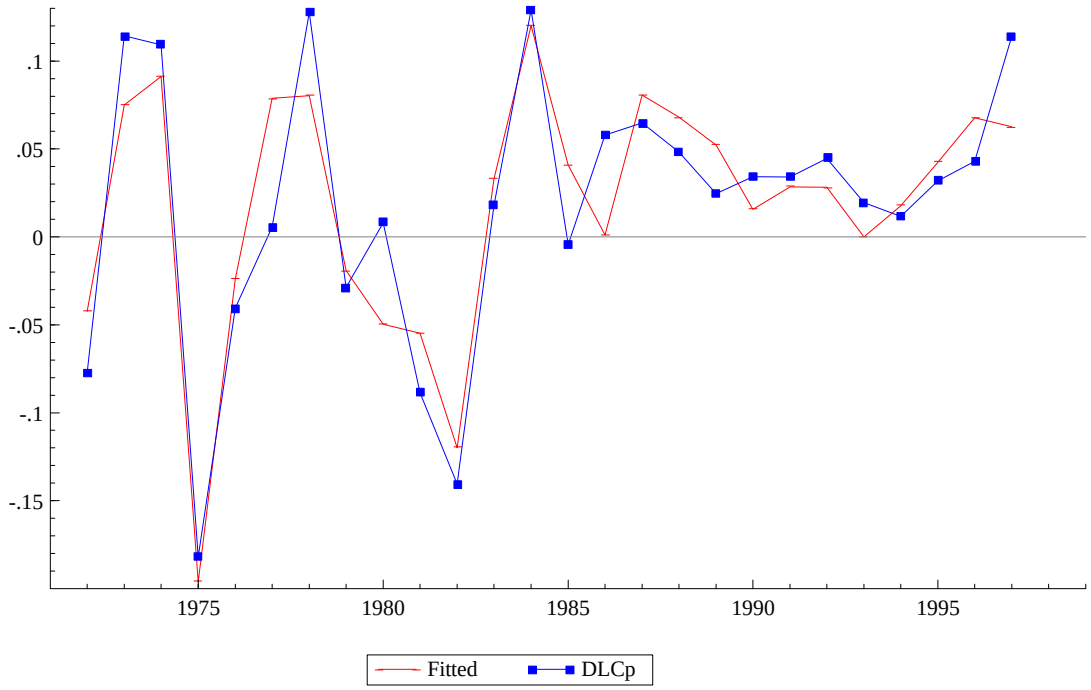


Table 3 ECM Models of Private Consumption Growth

Variables	Model (a)	Model (b)
dCp_{t-1}	0.341*	0.849**
	(0.164)	*(0.175)*
dX_t	-0.219*	-0.182*
	(0.104)	*(0.097)*
dX_{t-1}	-----	-0.123**
		(0.058)
dCg_t	0.057**	-----
	(0.027)	
dCg_{t-1}	-0.055**	-----
	(0.026)	
dIg_t	-0.007	-----
	(0.030)	
dIg_{t-1}	-0.068**	-----
	(0.025)	
dA_t	-----	-0.038
		(0.041)
dA_{t-1}	-----	0.041
		(0.027)
$dX83_t$	0.374**	0.243*
	(0.128)	*(0.128)*
$dIg83_t$	0.099*	-----
	(0.048)	

$dA83_t$	-----	0.111*
		(0.055)
$ECMAXT_{t-1}$	-----	-1.357**
		(0.207)
$ECMIgXT_{t-1}$	-1.192**	-----
	(0.191)	
	Diagnostics	
R-Squared	0.823 [0.000]	0.816 [0.000]
Serial correlation	2.420 [0.499]	2.420 [0.123]
Normality	1.491 [0.475]	0.070 [0.966]
Reset	0.636 [0.438]	0.083 [0.776]
Predictive Test	3.287[0.656]	2.531[0.772]
Chow Test	7.5937[0.002]	2.629 [0.068]

Notes: Numbers in parenthesis are standard errors (* and ** indicate significant at 10% and 5% respectively); those in square brackets are *p*-values. A constant is included in both models but is not significant. The R-squared diagnostic is the F-test for the joint significance of the variables (under the null the R-squared is equal to zero). The null hypothesis under the other diagnostics is that they satisfy the Guass-Markov conditions for OLS. The predictive test is a χ^2 test for the within-sample forecasting ability of the models (based on the last 5 observations, the null is that the model tracks the observations well). The Chow test is for structural stability between the pre- and post- 1983 periods.

This argument is also true for the export term as the pass-through of export earnings was low in the pre-1983 period and so 'most' ended-up as government spending. Even if the retained export earnings were used 'judiciously' for government investments they did not have significant short-run consequences for growth, a point supported by the significant interactive export dummy for the post-1983 period. Third, the short-run impact of aid is only significant in the adjustment and post-adjustment period. Fourth, both variants indicate that private consumption returns completely within one year to its equilibrium level following a shock, with point estimates (of the error correction coefficients) indicating possible overshooting, a feature that may be due to the use of private consumption as a proxy for gross output.[10]

Policy and Growth

10 This inference is supported by the fact that when we estimate the ECM for GDP growth (Appendix B), the ECM term is less than unity (i.e. there is no over-shooting).

The contrast between the short- and long-run responses for exports and government investment in Model (a) and exports (and to a lesser extent) aid in Model (b) in Table 3 represent particularly interesting results. While short-run competition for resources may offer a partial account, in that growth in exports and investment/aid may divert resources away from private consumption, the policy environment may have also played a role. This is especially so given the re-orientation in policy that occurred following the implementation of the ERP and its associated macroeconomic disciplines. For example, if the transmission of export earnings improved after 1983, year-on-year changes in export earnings should have an enhanced effect on private consumption. These effects have been shown to be considerable in similar developing countries (Lloyd *et al*., 1999). In addition, the ERP should have been associated with an improvement in economic policy in general, and some decline in corruption, that translated into increased efficiency of government investment. Similarly, the improved policy environment is likely to have enhanced the effectiveness of aid.

Using multiplicative dummy variables (0 if $t \leq 1982$, 1 otherwise) we may evaluate whether the change in policy stance between the two periods (*i.e.* pre- and post- ERP) impacted on growth, and if so via which mechanism (exports and/or investment/aid). The dummies are applied to the exports and government investment variables in Model (a) and to the exports and aid variables in Model (b).

Results in Table 3 suggest that there have been significant beneficial effects from policy re-orientation in Ghana. Specifically, the multiplicative dummies on exports and government investment in Model (a) have positive coefficients and are of a magnitude that implies that the inimical short-run effects of these variables on growth are not only ameliorated but possibly overturned post-1983. Similar results are found for Model (b) where coefficients on aid and exports are also positive and statistically significant at conventional levels. Both the aid and export dummy have coefficients with magnitudes that off-set the negative impacts post-1983. It should be noted that, given the size of the standard errors of the estimated coefficients, there is insufficient evidence to show that the variables have a positive net effect on growth post-1983, merely that they counteract any inimical effects. However, given the sample size, the evidence is suggestive of a positive link in the short run after 1983, at least for aid and exports.

Overall, the results suggest that adherence to the conditions of the structural adjustment programme did improve the performance of the Ghanaian economy. It is worth considering whether the break identified here may represent a behavioural change, i.e. a shift in the long-run relationship.[11] We test for evidence of a structural break in the long-run in two ways. First, we estimate the general dynamic equation recursively and plot the recursive graphs for the individual coefficients and the residuals. There is no evidence of any significant break. Second, we use the more straightforward approach of including a step dummy for 1983, but this is not significant in the solved long-run equation (for both models *a* and *b*) and we still obtain cointegration. There is no evidence of a break in the long-run relationship.

This suggests that the apparent break in the long-run movement of private consumption can be explained by movements in the independent variables. If we accept that exports, aid and government investment are weakly exogenous to *Cp*, then we can say that private consumption started increasing after 1983 because one or other or all of these variables increased. We suggest that the policy reforms had an indirect impact on private consumption via the other variables in the model. We note also that the ratio of private consumption to GDP fell from 87% in 1983 to 76% in 1995. While this is consistent with a rise in private savings, it may also be explained by a rise in the relative share of other components of GDP (such as aid). There is no evidence that the level or rate of private savings in Ghana increased during the 1980s or early 1990s (Killick, 2000). For the period investigated, our model seems a reasonable representation of the determinants of private consumption (and indeed of GDP).

Although we cannot state that the improvement in performance (as measured by private consumption) after 1983 is due to any one of the explanatory variables more than the others, we can identify the relative contribution of each variable to long-run growth in private consumption. The results of this decomposition (based on the long-run relationship presented in Table 2) are reported in Table 4. They suggest that aid makes the greatest relative contribution to growth, accounting for about half the growth observed during the sample period. As some aid finances government consumption spending, which can have a direct impact on private consumption (via spending on

11 This suggestion is due to Chris Adam. The results mentioned here are available on request.

services and wages), it is not surprising that it has a greater impact than government investment. Furthermore, model (b) appears to account for more of growth than does model (a), again suggesting that aid is better targeted to growth-enhancing sectors than is government investment.

The decompostion results also suggest that both aid and government investment appear to make a greater relative contribution than exports. Hence, although the long-run elasticities presented in Table 2 suggest a rather diminutive role for aid and government investment in Ghana's growth record, the decomposition reveals their overall importance to the process, since unlike exports, which have grown relatively little over the period (18%), government investment and aid have grown by nearly 3 and 4 times repectively. Thus for Ghana at least, exports, aid and government investment have played key roles in the growth process, albeit via different means.

Table 4 Contribution of Independent Variables to Private Consumption Growth

Actual Private Consumption Growth (% attributable to)

	Government Investment	Foreign Aid	Exports
Model (a)	36.04	---	19.3
Model (b)	---	48.04	25.8

Notes: To derive the the contribution to growth, the long run elasticities are multiplied by the average annual growth in the respective independent variables and then expressed as a per cent of the average annual growth in private consumption.

VI. CONCLUSIONS

The purpose of this paper was to investigate the impact of aid on growth in Ghana using time series analysis. Underpinning our analysis is a Feder-Ram-type model in which growth depends on investment (public and private), labour force and exports. Aid contributes to growth through financing government spending, especially investment. For our purposes, output growth is represented as growth in private consumption (and the results hold up for a model with GDP growth). This is justified on both theoretical,

following Barro (1990), and empirical grounds (the data support the existence of a long-run relationship between private consumption and the gross output determinants).

We find that exports, foreign aid and government investment all make a positive contribution to long-run movements in private consumption in Ghana, as suggested by the cointegrating relationships obtained. Two long-run equations are reported, one including government investment and the other aid. A decomposition of the growth record in Ghana suggests that, aid and to a lesser extent, government investment, makes the greatest contribution to private consumption growth.

The short-run dynamics of the relationship were explored using two ECMs, one with government spending (investment and consumption) and the other with aid. The possibility that policy reform following structural adjustment, initiated with the ERP in 1983, created a more favourable environment for growth was incorporated through the use of a qualitative variable (taking the value of 1 for 1983 and subsequent years). This dummy interacted with export growth, aid growth and public investment growth in the appropriate ECMs. The results suggest that in the pre-ERP period, grwoth in exports and government investment tended to retard short-run growth (the estimated coefficients are negative and significant). In the post-ERP period both positively contributed to growth (the estimated coefficients on the interactive terms are positive and significant). Among other results, we find that although contemporaneous grwoth in government consumption had a positive impact on private consumption growth, the negative lagged effect off-set this.

The results for the ECM with aid are similar. Export growth appears to be negatively related to private consumption growth in the pre-1983 period, but positively related in the post-1983 period. The coefficients on the aid growth are insignificant. Any impact of aid on short-run growth in the pre-ERP period was negligible (although there is no evidence that it was negative). In the post-ERP period, the results for the interactive dummy suggest that aid had a positive and significant impact on short-run growth. This is consistent with the evidence that aid was positively associated with the level of private consumption in the long-run.

Overall, the results suggest that structural adjustment did improve the performance of the Ghanaian economy. The short-run growth-promoting effectiveness of exports, public investment and aid were all enhanced in the post-ERP period. This supports the argument that growth prospects are enhanced by a 'good' policy environment (Burnside and Dollar, 1997; World Bank, 1998). Our results do not show that policy is necessary for aid effectiveness; the coefficient on aid is positive in the long-run relationship. Furthermore, the presumption must be that aid contributed directly to the improved policy environment. There was a significant increase in aid receipts after 1983, especially during the adjustment process. Perhaps, in Ghana, conditionality did work. The positive coefficient on the interactive term with public investment suggests one mechanism through which aid effectiveness may have increased post-1983.

Given the approach adopted here, the results support the findings from cross-country regressions that aid effectiveness is through its effect on public investment (Hansen and Tarp, 2000b; Lensink and Morrissey, 2000). This is not surprising. In countries with a particularly poor policy environment, the productivity of public investment will probably be low. Consequently, aid effectiveness will be limited, but not necessarily eliminated (aid projects may have a higher return than public investment on average, and non-investment aid may be beneficial). Our results suggest that the policy environment in Ghana prior to adjustment did constrain the effectiveness of aid, investment and exports. Structural adjustment appears to have been beneficial and growth-enhancing.

We found no evidence that private investment had any significant effect on growth (in private consumption) in Ghana (the variable was insignificant in all regressions). Commentators on the economy of Ghana argue that even following adjustment little has been done to encourage private investment, a crucial ingredient for sustainable growth. The institutional structure of Ghana is still not appropriate to reduce the transaction and information costs that inhibit private sector investment and development (Killick, 2000: 65). Policy reform has contributed to the improved growth performance of Ghana, but much remains to be done. Aid has contributed to growth in Ghana, at least since the mid-1980s, partly by supporting policy reform and partly by financing investment.

REFERENCES

Banerjee, A., J. Dolado, J. Galbraith and D. Hendry (1993), *Co-integration, Error-Correction, and the Econometric Analysis on Non-Stationary Data*, Oxford: Oxford University Press, Advanced Texts in Econometrics.

Barro, R. (1990), 'Government Spending in a Simple Model of Endogenous Growth', *Journal of Political Economy*, 98: 5, 103-124.

Burnside, C. and D. Dollar (1997), 'Aid, Policies and Growth', The World Bank, *Policy Research Working Paper 1777* (published in *American Economic Review*, September 2000).

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

Davidson, J., D. Hendry, F. Srba and S. Yeo (1978), 'Econometric Modelling of the Aggregate Time-series Relationship between Consumers' Expenditure and Income in the United Kingdom', *Economic Journal,* 88, 661-692.

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

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

Frimpong-Ansah, J. H., (1991), *The Vampire State in Africa: The Political Economy of Decline in Ghana,* Trenton, NJ: African World Press.

Hansen, H. and F. Tarp (2000a), 'Aid Effectiveness Disputed', *Journal of International Development*, 12:3, 375-398.

Hansen, H. and F. Tarp (2000b), 'Aid and Growth Regressions', University of Nottingham: *CREDIT Research Paper 00/7* (forthcoming, *Journal of Development Economics*).

Hendry, D. and J. Doornik (1996), *Empirical Econometric Modelling Using PcGive 9.0 for Windows*. London: International Thomson Business Press.

Inder, B. (1993), 'Estimating Long-Run Relationships in Economics: A Comparison of Different Approaches', *Journal of Econometrics*, 57, 53-68

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

Killick, T. (2000), 'Fragile still? The Structure of Ghana's Economy, 1960-1994', in E. Aryeetey, J. Harrigan and M. Nissanke (eds), *Economic Reforms in Ghana: The Reality and Mirage*, London: James Currey, pp. 51-67.

Leechor, C. (1994), 'Ghana: frontrunner in adjustment', in I. Husain and R. Faruqee (eds), *Adjustment in Africa: Lessons from Country Case Studies*, Washington DC: The World Bank, pp. 153-192.

Lensink, R. and O. Morrissey (2000), 'Aid Instability as a Measure of Uncertainty and the Positive Impact of Aid on Growth', *Journal of Development Studies*, 36:3, 31-49.

Lloyd, T., C. Morgan, A. Rayner and C. Vaillant (1999), 'The Transmission of World Agricultural Prices in Cote d'Ivoire', *Journal of International Trade and Economic Development*, 8:1, 125-141.

Ram, R. (1986), 'Government Size and Economic Growth: A new Framework and some Empirical Evidence from Cross-section and Time Series Data', *American Economic Review,* 76, 191-203.

Ravallion, M. and S. Chen (1997), 'What Can New Survey Data Tell Us About Recent Changes in Living Standards in Developing and Transitional Economies?', *World Bank Economic Review*, 11:2, 357-382.

Toye, J. (1991), 'Ghana' in P. Mosley, J. Harrigan and J. Toye, *Aid and Power: Volume 2, Case Studies*, London: Routledge, 151-200.

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

World Bank (1998), *Assessing Aid: What Works, What Doesn t, and Why*, Washington, DC: Oxford University Press for the World Bank.

APPENDIX A: DATA AND JOHANSEN ESTIMATES

Despite the over-parameterisation and low power of VAR-based methods we use this approach to check whether the key results of the single equation method are supported, and to test whether we can justify the assumption that exports, foreign aid, and government investment are weakly exogenous.

VAR(2) models, reported in Table A1 are estimated for models (a) and (b). Results for model (a) suggest that we may have one cointegration vector. Looking at the first vector in the β-matrix we observe that the signs on the variables are quite similar to that obtained from the single equation estimates. Results for model (b) also suggest one cointegrating vector. The estimates from this vector show that all the variables have a positive effect on private consumption. Weak exogeneity tests, summarised in Table A2, suggest that of the three variables in each model private consumption is the least likely to be weakly exogenous. The null of weak exogeneity cannot be rejected for any of the explanatory variables at the 5% level although given the sample size, this is not too surprising. There is some evidence of endogeneity regarding the exports variable although this is not consistent across models.

Table A2 Weak Exogeneity Tests

	Model (a)		Model (b)	
	Chi-Squared	p-value	Chi-Squared	p-value
Private consumption	15.335	0.001	22.506	0.0000
Government investment	0.0073	0.9320	---	---
Exports	2.845	0.0917	1.0678	0.3014
Foreign aid	---	----	2.4589	0.1169

Notes: The null hypothesis here is that the variable is weakly exogenous. Results have been summarised from estimates obtained from the multivariate analysis.

Table A1. Multivariate Cointegration Results

Model with Government Investment

Ho:rank=p	-Tlog(1-\mu)	using T-nm	95%	-T\Sum log(.)	using T-nm	95%
p == 0	**28.87***	**22.2**	**25.5**	**45.31***	**34.85**	**42.4**
p <= 1	10.88	8.37	19.0	16.44	12.65	25.3

standardized \beta' eigenvectors

LCp	LRIg	LX	Trend
1.0000	**-0.027461**	**-0.21330**	**-0.013673**
0.58091	1.0000	-1.3586	-0.039849
-108.73	56.416	1.0000	-8.8280

standardized \alpha coefficients

LCp	**-1.2205**	0.027828	-0.00014519
LRIg	-0.15893	-0.25673	-0.0027630
LX	1.0368	0.13002	-0.00050189

long-run matrix Po=\alpha*\beta', rank 3

	LCp	LRIg	LX	Trend
LCp	-1.1886	0.053154	0.22239	0.016861
LRIg	-0.0076564	-0.40825	0.37993	0.036796
LX	1.1669	0.073238	-0.39829	-0.014926

Model with Foreign Aid

Ho:rank=p	-Tlog(1-\mu)	using T-nm	95%	-T\Sum log(.)	using T-nm	95%
p == 0	**31.73****	**24.4**	**25.5**	**45.54***	**35.03**	**42.4**
p <= 1	8.396	6.458	19.0	13.82	10.63	25.3

standardized \beta' eigenvectors

LCp	LX	LRA	Trend
1.0000	**-0.26307**	**-0.053873**	**-0.011220**
-4.2481	1.0000	-4.5563	0.29089
-1.3169	1.1297	1.0000	-0.11341

standardized \alpha coefficients

LCp	**-1.4586**	-0.0024979	-0.011987
LX	0.78007	-0.040403	-0.043528
LRA	2.0085	0.022840	-0.18766

long-run matrix Po=\alpha*\beta', rank 3

	LCp	LX	LRA	Trend
LCp	-1.4322	0.36766	0.077970	0.016998
LX	1.0090	-0.29479	0.098539	-0.015569
LRA	2.1586	-0.71754	-0.39993	0.0053909

Table A3 Raw Data Used in the Analysis

Year	*Cp*	*X*	*Ig*	*Ip*	*Cg*	*A*	*Labour*
1970	3432.90	1654.80	224.86	353.67	504.78	109.44	4047.60
1971	3571.60	1548.60	243.04	364.23	535.04	100.90	4170.50
1972	3305.60	1797.50	162.75	135.23	492.80	115.65	4292.70
1973	3706.00	1789.00	131.20	258.31	427.18	71.82	4409.80
1974	4134.00	1404.30	147.10	454.54	470.37	58.29	4519.20
1975	3446.20	1377.90	191.81	322.07	503.75	180.53	4619.60
1976	3309.60	1446.50	252.04	94.05	405.75	90.20	4708.30
1977	3328.20	1086.20	349.41	91.39	136.34	113.95	4781.20
1978	3780.80	1039.00	167.69	64.61	355.60	134.40	4850.30
1979	3673.40	1021.30	136.51	138.93	385.99	176.95	4935.20
1980	3703.10	882.56	59.69	178.39	353.14	182.50	5047.80
1981	3388.80	804.41	95.99	90.79	260.03	140.52	5184.40
1982	2944.70	927.03	42.20	86.21	336.13	132.99	5342.60
1983	2997.80	502.59	32.47	103.58	231.73	98.17	5521.60
1984	3410.60	551.10	76.28	194.83	263.60	191.93	5719.10
1985	3395.70	672.09	156.85	239.64	307.64	180.21	5931.40
1986	3598.30	750.78	300.46	107.56	217.99	274.02	6144.10
1987	3839.00	826.51	340.15	136.41	153.95	371.69	6356.80
1988	4028.80	871.24	288.95	256.03	220.49	536.16	6568.80
1989	4129.40	979.17	433.32	236.31	132.83	693.04	6779.70
1990	4273.10	1039.90	460.25	296.41	102.03	501.47	6988.90
1991	4421.50	1136.30	431.25	444.52	189.07	737.18	7198.00
1992	4623.40	1167.10	589.36	140.29	228.98	547.57	7406.50
1993	4714.80	1366.40	668.12	762.59	410.02	623.05	7614.20
1994	4770.10	1428.00	825.93	575.58	283.37	623.78	7820.60
1995	4925.00	1582.70	907.49	457.73	151.52	653.27	8025.30
1996	5141.40	1954.30	899.37	490.61	209.77	637.65	8235.90
1997	5762.40	1946.30	876.04	759.50	303.61	504.54	8452.80

Notes: *Lab* Total labour force (thousands)
Cp Private consumption ($US million; constant prices 1995=100)
X Exports ($US million; constant prices)
Ig Government investment ($US million; constant prices)
Ip Private investment ($US million; constant prices)
A Foreign aid ($US million; constant prices)
Cg Current government consumption ($US million; constant prices)

APPENDIX B: MODELS OF GDP GROWTH

Ignoring the potential identity problem we estimate the long run versions of models *a* and *b* using real GDP. There is evidence that the variables are cointegrated, with the independent variables having the expected signs, and the coefficients are quite similar to those in Table 2 (Table B1). The parsimonious ECMs are also not very different from the private consumption models in terms of their predictions. In some cases, there were problems with the diagnostic tests, justifying our preference for the models based on private consumption. In summary:

- In model *a* (Table B2) export growth had an insignificant effect on output growth over the pre-1983 period, but a positive impact after 1983. Government investment growth had a negative impact on output growth pre-1983 and this appears to have been off-set post-1983. The speed of adjustment is about 82 per cent (i.e. no over-shooting). Explanatory power is quite high.
- In model *b* (Table B3) export growth appears to have had a negative impact on GDP growth that was not fully off-set after 1983. Aid growth had a negative effect on output growth prior to 1983 but a net positive impact after 1983. An impulse dummy for 1981 was necessary to correct for over-shooting; the speed of adjustment is then about 85 per cent.

Short run dynamic models for real GDP growth.

- Over 70 per cent of the variation in growth is explained by the independent variables in model *a* (Table B4). Both exports and government investment appear to have a net positive impact on growth after 1983. The RESET test was not passed.
- In model *b* (Table B5) impulse dummies for the years 1978 and 1981 were needed for the residuals to pass the normality test, and the RESET test was not passed. The results are consistent with changes in aid and exports being negatively associated with growth prior to 1983 but having a net positive impact after 1983.

Table B1. Long run estimates for model using GDP

Variable	*Model (a)*	*Model (b)*
Constant	6.236 *(0.199)*	6.052 *(0.136)*
Exports (X_t)	0.262 *(0.039)*	0.278 *(0.019)*
Trend	0.018 *(0.002)*	0.017 *(0.002)*
Government Investment (Ig_t)	0.017 *(0.021)*	
Foreign Aid (A_t)		0.035 *(0.024)*
t-value for ECM Test	-3.711	-4.608
t-value for Adapted EG Test	-6.254	-6.514

Table B2. Parsimonious ECM for GDP growth (with *Ig*)

Dependent variable is real GDP growth. Sample from 1972 to 1997

Variable	Coefficient	Std.Error	t-value	t-prob	PartR^2
Constant	-0.0073277	0.012905	-0.568	0.5776	0.0186
DLY_1	0.25765	0.17711	1.455	0.1639	0.1107
DLX	-0.088816	0.089619	-0.991	0.3356	0.0546
DLIg	-0.045625	0.020381	-2.239	0.0389	0.2277
DLIg_1	-0.041656	0.017906	-2.326	0.0326	0.2415
s83dlx	0.32520	0.093356	3.483	0.0028	0.4165
s83dlig	0.083235	0.032081	2.595	0.0189	0.2837
ECMYIGXT_1	-0.82099	0.23707	-3.463	0.0030	0.4136
s83	0.033254	0.018241	1.823	0.0859	0.1635

R^2 = 0.803495 F(8,17) = 8.689 [0.0001]

AR 1- 2 F(2, 15) = 1.8687 [0.1885]
ARCH 1 F(1, 15) = 0.19532 [0.6648]
Normality Chi^2(2)= 0.83118 [0.6600]
RESET F(1, 16) = 3.228 [0.0913]

Table B3. Parsimonious ECM for GDP growth (with A)

Dependent varable is real GDP growth. Sample 1972 to 1997					
Variable	Coefficient	Std.Error	t-value	t-prob	PartR^2
Constant	-0.10170	0.067874	-1.498	0.1548	0.1302
DLY_1	0.92306	0.12798	7.213	0.0000	0.7762
DLA	-0.10216	0.020117	-5.078	0.0001	0.6322
DLX	-0.15005	0.047526	-3.157	0.0065	0.3992
DLX_1	-0.15920	0.027468	-5.796	0.0000	0.6913
LCg	0.017170	0.011804	1.455	0.1664	0.1236
s83	0.029007	0.010059	2.884	0.0114	0.3566
s83dlx	0.23086	0.049390	4.674	0.0003	0.5929
s83dla	0.13034	0.025334	5.145	0.0001	0.6383
ECMYAXT_1	-0.85342	0.19113	-4.465	0.0005	0.5707
i81	-0.057417	0.021848	-2.628	0.0190	0.3153
R^2 = 0.944594 F(10,15) = 25.573 [0.0000]					
AR 1- 2 F(2, 13) =	1.4836 [0.2628]				
ARCH 1 F(1, 13) =	3.6509 [0.0783]				
Normality Chi^2(2)=	0.41421 [0.8129]				
RESET F(1, 14) =	1.4063 [0.2554]				

Table B4. Dynamic Short Run GDP growth model (with *Ig*)

Dependent variable is real GDP growth. Sample 1972 to 1997					
Variable	Coefficient	Std.Error	t-value	t-prob	PartR^2
Constant	0.14852	0.13422	1.107	0.2839	0.0672
DLY_1	-0.22758	0.15976	-1.425	0.1724	0.1066
DLX	-0.35472	0.090581	-3.916	0.0011	0.4743
DLIg	-0.046412	0.025339	-1.832	0.0846	0.1648
s83dlx	0.47018	0.11388	4.129	0.0007	0.5007
s83dlig	0.077271	0.037873	2.040	0.0572	0.1967
LCg_1	-0.032184	0.022463	-1.433	0.1701	0.1077
s83	0.061205	0.022779	2.687	0.0156	0.2981
R^2 = 0.713366 F(7,17) = 6.0442 [0.0012]					
AR 1- 1 F(1, 16) =	0.51234 [0.4844]				
ARCH 1 F(1, 15) =	0.64714 [0.4337]				
Normality Chi^2(2)=	2.9532 [0.2284]				
Xi^2 F(13, 3) =	0.68239 [0.7303]				
RESET F(1, 16) =	8.2047 [0.0112] *				

Table B5. Dynamic Short Run GDP growth model (with *A*)

Dependent variable is real GDP growth. Sample 1972 to 1997

Variable	Coefficient	Std.Error	t-value	t-prob	PartR^2
Constant	-0.023976	0.0059900	-4.003	0.0009	0.4852
DLY_1	0.33199	0.10874	3.053	0.0072	0.3541
DLA	-0.10358	0.015316	-6.763	0.0000	0.7290
DLX	-0.25122	0.039346	-6.385	0.0000	0.7057
s83	0.047257	0.0084999	5.560	0.0000	0.6452
s83dlx	0.29432	0.050284	5.853	0.0000	0.6683
s83dla	0.15457	0.025723	6.009	0.0000	0.6799
i78	0.10382	0.018195	5.706	0.0000	0.6570
i81	-0.063607	0.018971	-3.353	0.0038	0.3981

R^2 = 0.923375 F(8,17) = 25.608 [0.0000]

AR 1- 1 F(1, 16) = 0.17042 [0.6852]
ARCH 1 F(1, 15) = 0.035471 [0.8531]
Normality Chi^2(2)= 4.6711 [0.0968]
RESET   F(1, 16) = 5.0169 [0.0397] *

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