CREDIT Research Paper

No. 02/05

Aid and Growth in Sub-Saharan Africa: Accounting for Transmission Mechanisms

by

Karuna Gomanee, Sourafel Girma and Oliver Morrissey

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

The Centre for Research in Economic Development and International Trade is based in the School of Economics at the University of Nottingham. It aims to promote research in all aspects of economic development and international trade on both a long term and a short term basis. To this end, CREDIT organises seminar series on Development Economics, acts as a point for collaborative research with other UK and overseas institutions and publishes research papers on topics central to its interests. A list of CREDIT Research Papers is given on the final page of this publication.

Authors who wish to submit a paper for publication should send their manuscript to the Editor of the CREDIT Research Papers, Professor M F Bleaney, at:

Centre for Research in Economic Development and International Trade,
School of Economics,
University of Nottingham,
University Park,
Nottingham, NG7 2RD,
UNITED KINGDOM

Telephone (0115) 951 5620
Fax: (0115) 951 4159

CREDIT Research Papers are distributed free of charge to members of the Centre. Enquiries concerning copies of individual Research Papers or CREDIT membership should be addressed to the CREDIT Secretary at the above address. Papers may also be downloaded from the School of Economics web site at:
www.nottingham.ac.uk/economics/research/credit

CREDIT Research Paper

No. 02/05

Aid and Growth in Sub-Saharan Africa: Accounting for Transmission Mechanisms

by

Karuna Gomanee, Sourafel Girma and Oliver Morrissey

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

The Authors
Karuna Gomanee is a Research Student, Sourafel Girma a Research Fellow and Oliver Morrissey is Reader in Development Economics and Director of CREDIT, all in the School of Economics, University of Nottingham.

February 2002

Aid and Growth in Sub-Saharan Africa: Accounting for Transmission Mechanisms

by
Karuna Gomanee, Sourafel Girma and Oliver Morrissey

Abstract
This paper is a contribution to the literature on aid and growth. Despite an extensive existing empirical literature in this area, studies have not paid much attention to the importance of transmission mechanisms in determining the influence of aid inflows on growth rates. In other words, existing studies have failed to specify the mechanisms via which aid should affect growth. We identify investment as the most significant transmission mechanism, and also consider effects of aid via government spending and imports. With the use of residual generated regressors, we estimate the total effect of aid on growth, accounting for the effect via investment. Pooled panel results for a sample of sub Saharan African countries over the period 1970 to 1997 point to a highly significant positive effect of foreign aid on growth. On average, each one percentage point increase in the aid/GNP ratio adds one-third of one percentage point to the growth rate. The results are robust to issues of endogeneity, outliers and country-specific effects. Africa's poor growth record should not therefore be attributed to aid ineffectiveness.

Outline

1. Introduction
2. Transmission Mechanisms
3. Data and Estimation Issues
4. Results and Discussion
5. Conclusion

I. INTRODUCTION

A fundamental argument for aid, at least on economic grounds, is that it contributes to economic growth in recipient countries – a testable hypothesis. Two recent papers have breathed new life into the empirical question of aid effectiveness. Burnside and Dollar (2000) find that when other determinants of growth are controlled for, especially an indicator of economic policy, aid has no effect. Aid only makes a positive contribution to growth in those countries with high values for the policy indicator; if policy is poor, aid is ineffective. This result is explained by the tendency of recipients, especially if they have poor policies, to divert aid to government consumption spending rather than using it to finance growth-promoting investment (Burnside and Dollar, 2000: 863). Hansen and Tarp (2001) beg to differ. Using essentially the same data for the same sample, but with different specifications and estimators, they find that aid does have a positive effect on growth and this result is not conditional on policy. The jury is out.

This paper is not an attempt to resolve disputes in the literature. Rather, we want to focus on a particular issue – the treatment of investment in the specification of the growth equation. Burnside and Dollar (2000, hereafter BD) argue that aid adds to investment whereas policy determines the productivity of investment and therefore include an 'aid×policy' interaction term but exclude investment. Hansen and Tarp (2001, hereafter HT) acknowledge that the implicit growth theory will have investment, not aid, as an argument. They present some results including aid and investment. In general, aid is not significant in these regressions, but they do find that aid is a significant determinant of investment.

This represents a deficiency in the existing aid effectiveness literature. Aid is intended to affect growth via its effect on investment. However, not all aid is intended for investment, and not all investment is financed by aid. If one adopts the approach of omitting investment, the regression is misspecified and the estimated coefficient on aid is biased (downward, as a significant proportion of aid is not used for investment). If one includes aid *and* investment, there is double counting (as some aid is used for investment), and the coefficient on aid is again biased downwards. We propose the technique of generated regressors to address this problem.

The analysis is conducted for a sample of 24 sub Sahara African (SSA) countries. There is considerable evidence in the empirical growth literature that SSA countries are different. It is generally the case that in cross-country growth regressions an 'Africa' dummy is negative and significant (Collier and Gunning, 1999). Furthermore, they tend to be major aid recipients. Despite large aid inflows, SSA countries on average experienced only 0.6% growth in real per capita GDP per annum over the period 1970 to 1997, and only six of the 24 in our sample have managed to upgrade to the group of middle income countries.[1] *A priori*, this may appear to be a case of aid ineffectiveness. If aid has been misused and ineffective, we should find evidence of this in a sample comprising SSA countries.

Whilst our specific focus is on the treatment of aid and investment, it is clear from the aid effectiveness literature that any effect of aid on growth is indirect. Section 2 presents a brief discussion of the various factors that mediate the effect of aid on growth, what we refer to as the transmission mechanisms. In addition to investment, aid may affect growth via effects on government spending or imports. The data used and econometric methods are discussed in Section 3 (with further details in the Appendices). Section 4 presents the empirical results. Finally, Section 5 concludes with directions for future research.

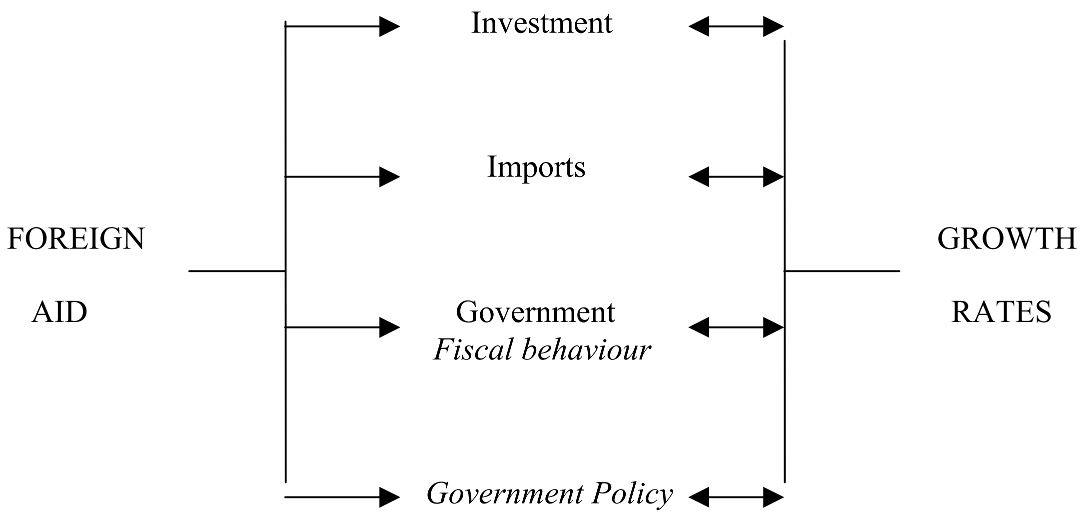
II. TRANSMISSION MECHANISMS

Although there have been major advances in growth theory, the conceptual underpinning of the link between aid and growth remains rooted (implicitly if not explicitly) in the two-gap model pioneered by Chenery and Strout (1966). The analytical framework is grounded in a Harrod-Domar growth model where savings are needed to fund the investment required to attain a target growth rate, conditional on the productivity of capital. Poor countries lack sufficient resources to finance investment and imports of capital goods and technology. Aid to finance investment can directly fill the savings-investment gap and, as it is in the form of hard currency, can fill the foreign exchange gap. As official aid is issued to government, it can also fund government spending and compensate for a small domestic tax base. Bacha (1990) demonstrates that government fiscal behaviour represents an important channel through which aid flows can influence

1 Botswana, Gabon, Mauritius, Seychelles, South Africa and Swaziland according to World Bank (2000) classification.

growth. Recent studies also highlight the potential importance of government policy as a determinant of the effects of aid. Figure 1 summarises the potential linkages between aid and growth.

Figure 1. Transmission Mechanisms for Aid to Growth



A proper framework to study how aid works should address all of these interactions. The analysis here focuses on the effect of aid on growth taking into account the transmission mechanisms of investment, trade (imports) and fiscal behaviour (government consumption spending). If aid finances investment then, conditional on the productivity of investment, that aid contributes to growth. Low-income countries will need to import capital goods and intermediate inputs (and in most cases fuel), but export earnings are often low and volatile. Aid can finance necessary imports, so this is a potential transmission mechanism. If aid is treated as fungible, so that funds intended for investment are diverted to recurrent expenditures, effectiveness should be reduced. This is addressed by considering government consumption as a (constraining) transmission mechanism. The basic approach is to identify if aid determines the transmission variables. If it does, this effect is accounted for in estimating the aid-growth relationship.

There are two reasons why we do not pursue the transmission mechanism via government policy in this paper. First, the conventional view, at least in the context of cross-country growth regressions, is that it is difficult to establish that aid affects policy (BD; World Bank, 1998). In simple terms, the nature of this transmission mechanism and how to model it is not well understood. We would therefore expect this mechanism to be weak in cross-country regressions.[2] Second, recent work on aid effectiveness incorporates policy indicators as control variables, and we do this. It is an empirical question as to whether one can identify an effect of aid controlling for policy variables, or an aid×policy term is required.

Another issue we do not incorporate is the tendency for SSA countries to be subject to political and economic instability. Relative to other regions, SSA is especially susceptible to climatic and agricultural risk and especially vulnerable to terms of trade shocks, famines, political conflict, droughts and, more recently, floods. Guillaumont *et al* (1999) find that SSA has higher levels of primary instabilities (political, climatic and terms of trade) than other developing country regions. Such vulnerability is a source of 'economic uncertainty' that may reduce growth rates and help to explain aid ineffectiveness. Lensink and Morrissey (2000) use aid instability, deviations of aid from a trend incorporating adaptive expectations, as a measure of uncertainty. They find that when one controls for such uncertainty in the aid-growth regression, the coefficient on aid is positive and significant whereas the coefficient on the aid instability measure is negative and significant. This result holds for the sample of SSA countries. They also find that the principal (positive) impact of aid is via its impact on investment, a result corroborated by HT.

There is related evidence for the importance of instability or uncertainty in SSA. Gyimah-Brempong and Traynor (1999) find that political instability has a direct negative effect on growth and also an indirect effect via discouraging investment. Guillaumont *et al* (1999) find that primary instabilities in SSA reduce growth by distorting economic policy; the rate of investment is volatile, hence the growth rate is lowered. As discussed in the next section, by including policy indicators (notably inflation), a political variable and investment in our specification we hope to pick up some of these effects. We can also try

2 The point is that the way in which aid affects policy is complex and will depend on specific, usually unmeasurable, features of the recipient. Furthermore, aid may affect some policies and not others, and may affect policies over varying time spans (often of five and more years). This is a complex research topic in its own right, beyond the scope of this paper.

to account for these omitted variable effects in the estimation (using fixed or random effects estimators).

The specific aim of this paper is to account for the transmission mechanism of aid on growth via investment. Although we concentrate on a sample of SSA countries, we want to relate the results to the recent contributions on aid effectiveness (BD and HT). Consequently, we choose a specification close in spirit to that used in these studies. It is well known that there are many variables that might be significant in cross-country growth regressions, but degrees of freedom considerations and data constraints require choices to be made. The data used here and the estimation techniques are discussed in the next section.

III. DATA AND ESTIMATION ISSUES

Estimation is conducted in a panel of seven four-year periods over 1970-97. Our dependent variable (*GROWTH*) is (period) growth of real per capita GDP (data definitions and sources are provided in Appendix A). Real GDP per capita in the year preceding the period (*GDP0*) is included to capture initial country specific effects.[3] The percentage of population aged 15 or above who have completed primary education (*PRIC15*) and investment as a share of GDP (*INV*) are included as indicators of (additions to) human and physical capital. We use two measures of aid, both expressed as a percentage of GNP and taken from OECD (1999).[4] The first is simply the total of grant aid (*GRANTS*) while total aid (*TAID*) is net ODA (the sum of ODA grants and net loans) excluding food aid and technical cooperation. Squared aid terms (*GRANTSQ* and *TAIDSQ*) are included to account for diminishing returns. Most studies of aid effectiveness posit a non-linear relationship and therefore include a squared term (see Morrissey, 2001).

We include a number of indicators of political and economic policy features of the countries. Alesina *et al* (1992) construct a democracy index *DEM* taking values between

3 Many studies, such as BD, use *lnGDP0* rather than *GDP0*, essentially as the log specification is a test for convergence. As our sample is restricted to SSA and initial GDP is used to control for initial country conditions rather than to test for convergence, we use *GDP0*. We did include *lnGDP0* in the regressions and the results are similar although significance levels on all variables are reduced, as can be expected given that the transformation *GDP0* to *lnGDP0* reduces the variance of the series.

4 BD use the World Bank EDA aid data, that adds the grant element of concessional loans to pure grants. However, HT demonstrate that OECD and EDA data yield similar results.

1 and 3 based on information on electoral systems.[5] Higher values indicate weaker political rights. Three policy variables are included: the inflation rate (*INFL*), government consumption as a share of GDP (*GCON*) and imports as a percentage of GDP (*MGDP*) as an indicator of openness.[6] The latter two variables also represent potential transmission mechanisms. As we report and discuss later, however, the effect of aid is not mediated by these variables. Hence in the regressions, all three can be interpreted as policy indicators.

The base specification in general terms is therefore (suppressing country and time subscripts, and designating the error term as *U*):

$$\boldsymbol{g} = \beta_C{}'\mathrm{c} + \boldsymbol{\beta_A A} + \beta_E{}'\mathrm{e} + \beta_P{}'\mathrm{p} + \boldsymbol{U} \qquad \mathbf{(1)}$$

The dependent variable is growth (*g*) and the measure of aid is designated by *A*. There are three vectors of other variables. The vector of conditioning variables (**c**) includes initial income, investment and human capital. The economic policy indicators (**e**) are inflation, government consumption and the import/GDP ratio. The political indicator (**p**) is democracy. Descriptive statistics for the data are provided in Appendix Tables A1-A3.

As our panel data has both time and cross-section dimensions, the estimation issues are combinations of those encountered in purely time series or cross section studies. Two core issues that characterise any empirical study based on panel data are endogeneity and country-specific effects. The former relates to problems which arise from the time series dimension whilst the latter results from observing several countries together. We consider each briefly (details are in Appendix B) before discussing the generated regressor technique employed in the analysis.

A critical assumption of OLS is that there is zero correlation between the error term and any explanatory variable. If this is violated, the latter is endogenous and OLS estimates will not be consistent. The standard instrumental variables (IV) solution is to perform a

---

5 1 for democratic regimes (countries with free competitive general elections with more than 1 party running), 2 for mixed democratic and authoritarian features (countries with some form of elections but with severe limits in the competitiveness of such ballots) and 3 for authoritarian regimes (countries in which their leaders are not elected).

two stage procedure whereby instruments are used for the endogenous variable. The issue of endogeneity and the appropriate choice of instruments lies at the root of the differences in results of BD and HT. BD initially posit two equations, one in which growth is a function of aid, aid×policy, and vectors of policy and other variables, and a second in which aid itself is a function of the vectors of policy and other variables. Given the likelihood that the error term between these two equations is correlated, they propose a 2SLS estimation in which the first stage is to instrument for aid. They select as instruments variables believed to be important in aid allocation decisions that are not determinants of growth.[7] HT, on the other hand, instrument for aid using its own lagged values (and carry this approach to its logical extreme by also using GMM estimators), justified on the argument that lagged aid is predetermined with respect to growth in the subsequent period. The results are very different, and it is generally the case that results using IV techniques are sensitive to the choice of instruments.

We use the Hausman test to investigate whether investment and aid terms are indeed endogenous. This involves comparing the results of OLS and IV regressions (using the Sargan test for the validity of instruments). The test strongly fails to reject the null hypothesis that regressors and error term are uncorrelated (Appendix B, Table B1). Consequently, in our sample, we find no evidence of the need to use instruments.

Another problem frequently encountered in estimation relates to outliers, values of the dependent variable that are unusual, given the values of the explanatory variables (response outliers), or unusual values of an explanatory variable (design outliers). The inclusion or exclusion of outliers, especially if the sample size is small, can substantially alter the results of regression analysis. If useful generalisations are to be drawn, it becomes important to ensure that the results reflect what is going on in the majority of the sample rather than being driven by a few outlying observations only.

In the empirical literature, various approaches have been used to address the issue of outliers. In some cases, the regression model is re-estimated iteratively omitting one

---

6 The difficulty of measuring openness is recognised in the literature. This measure is however chosen as it also reflects a transmission mechanism.

7 BD (p. 862) report the IV regression for aid for low-income countries. While the explanatory power is good, the most significant determinants are initial GDP and population. The former at least would be expected to be correlated with growth.

observation at a time with the aim of identifying that which exerts a significant influence on the set of estimates. This is known as the 'deletion method'. It would clearly be quite a cumbersome process, especially for a large data set. In other cases, observations with high residuals are excluded from the sample. Both procedures can be seen as part of a sensitivity analysis after the main results have been obtained. It is also quite common to omit data points with extreme values of the explanatory variables. Several standard deviations away from the mean value can define extreme values. There is an element of subjectivity associated with this definition. For example, BD dropped observations that are five standard deviations away from the average data point, whereas HT dropped those which are two standard deviations away. We have here chosen an alternative method – robust regression (Rousseeuw and Leroy, 1987), detailed in Appendix B.

Robust regression, which retain all observations but attaches lower weight to outliers, is used throughout this paper. Gabon and Botswana are identified as outliers when the 'data points taking extreme values' approach is used and they both receive the lowest weights in the estimations. This could be anticipated as both are countries that have used effectively their natural resources, oil in the case of Gabon and diamonds in the case of Botswana. The advantage with the robust estimation procedure is that it minimises the influence of outlying observations on the estimated equation rather than omitting them altogether from an already small sample of which they are part.

Another inherent problem in panel growth regressions is that one is observing a relationship across countries, hence there is potential heterogeneity. SSA countries are similar to each other in respect to some structural characteristics, relating mainly to their stage of economic and political development and climatic conditions. However, they comprise a heterogeneous group of countries in terms of size, population, level of GDP, institutional arrangements, resource endowments and so on. While we try to control for many of these variables (and robust estimation accounts for some of the problems), we cannot discount the possibility of country-specific effects due to omitted variables.

In a dynamic panel model, like the growth equation we consider, the basic difficulty with fixed effects lies in the fact that their presence renders the lagged dependent variable (*GDPO*) correlated with the equation disturbance. The standard 'within' transformation typically used in static models fails to deliver consistent estimators as it would not eliminate the fixed effects. A popular way of circumventing this problem is to remove the fixed effects via first differencing and then use variants of the instrumental variable estimation technique (e.g. GMM). We tried using lagged values of GDP and other covariates as instruments in the first-differenced (i.e. growth rate of growth) equations in the spirit of Arellano and Bond (1991), but results were not robust - small changes in the instrumental variables set produced dramatic variations in the estimated coefficients. Furthermore, in addition to reducing the sample size, the first difference transformation seems to result in loss of most of the variation and covariation in the data (see Appendix A).

We abandoned the GMM approach on theoretical grounds also. Recently the fundamental assumption of pooling individual times series data has been questioned. Robertson and Symons (1992) and Pesaran and Smith (1995) demonstrate that standard GMM estimators of the type discussed above lead to invalid inference if the response parameters are characterised by heterogeneity. For example, suppose that the response to a percentage increase in aid differs systematically across countries (a realistic assumption). In a pooled regression, the aim is of course to identify the average (across countries) effect of aid on growth. What Robertson and Symons (1992) and Pesaran and Smith (1995) have convincingly demonstrated is that in these circumstances standard panel GMM estimators will not deliver unbiased estimates of the mean effect. The latter went on to argue that since valid instruments are hard to come by for heterogeneous dynamic panels, one is better to average parameters from individual time series regressions. This is not feasible in our context, as the individual countries' time series lengths are not adequate (we only have seven time periods, due to the period averaging).

Another theoretical reason why GMM is not suitable for our purpose has to do with the fact that we are using a generated regressor, in the hope of accounting for the transmission mechanisms in the aid-growth relationship. It is not obvious how standard panel GMM estimators could handle generated regressors, and to our knowledge the problem has not yet been addressed in the econometric literature. For these reasons, we do not employ GMM techniques.

Residual Generated Regressors

It has become common practice to estimate regression equations in which constructed variables appear. The most popular method to generate regressors is to use predicted values or residuals from a supplementary regression (indeed, IV is an example of the former). Given the prevalence of such models, Pagan (1984) presented 'a fairly complete treatment' of the econometric issues underlying regressions with generated variables. As this is the method we use to incorporate transmission mechanisms, a brief discussion is in order. Formally, the approach is a special case of the following general model (in matrix form):

$$\mathbf{Y} = \mu\, \mathbf{X}^* + \gamma(\mathbf{X}-\mathbf{X}^*) + \mathbf{U} \tag{2a}$$

$$\mathbf{X} = \mathbf{X}^* + \eta = \omega\mathbf{Z} + \eta \tag{2b}$$

The expression (**X-X***) represents that part of **X** which is explained by factors other than **Z**. Equation 2b estimates the relationship between **Z** and **X** such that ω gives a measure of the strength of the link that exists between them. Two procedures have been proposed to estimate models of this form. One could maximise the log likelihood function and obtain the maximum likelihood estimators $\tilde{\mu}$, $\tilde{\gamma}$ and $\tilde{\omega}$. Alternatively, one could construct the two-step estimators $\hat{\gamma}$ and $\hat{\mu}$ by first estimating (2b) and then regressing y against $\hat{X}$ and $(X-\hat{X})$. Pagan (1984) shows that the two-step procedure gives asymptotically efficient estimates and that TSLS estimates will provide the correct values for the standard error of $\hat{\mu}$.

However, if the variance estimator of the residual-generated regressor converges to σ_U^2, OLS would seem to provide correct estimates for the standard error of $\hat{\gamma}$. In our study, $\mu = 0$, i.e. we construct the generated regressor using only the residuals from a supplementary equation. This implies that OLS gives us the correct estimates of variance as well as efficient coefficient estimates. This conclusion is independent of whether (2a) includes additional regressors or/and the latter appear in the matrix Z – in our case, aid appears in (2b). Hence, the use of residuals does not invalidate the inferences made and coefficient estimates are efficient.

We construct the variable representing that part of investment that is not attributed to aid (*INVRES*) using residuals from an aid-investment bivariate regression (capturing the transmission from aid to investment). *INVRES* is the estimate of κ_I from the regression

$INV = \kappa_1 + \kappa_2\, AID$.[8] We then substitute *INVRES* for *INV* in the growth regression. It is worth noting that this transformation affects only the estimated coefficient on the aid variables. This can easily be demonstrated in general terms. Suppose the initial regression is:

$$g = \beta_1 X + \beta_2 A + \boldsymbol{\beta}_{\mathbf{Z}}'\mathbf{z} + U \tag{1a}$$

where z is the vector of other variables, substituting $X = \kappa_1 + \kappa_2\, A$:

$$g = \beta_1(\mathrm{X}\text{-}\kappa_2\, A) + \beta_1(\kappa_2\, A) + \beta_2 A + \boldsymbol{\beta}_{\mathbf{Z}}'\mathbf{z} + U \tag{1b}$$

or

$$g = \beta_1\kappa_1 + (\beta_1\kappa_2 + \beta_2)A + \boldsymbol{\beta}_{\mathbf{Z}}'\mathbf{z} + U \tag{1c}$$

Thus, it is clear that only the coefficient on the aid variable is altered. In cases where the 'transmission' variable (*X*) has a positive effect on growth, and aid has a positive effect on the variable, this method will provide for a larger coefficient on aid. If the variable has a negative effect on growth, and aid is a positive determinant of the variable, the coefficient on aid is reduced. If it transpires that aid is not a determinant of the variable, there is no effect and the method is not used.

IV. RESULTS AND DISCUSSION

Our basic specification is:

$$\begin{aligned} GROWTH_{it} \quad &= \delta_0 + \delta_1 GDP0_{i,t-1} + \delta_2\, PRIC15_{it} + \delta_3\, INV_{it} + \delta_4 DEM_i + \delta_5 INFL_{it} \\ &\quad + \delta_6 GCON_{it} + \delta_7 MGDP_{it} + \delta_8\, AID_{it} + \delta_9 AIDSQ_{it} + u_{it} \end{aligned} \tag{3}$$

The variables are discussed in Section 3 above. Three potential transmission variables are included (*INV*, *GCON* and *MGDP*). We first test if these are indeed transmission mechanisms for the effect of aid, and the results are reported below. It transpires that aid

8 Two other approaches have been explored to quantify the total effect of aid on growth – a system of equations and deriving κ_2 from an investment regression where aid is only one of the explanatory variables. Here, we focus on the residual generated regressor approach.

is only a significant determinant of investment and imports, among these variables, but only investment is a significant determinant of growth. We then present and discuss our final set of results.

IV.i Transmission Mechanisms

The investment regression is given as:

$$INV_{it} = \beta_0 + \beta_1 INV_{i,t-1} + \beta_2 \; PRIC15_{it} + \beta_3 INFL_{it} + \beta_4 GASTILS_i + \beta_5 LNCRED_{it} + \beta_6 AID_{it} + \beta_7 AIDSQ_{it} + \varepsilon_{it} \qquad (4)$$

We use *INV* as the dependent variable to investigate if this transmission mechanism is operational. To account for the dependence of current investment levels on physical and human capital stock, we include one period lagged investment and percentage of population aged 15 or above who have completed primary education (*PRIC15*). The policy and political indicator comprise the inflation rate (*INFL*) and Gastils index of rights (*GASTILS*). The latter takes values between 1 and 7, where higher values indicate less freedom. With regards to the widely acknowledged view that finance is the key to investment, we include logarithm of credit available to private sectors (% of total domestic credit) in addition to foreign aid as an alternative source of finance. Table 1 presents the set of estimates.

The regressions generate coefficient estimates with the expected signs. We obtain evidence of a highly significant positive effect of aid on investment. On average, an increase in *GRANTS* and *TAID* by one percentage point raises the investment share in GDP by about 0.33 and 0.53 percentage points respectively. As expected, *TAID* is more important both in terms of magnitude and significance. Results appear to suggest that investment is a significant transmission mechanism and therefore it is necessary to consider the ‘double-counting’ problem.

Table 1: Pooled OLS Investment regressions

	INV	INV
INV_1	0.785	0.799
	(5.51)***	(5.69)***
GASTILS	-0.902	-0.984
	(2.59)**	(2.94)***
PRIC15	0.275	0.290
	(1.80)*	(1.94)*
LNCRED	1.773	2.005
	(2.79)***	(3.04)***
INFL	-0.003	-0.002
	(2.43)**	(1.69)*
GRANTS	**0.333**	
	(2.09)**	
GRANTSQ	**-0.007**	
	(2.77)***	
TAID		**0.528**
		(3.04)***
TAIDSQ		**-0.012**
		(3.56)***
Constant	-2.074	-4.341
	(0.54)	(1.06)
Observations	126	126
R-squared	0.65	0.66
F-Stat	27.17	22.91
Prob>F-Stat	0.00	0.00

Notes: All regressions run in a panel of seven four-year periods over 1970-97. Time dummies included in all regressions. Absolute t-values based on White heteroscedasticity-consistent standard errors are reported in brackets.
* Significant at 10% level. ** 5% level. *** 1% level. F-Stat tests the joint significance of all coefficients.

The import regression is given as:

$$MGDP_{it} = \eta_0 + \eta_1 XGDP + \eta_2 AID_{it} + \eta_3 TOT_{it} + \eta_4 ER_{it} + \eta_5 BMP_{it} + \eta_6 CFA + e_{it} \qquad (5)$$

Table 2: Pooled OLS Imports regressions

	IMPORT	IMPORT

XGDP	0.614	0.610
	(5.51)***	(5.50)***
GRANTS	**0.921**	
	(3.24)***	
TAID		**0.713**
		(3.42)***
TOT	-0.045	-0.049
	(2.04)**	(2.14)**
RER	-0.003	-0.004
	(1.96)*	(2.07)**
BMP	-0.027	-0.029
	(2.02)**	(2.07)**
CFA	-6.236	-6.187
	(1.80)*	(1.75)*
Constant	22.095	25.115
	(3.16)***	(3.24)***
Observations	131	131
R-squared	0.33	0.31
F-Stat	13.36	14.01
Prob>F-Stat	0.00	0.00

Notes: As for Table 1.

We use *MGDP* as the dependent variable. Exports are introduced as an additional source of financing imports, other than aid flows. Three indicators of the trade environment are included: terms of trade (*TOT*), real exchange rate (*ER*), black market premium (*BMP*) and a dummy (*CFA*) that takes value of 1 for countries which are members in CFA franc zone.

Overall, the regressions perform well (Table 2). The chosen specification explains at least 30% of the variation in the dependent variable. Aid flows seem to be a significant source of finance for imports (as would be expected). On average, a one percentage point increase in *GRANTS* increases imports by 0.9 percentage points, whilst each extra percentage point of *TAID* adds 0.7 percentage points to the share of imports in GDP. Based on these estimates, it would appear that imports are a potential transmission mechanism.

We use government consumption as a share of GDP (*GCON*) as our dependent variable to estimate the following equation:

$$GCON_{it} = \lambda_0 + \lambda_1\, TRGDP_{it} + \lambda_2 INFL + \lambda_3 EXTDEBT_{it} + \lambda_4 AID_{it} + \lambda_5 STATE_i + u_{it} \qquad (6)$$

Table 3: Government Consumption Regressions

	GCON	GCON
TRGDP	0.524	0.516
	(8.97)***	(8.89)***
INFL	0.003	0.003
	(4.47)***	(4.19)***
EXTDEBT	-0.001	0.000
	(0.09)	(0.03)
GRANTS	**0.106**	
	(1.38)	
TAID		**0.076**
		(1.02)
STATE	-1.508	-1.296
	(1.71)*	(1.56)
Constant	4.809	5.187
	(3.12)***	(3.48)***
Observations	138	138
R-squared	0.51	0.50
F-Stat	10.89	11.51
Prob>F-Stat	0.00	0.00

Notes: As for Table 1.

Public sector decision-makers allocate revenue among various expenditure categories. Stated differently, government revenue determines government expenditure. Thus, we consider both domestic and foreign sources of government revenue as determinants of government consumption – total tax revenue as a share of GDP (*TRGDP*), inflation (*INFL*) to represent seignorage, external debt as a share of GDP (*EXTDEBT*) and foreign aid flows (*AID*). Finally, in recognition of the fact that features of the existing political institution influences allocation of government resources, we introduce *STATE* (Englebert, 2000). The latter takes value of 1 (0 otherwise) for legitimate countries which are believed to have more efficient governments. Table 3 presents the estimation results.

In general, the regressions perform reasonably well. They explain about 50% of the variation in government consumption. All variables enter with the expected signs. However, the results suggest that aid flows do not tend to finance government non-productive expenditure. Instead, it seems that governments in SSA countries rely quite significantly on distortionary taxes and seignorage to finance their recurrent spending. Consequently, we assume that the coefficient on *GCON* in aid-growth regressions does not include any substantial indirect effect of aid. Note that these results do not support the common assertion that aid is fungible (although the regressions are not a direct test of this), at least for this sample.

IV.ii Aid-Growth Regressions

Having identified that investment and imports are the main transmission mechanisms through which aid affects growth rates, we now report the estimation results of the growth model as specified by equation (1). Table 4 presents the robust aid-growth regressions. All variables enter with the expected sign except for *GDPO*. Since *TAID* excludes food aid (which does not directly affect growth) and technical cooperation (which might influence growth but with a long time lag), as expected it has a slightly larger impact on growth than *GRANTS*. An extra percentage point of *GRANTS* and *TAID* disbursed is estimated to increase growth rates by about 0.16 and 0.17 percentage points respectively. Interestingly, we find that the lagged effect of aid on growth is more important than its immediate impact. The negatively signed aid squared terms are consistent with the proposition of an aid Laffer curve (Lensink and White, 2001), or more generally diminishing returns to aid.

By including both transmission mechanisms and aid in our regressions, the total effect of aid on growth is spread out across the coefficients on these variables. The coefficient on our aid term will be an incorrect measure of overall aid effectiveness. Thus, we use the residual generated regressor to overcome this problem. The results suggest that the significant impact of aid on imports does not translate into any important growth effects. Consequently, the investment term is the only relevant transmission mechanism.

Table 4: Robust Aid-Growth Regressions

Effect of current aid	*Effect of lagged aid*

GDPO	0.001	0.001	0.001	0.001
	(2.38)**	(2.35)**	(2.22)**	(2.07)**
PRIC15	0.212	0.205	0.182	0.177
	(3.09)***	(2.99)***	(2.34)**	(2.27)**
INV	0.109	0.111	0.105	0.106
	(4.42)***	(4.49)***	(4.01)***	(4.02)***
DEM	-1.261	-1.328	-1.287	-1.231
	(3.52)***	(3.69)***	(3.34)***	(3.19)***
INFL	-0.004	-0.004	-0.004	-0.004
	(2.50)**	(2.50)**	(2.55)**	(2.68)***
GOVCON	-0.149	-0.143	-0.151	-0.134
	(2.64)***	(2.58)**	(2.59)**	(2.33)**
MGDP	0.002	0.002	-0.001	0.000
	(0.22)	(0.21)	(0.12)	(0.02)
GRANTS	**0.161**			
	(1.89)*			
GRANTSQ	**-0.003**			
	(1.65)			
TAID		**0.174**		
		(1.85)*		
TAIDSQ		**-0.004**		
		(1.69)*		
GRANTS_1			**0.265**	
			(2.59)**	
GRANTS_1SQ			**-0.006**	
			(2.22)**	
TAID_1				**0.242**
				(2.25)**
TAID_1SQ				**-0.006**
				(1.99)**
Constant	0.525	0.655	0.477	0.310
	(0.32)	(0.39)	(0.28)	(0.17)
Observations	149	149	135	135
R-squared	0.46	0.46	0.44	0.43

Notes: As for Table 1 except that t-statistics are not based on White-heteroscedasticity-consistent standard errors, as a weighting system is used for the robust regression.

Table 5: Robust Aid-Growth Regressions with *INVRES*

	Effect of current aid		*Effect of lagged aid*	
GDPO	0.001	0.001	0.001	0.001
	(2.38)**	(2.35)**	(2.22)**	(2.07)**
PRIC15	0.212	0.205	0.182	0.177
	(3.09)***	(2.99)***	(2.34)**	(2.27)**
INVRES	0.109	0.111	0.105	0.106
	(4.42)***	(4.49)***	(4.01)***	(4.02)***
DEM	-1.261	-1.328	-1.287	-1.231
	(3.52)***	(3.69)***	(3.34)***	(3.19)***
INFL	-0.004	-0.004	-0.004	-0.004
	(2.50)**	(2.50)**	(2.55)**	(2.68)***
GCON	-0.149	-0.143	-0.151	-0.134
	(2.64)***	(2.58)**	(2.59)**	(2.33)**
MGDP	0.002	0.002	-0.001	0.000
	(0.22)	(0.21)	(0.12)	(0.02)
GRANTS	**0.306**			
	(3.46)***			
GRANTSQ	**-0.003**			
	(1.65)			
TAID		**0.319**		
		(3.31)***		
TAIDSQ		**-0.004**		
		(1.69)*		
GRANTS_1			**0.431**	
			(4.08)***	
GRANTS_1SQ			**-0.006**	
			(2.22)**	
TAID_1				**0.402**
				(3.66)***
TAID_1SQ				**-0.006**
				(1.99)**
Constant	0.525	0.655	0.477	0.310
	(0.32)	(0.39)	(0.28)	(0.17)
Observations	149	149	135	135
R-squared	0.46	0.46	0.44	0.43

Notes: As for Table 4.

Table 5 reports the aid-growth regressions in which *INVRES*,[9] which can be thought of as that part of *INV* that is not a function of aid, has been introduced. The new set of

9 *INVRES* is recovered from the following regressions (t-ratios in brackets):

INV=1.33GRANTS R^2=0.41 ; INV=1.58GRANTS_1 R^2=0.46
(12.78) (13.20)

INV=1.30TAID R^2=0.39 ; INV=1.51TAID_1 R^2=0.42
(12.17) (12.16)

coefficient estimates for aid variables are greater than in the original model, both in terms of magnitude and significance. This supports our hypothesis that the aid coefficient in a regression including an investment term will be an underestimate of the true effect of aid on growth. An additional percentage point of *GRANTS* and *TAID* disbursed is now estimated to increase growth rates by about 0.31 and 0.32 percentage points respectively. Again, we find that the lagged effect of aid on growth is more important than its immediate impact.

In line with previous studies we find evidence of diminishing returns to aid, but leave to a future paper the task of identifying the critical level of aid/GNP beyond which aid does not contribute to growth. In contrast to studies such as Burnside and Dollar (2000), we find no evidence that aid revenues are used to finance government consumption spending, although we do find that such expenditures have a negative effect on growth. Inflation is included as a (macroeconomic) policy control, and has the expected negative sign. More democratic regimes appear to have higher growth performance (the coefficient on *DEM* is negative). The variables with positive effects on growth are aid, investment, education and initial GDP (i.e. divergence in the sample as countries with higher incomes at the start of the period tended to have higher growth rates during the period).

V. CONCLUSION

Our concern has been to address the question of aid effectiveness in sub-Saharan Africa. Studies of the impact of aid on growth fail to recognise that aid does not have a direct effect; it operates via transmission mechanisms, such as investment or government spending. The contribution of this paper lies in throwing some light on this neglected aspect.

Investment, the most important transmission mechanism, is often omitted from the regressions. As a result, estimated aid coefficients in typical growth regressions suffer from omitted variable bias. However, including an investment term in the regression would lead to identification problems as some of aid finances investment (there will be double-counting). In this paper we use the technique of generated regressors to address this problem. This enables us to identify that part of the effect on growth of the relevant transmission mechanism that is not due to aid, so that double counting and omitted variable bias problems are avoided.

We apply this method to examine the relationship between aid and growth using a panel of 24 SSA countries over the period 1970 to 1997. Despite large aid inflows, SSA countries on average experienced only 0.6% growth in real per capita GDP per annum over the period. On the face of it, this may appear to be a case of aid ineffectiveness. Our econometric results, which are robust regarding outliers, endogeneity and country-specific effects, consistently show that aid has had a positive effect on growth, largely through aid-financed investment. On average, each one percentage point increase in the aid/GNP ratio adds one-third of one percentage point to the growth rate. Africa's poor growth record should not therefore be attributed to aid ineffectiveness.

REFERENCES

Alesina, A., S. Ozler, N. Roubini and P. Swagel (1992), 'Political Instability and Economic Growth', *NBER Working Paper 4173*.

Arellano, M. and S. Bond (1991), 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations', *Review of Economic Studies*, 58, 29-51.

Bacha, E. (1990), 'A Three-gap Model of Foreign Transfers and the GDP Growth Rate in developing Countries', *Journal of Development Economics*, 32, 279-296.

Beaton, A. E. and J. W. Tukey (1974), 'The fitting of power series, meaning polynomials, illustrated on band-spectroscopic data', *Technometrics*, 16, 146-185

Breusch, T. and A. Pagan (1980), 'The Lagrange multiplier test and its applications to model specification in econometrics', *Review of Economic Studies*, 47, 239-253.

Burnside, C. and D. Dollar (2000). 'Aid, Policies, and Growth.' *American Economic Review*, 90:4, 847-868.

Chenery, H.B. and Strout, A.M. (1966), 'Foreign Assistance and Economic Development', *American Economic Review*, 56, 679-733.

Collier, P. and J. Gunning (1999), 'Explaining African Economic Performance', *Journal of Economic Literature*, 37 (1), 64-111.

Cook, R. D. (1977), 'Detection of influential observations in linear regression', *Technometrics*, 19, 15-18.

Englebert, P.(2000), 'Solving the Mystery of AFRICA Dummy', *World Development*, 28, 1821-1835.

Guillaumont, P., S. Guillaumont Jeanney and J-F. Brun (1999), 'How Instability Lowers African Growth', *Journal of African Economies*, 8:1, 87-107.

Gyimah-Brempong, K. and T. Traynor (1999), 'Political Instability, Investment and Economic Growth in Sub-Saharan Africa', *Journal of African Economies*, 8:1, 52-86.

Hamilton, L. C. (1991), 'How robust is robust regression?', *Stata Technical Bulletin*, 2, 21-26.

Hansen, H. and F. Tarp (2001), 'Aid and Growth Regressions', *Journal of Development Economic*s, 64:2, 547-570.

Hausman, J. (1978), 'Specification Tests in Econometrics', *Econometrica*, 46, 1251-1271.

Huber, P. J. (1964), 'Robust estimation of a location parameter', *Annals of Mathematical Statistics*, 35, 73-101.

Goodall, C. (1983), 'M-estimators of location: an outline of the theory', in *Understanding Robust and Exploratory Data Analysis*', John Wiley, New York, 339-431.

Hadjimichael, M.T, D. Ghura, M. Muhleisen, R. Nord and E.M. Ucer.(1995), 'Sub-Saharan Africa: Growth, Savings and Investment, 1986-93', *Occasional Paper 118*, Washington, DC: International Monetary Fund.

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.

Lensink, R. and White, H. (2001), 'Are There Negative Returns to Aid?', *Journal of Development Studies*, 37:6, 42-65.

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

OECD (1999), *Geographical Distribution of Financial Flows to Aid Recipients*, available on CD-ROM.

Pagan, A. (1984), 'Econometric Issues in the Analysis of Regressions with Generated Regressors', *International Economic Review*, 25, 221-247.

Pesaran, M. H. and R. Smith (1995), 'Estimating long-run relationships from dynamic heterogenous panels', *Journal of Econometrics*, 68, 79-112.

Robertson, D. and J. Symons (1992), 'Some strange properties of panel data estimators', *Journal of Applied Econometrics*, 7, 175-189.

Rousseeuw, P. J. and A. M. Leroy (1987), *Robust Regression and Outlier Detection*, John Wiley, New York.

Sargan, J. D. (1958), 'The Estimation of Economic Relationships Using Instrumental Variables', *Econometrica*, 26, 393-415.

World Bank (1998), *Assessing Aid: What Works, What Doesn't, and Why*, Washington, DC: Oxford University Press for the World Bank.

World Bank Africa Database 2000, available on CD-ROM.

APPENDIX A. DEFINITIONS AND SOURCES OF DATA

GROWTH: growth of real GDP per capita

GDPO: real GDP per capita (in the year preceding the period).

PRIC15: population aged 15 or above having completed primary education.(%), at beginning of each period. Source: Barro and Lee Data Set, (Harvard CID-World Bank).

INV: gross domestic investment (% of GDP)

DEM: democracy index, in 1970 and 1982; values between 1 and 3 with lower values being more democratic. Source: Alesina et al (1992).

INFL: inflation rate.

GCON: government consumption (% of GDP)

MGDP: imports (% of GDP)

XGDP: exports (% of GDP)

TOT: terms of trade

ER: real exchange rate, calculated from the nominal exchange rate figures.

BMP: black market premium. Source: Global Development Data.

CFA: dummy takes value of 1 for CFA franc zone member countries and 0 otherwise. Source: Hadjimichael et al (1995).

CRED: credit available to private sector (% of total domestic credit)

GASTILS: Gastils Political Rights index. Source: Easterly and Levine data, downloaded from the World Bank Data Surfer website.

GRANTS: ODA grants (% of GNP). Source: OECD(1999).

TAID: ODA grants+net loans-technical cooperation-food aid (% of GNP). Source: OECD(1999)

TRGDP: total tax revenue (% of GDP)

EXTDEBT: external debt (% of GDP)

STATE: dummy takes value of 1 for legitimate countries and 0 otherwise. Source: Englebert(2000).

Unless otherwise stated, the source for all variables is World Bank Africa Database (2000). All variables refer to period averages 1970/73, 1974/77, 1978/81, 1982/85, 1986/89, 1990/93 and 1994/97 except *GDPO* and the time invariant regressors.

Table A1 Summary Statistics for Cross-Section Data

Variable	N	Mean	Std. Dev.	Minimum	Maximum
GROWTH	34	0.660	3.750-12.618	18.51	
GDPO	34	1242.382	1096.644247	6409	
INV	34	19.547	10.518	3.268	84.551
PRIC15	24	7.257	3.71	1	19.9
DEM	31	2.656	0.644	1	3
GRANTS	34	8.161	6.992	0.044	57.317
TAID	34	7.96	7.188	-0.009	50.712
INFL	34	50.631	428.068	-3.574	6287
GOV	34	15.461	5.749	5.859	43.938
MGDP	34	38.317	22.411	8.333	142.697

Table A1 shows that the standard deviation of many of the variables is quite high, suggesting that fixed or country-specific effects may be pronounced. Robust regression accounts for some, but not all, of the difficulties. In the discussion of correcting for fixed effects in Section 3 we note that taking first differences may exacerbate measurement error problems in the data (by increasing the ratio of noise to signal). The first difference transformation obviously reduces the sample size, but also seems to result in loss of most of the variation in the data, as shown in Table A2. Furthermore, Table A3 shows that the significance and even sign of partial correlations between growth and explanatory variables is altered if a first difference model is used rather than a specification of variables in levels. These features of the data explain why GMM techniques do not give robust results.

Table A2: Variation in data for some key variables

	Coefficient of Variation		*Observations*	
	Level	*First Difference*	*Level*	*First Difference*
GDPO	113.290	12.076	238	204
INV	185.837	4.970	238	204
PRIC15	195.687	8.526	169	144
GRANTS	116.738	18.973	233	199
TAID	110.709	23.327	233	199
INFL	11.828	9.963	238	204
GCON	268.870	-1.684	230	195

Table A3: Partial correlation of key variables with growth when level and first-difference models are used

	GRANTS			*TAID*	
	Level	*First Difference*		*Level*	*First Difference*
GDPO	0.0703	-0.3829	*GDPO*	0.0633	-0.3799
	(0.386)	(0.00)		(0.435)	(0.00)
INV	0.3828	0.1117	*INV*	0.3830	0.1125
	(0.00)	(0.209)		(0.00)	(0.206)
PRIC15	0.1769	-0.100	*PRIC15*	0.1754	-0.0969
	(0.028)	(0.259)		(0.03)	(0.276)
GRANTS	0.0040	-0.0279	*TAID*	-0.0165	0.0026
	(0.961)	(0.755)		(0.839)	(0.977)
INFL	-0.1985	-0.0043	*INFL*	-0.2001	-0.0023
	(0.014)	(0.962)		(0.013)	(0.979)
GCON	-0.1626	-0.1432	*GCON*	-0.1621	-0.1369
	(0.044)	(0.107)		(0.045)	(0.123)

Note: p-values for significance are reported in parentheses. Partial correlations vary when the set of explanatory variables is changed. The first set of columns are partial correlation with growth when *GRANTS* is the aid variable, and the second set of columns when *TAID* is the aid variable.

APPENDIX B. ECONOMETRIC ISSUES

The Classical Linear Regression Model, the cornerstone of most econometric theory, makes several assumptions underlying the method of OLS. One critical assumption is that $E(X_{it}, U_{it}) = 0$. In cases where this zero correlation between the error term (U_{it}) and an explanatory variable (X_{it}) is violated, we say the latter is endogenous. Under such circumstances OLS estimates will not be consistent and instrumental variables (IV) techniques are required. The instruments should satisfy two properties: they should be correlated with the endogenous variable but uncorrelated with the error term. If suitable instruments are found consistent estimates can be obtained by the IV method. However, it is in practice very difficult to find suitable instruments and results are highly sensitive to the choice of instrument set. Hence, it is appropriate to test specifically for endogeneity as IV methods may not be required.

In this Appendix we first detail the tests for endogeneity and then describe the robust estimation method adopted to account for outliers.

The Hausman (1978) test for Endogeneity

Testing for endogeneity is essentially a test of whether a regressor (X_{it}) is correlated with the error term (U_{it}). If it is, the IV method will produce consistent estimates. Otherwise, both OLS and IV estimators will be consistent although the latter is less efficient, i.e. the two sets of estimates will not be systematically different. This forms the intuition behind the Hausman (1978) specification test which tests appropriateness of OLS estimates based on the difference between OLS and IV estimates. The hypothesis tested is formally given as:

H_0: Cov (X_{it}, U_{it}) = 0 $\Rightarrow$ OLS consistent
IV consistent but less efficient.

H_1: Cov (X_{it}, U_{it}) $\neq$ 0 $\Rightarrow$ OLS inconsistent
IV consistent

Table B1: Standard OLS Growth regressions

	GROWTH	GROWTH
GDPO	0.001	0.001
	(2.44)**	(2.58)**
PRIC15	0.201	0.197
	(2.89)***	(2.85)***
INV	0.133	0.131
	(5.33)***	(5.29)***
DEM	-1.556	-1.579
	(4.29)***	(4.36)***
INFL	-0.001	-0.001
	(1.88)*	(1.72)*
GOVCON	-0.184	-0.171
	(3.25)***	(3.07)***
MMGDP	0.009	0.010
	(0.90)	(0.97)
GRANTS	**0.204**	
	(2.37)**	
GRANTSQ	**-0.004**	
	(2.04)**	
TAID		**0.237**
		(2.51)**
TAIDSQ		**-0.005**
		(2.20)**
Constant	0.695	0.347
	(0.42)	(0.20)
Observations	150	150
R^2	0.49	0.49
F-Stat	8.48	8.56
Prob>F-Stat	0.00	0.00
Testing for endogeneity of aid:		
R^2 of first stage regression	0.54	0.55
$\chi^2(k)$	0.15	0.02
Prob>$\chi^2(k)$	1.00	1.00
Testing for endogeneity of investment:		
R^2 of first stage regression	0.33	0.33
$\chi^2(k)$	7.40	9.60
Prob>$\chi^2(k)$	0.918	0.791

Notes : All regressions run in a panel of seven four-year periods over 1970-97. Time dummies included in all regressions. Absolute t-values are reported in brackets. * Significant at 10% level. ** 5% level. *** 1% level. F-Stat tests the joint significance of all coefficients. $\chi^2(k)$ represents the chi-squared statistic for Hausman test.

The Hausman test statistic is χ^2 (K) = $[\tilde{\delta} - \delta^*]' \hat{\Sigma}^{-1} [\tilde{\delta} - \delta^*]$ where $\tilde{\delta}$ is the vector of (less efficient) IV estimates and δ^* the vector of (more efficient) OLS estimates of the parameter δ, Σ is the variance-covariance matrix, and K the total number of regressors. Table B1 presents the results obtained when the Hausman test is performed for a growth regression to investigate whether investment and aid terms are endogenous. The probability that the critical value exceeds the test statistic is high in all cases. The test therefore strongly fails to reject the null hypothesis that regressors and error term are uncorrelated. Consequently, we obtain evidence in favour of OLS estimators.

Sargan(1958) validity of instruments test

The comparison of OLS to IV estimates using the Hausman test assumes that valid instruments are used. Sargan (1958) provides a test for the validity of instruments. This is based on the sum of squares function, $S_{IV}(\delta)$, that is minimised to obtain the IV estimator.

$$S_{IV}(\delta) = (\mathbf{y} - \mathbf{X}\delta)' \mathbf{W}(\mathbf{W}'\mathbf{W})^{-1} \mathbf{W}'(\mathbf{y} - \mathbf{X}\delta) = (\mathbf{y} - \mathbf{X}\delta)' \mathbf{P_W} (\mathbf{y} - \mathbf{X}\delta)$$

where W is a matrix of instruments and δ a vector of coefficients. The minimum value obtained is $\tilde{\mathbf{e}}' \mathbf{P_W} \tilde{\mathbf{e}}$. Sargan's test statistic χ^2 (V) follows a chi-squared distribution with V = $(P$-$K)$ degrees of freedom, where P is the number of instruments and K the total number of regressors. Thus χ^2 (V) = S_{IV} $(\delta)/\sigma^2$ = $\tilde{\mathbf{e}}' \mathbf{P_W} \tilde{\mathbf{e}}/\sigma^2$. A high value of χ^2 (V) indicates rejection of the null hypothesis and suggests that the list of instruments used is incorrect.

Based on the results obtained by instrumenting investment in our growth regression we obtain χ^2 (V) = 1.38 and χ^2 (V) = 1.45 when *GRANTS* and *TAID* are used respectively. Using the 10% critical value (2.71), this statistic fails to reject our null hypothesis. Thus, credit available to private sectors as a share of total domestic credit and Gastils political rights variable prove to be valid instruments. We obtain similar support for using lagged aid terms as instruments for the aid variable.

Can we rely on the Hausman test result in the presence of country specific effects? As standard panel tests for fixed effects are not valid in the presence of lagged dependent variables we perform the test without the term *GDPO*. If we fail to reject the absence of fixed effects (that is a term capturing the combined effects of omitted time-invariant variables), it is (almost certainly) true to say there won't be any fixed effects when we include the lagged dependent term. We therefore carry out the Breusch and Pagan (1980) Lagrange Multiplier test of the null hypothesis that σ_v^2 is equal to zero. If the null hypothesis holds, it implies that v_i is always zero, that is, there is no serious risk of omitted country-specific effects. In this case, the Hausman test result is valid and we can use OLS to estimate our growth regression. This test produces chi-squared values equal to 3.20 and 3.32 when *GRANTS* and *TAID* are the relevant aid variables, respectively. The 5% critical value from the chi-squared distribution with one degree of freedom is 3.84, so the statistic falls in the acceptance region. Hence, we can safely assume that the included time-invariant control variables have sufficiently captured cross-country differences. Also, the result of the Hausman test is valid.

Robust Estimation to Account for Outliers

There are two definitions according to which an observation can be considered an outlier or extreme value. A 'response outlier' occurs when the dependent variable (y_i) takes on a value that is unusual, given the explanatory variables (x_i's). In other words, y_i is not close to $E(y|x_i)$ - it is in the tail of the distribution of y given $x = x_i$. A 'design outlier' occurs when an explanatory variable is significantly different, either very small or very large, in comparison to the remainder of the data, that is, x_i is not close to other observations on x. The inclusion or exclusion of outliers, especially if the sample size is small, can substantially alter the results of regression analysis. One common approach is to exclude extreme values, but the exclusion criterion is necessarily *ad hoc* and this implies a loss of information. A preferable approach is to include the extreme values but weight the observations. This is what we do using robust regression (Rousseeuw and Leroy, 1987), a three-step procedure to deal with outliers. The first step involves estimating the regression and calculating Cook's (1977) Distance measure of influence. Cook's *D* for the i^{th} observation is a measure of the distance between the coefficient estimates when observation i is included and when it is not. It is formally given as:

$$D_i = \frac{\hat{e}_{si}^2 (s_{pi} / s_{ri})^2}{k}$$

where $\hat{e}_{si}$ refers to standardised residuals, s_{ri} to standard error of the residuals and s_{pi} to standard error of prediction; k represents the number of independent variables including the intercept term. High values of Cook's D imply that the i^{th} observation has significant influence on estimation results, therefore, can be deemed to be an outlier. At an initial stage, robust regression screens data points in search of such outliers and eliminates observations for which Cook's distance exceeds 1 – these are the gross outliers. Thereafter, robust regression involves an iterative weighted least squares method whereby the outliers are identified and weights are assigned.

The second step in robust regression involves estimation of the model based on the sample from which gross outliers have been excluded. Then weights are calculated based on absolute residuals, as proposed by Huber (1964). The Huber weighting function works as follows: cases with small residuals receive weights of 1 while those with larger residuals (outliers) receive gradually smaller weights. If $e_i = y_i - X_i b$ is the i^{th} case residual, then the i^{th} scaled residual is given by $u_i = e_i/s$ where the scale estimate $s = M/0.6745$ and $M = \text{med}(|e_i - \text{med}(e_i)|)$ is the median absolute deviation from the median residual. Huber case weights are then obtained as:

$$w_i = \begin{cases} 1 & \text{if } |u_i| \leq c_h \\ c_h / |u_i| & \text{otherwise} \end{cases}$$

The tuning constant $c_h = 1.345$, and cases with absolute scaled residual less than 1.345 are assigned weights of 1. Down-weighting begins with cases whose absolute residual exceed $(1.345 / 0.6745)\text{M} \approx 2\text{M}$. Hence, less importance is attached to observations with high-scaled residual. The regression model is then re-estimated using those weights. Absolute residuals are again used to calculate Huber weights. This process of calculating weights and re-estimating regression is repeated again and again. Iterations stop when the maximum change in weights falls below a certain level, that is, until the weights from two consecutive iterations converge. The third step in robust regression involves calculating biweights, as proposed by Beaton and Tukey (1974). More specifically, this function assigns a weight to all cases with nonzero residuals, according to the smoothly decreasing biweight function:

$$w_i = \begin{cases} \{1- (u_i / c_b)^2\}^2 & \text{if } |u_i| \leq c_b \\ 0 & \text{otherwise} \end{cases}$$

where c_b= 4.685*(biweight tuning constant / 7). The biweight tuning constant refers to the value used to scale the median absolute deviation from the median residual. Goodall (1983) suggests using a value between 6 and 9, inclusive, as a tuning constant. If the value 7 is chosen, then the above biweight function would imply that cases with absolute residuals exceeding $(4.685 / 0.6745)M \approx 7M$ are assigned zero weight. In other words, they are effectively dropped from the sample. Again, iterations of weight construction and regression estimation are performed until convergence of weights is reached. The tuning constants c_b and c_h are set to 1.345 and 4.685 respectively in the statistical package we use for estimation (*STATA*). Lower tuning constants down-weight outliers more drastically and may lead to unstable estimates, whilst higher tuning constants produce milder down-weighting and produces estimators close to OLS. The default tuning constants allows robust regression to produce estimates with properties corresponding to 95% of the efficiency of OLS (Hamilton, 1991). Huber weights have problems dealing with severe outliers while biweights sometimes fail to converge or have multiple solutions. Hence, both weighting functions are used. The initial Huber weighting is expected to improve the behaviour of biweight estimators.

CREDIT PAPERS

00/1 **Robert Lensink,** “Does Financial Development Mitigate Negative Effects of Policy Uncertainty on Economic Growth?”
00/2 **Oliver Morrissey,** “Investment and Competition Policy in Developing Countries: Implications of and for the WTO”
00/3 **Jo-Ann Crawford and Sam Laird,** “Regional Trade Agreements and the WTO”
00/4 **Sam Laird,** “Multilateral Market Access Negotiations in Goods and Services”
00/5 **Sam Laird,** “The WTO Agenda and the Developing Countries”
00/6 **Josaphat P. Kweka and Oliver Morrissey,** “Government Spending and Economic Growth in Tanzania, 1965-1996”
00/7 **Henrik Hansen and Fin Tarp,** “Aid and Growth Regressions”
00/8 **Andrew McKay, Chris Milner and Oliver Morrissey,** “The Trade and Welfare Effects of a Regional Economic Partnership Agreement”
00/9 **Mark McGillivray and Oliver Morrissey,** “Aid Illusion and Public Sector Fiscal Behaviour”
00/10 **C.W. Morgan,** “Commodity Futures Markets in LDCs: A Review and Prospects”
00/11 **Michael Bleaney and Akira Nishiyama,** “Explaining Growth: A Contest between Models”
00/12 **Christophe Muller,** “Do Agricultural Outputs of Autarkic Peasants Affect Their Health and Nutrition? Evidence from Rwanda”
00/13 **Paula K. Lorgelly,** “Are There Gender-Separate Human Capital Effects on Growth? A Review of the Recent Empirical Literature”
00/14 **Stephen Knowles and Arlene Garces,** “Measuring Government Intervention and Estimating its Effect on Output: With Reference to the High Performing Asian Economies”
00/15 **I. Dasgupta, R. Palmer-Jones and A. Parikh,** “Between Cultures and Markets: An Eclectic Analysis of Juvenile Gender Ratios in India”
00/16 **Sam Laird,** “Dolphins, Turtles, Mad Cows and Butterflies – A Look at the Multilateral Trading System in the 21st Century”
00/17 **Carl-Johan Dalgaard and Henrik Hansen,** “On Aid, Growth, and Good Policies”
01/01 **Tim Lloyd, Oliver Morrissey and Robert Osei,** “Aid, Exports and Growth in Ghana”
01/02 **Christophe Muller,** “Relative Poverty from the Perspective of Social Class: Evidence from The Netherlands”
01/03 **Stephen Knowles,** “Inequality and Economic Growth: The Empirical Relationship Reconsidered in the Light of Comparable Data”
01/04 **A. Cuadros, V. Orts and M.T. Alguacil,** “Openness and Growth: Re-Examining Foreign Direct Investment and Output Linkages in Latin America”
01/05 **Harold Alderman, Simon Appleton, Lawrence Haddad, Lina Song and Yisehac Yohannes, “**Reducing Child Malnutrition: How Far Does Income Growth Take Us?”

01/06 **Robert Lensink and Oliver Morrissey,** "Foreign Direct Investment: Flows, Volatility and Growth"

01/07 **Adam Blake, Andrew McKay and Oliver Morrissey,** "The Impact on Uganda of Agricultural Trade Liberalisation"

01/08 **R. Quentin Grafton, Stephen Knowles and P. Dorian Owen,** "Social Divergence and Economic Performance"

01/09 **David Byrne and Eric Strobl,** "Defining Unemployment in Developing Countries: The Case of Trinidad and Tobago"

01/10 **Holger Görg and Eric Strobl,** "The Incidence of Visible Underemployment: Evidence for Trinidad and Tobago"

01/11 **Abbi Mamo Kedir,** "Some Issues in Using Unit Values as Prices in the Estimation of Own-Price Elasticities: Evidence from Urban Ethiopia"

01/12 **Eric Strobl and Frank Walsh,** "Minimum Wages and Compliance: The Case of Trinidad and Tobago"

01/13 **Mark McGillivray and Oliver Morrissey,** "A Review of Evidence on the Fiscal Effects of Aid"

01/14 **Tim Lloyd, Oliver Morrissey and Robert Osei,** "Problems with Pooling in Panel Data Analysis for Developing Countries: The Case of Aid and Trade Relationships"

01/15 **Oliver Morrissey,** "Pro-Poor Conditionality for Aid and Debt Relief in East Africa"

01/16 **Zdenek Drabek and Sam Laird,** "Can Trade Policy help Mobilize Financial Resources for Economic Development?"

01/17 **Michael Bleaney and Lisenda Lisenda,** "Monetary Policy After Financial Liberalisation: A Central Bank Reaction Function for Botswana"

01/18 **Holger Görg and Eric Strobl,** "Relative Wages, Openness and Skill-Biased Technological Change in Ghana"

01/19 **Dirk Willem te Velde and Oliver Morrissey,** "Foreign Ownership and Wages: Evidence from Five African Countries"

01/20 **Suleiman Abrar,** "Duality, Choice of Functional Form and Peasant Supply Response in Ethiopia"

01/21 **John Rand and Finn Tarp,** "Business Cycles in Developing Countries: Are They Different?"

01/22 **Simon Appleton,** "Education, Incomes and Poverty in Uganda in the 1990s"

02/01 **Eric Strobl and Robert Thornton,** "Do Large Employers Pay More in Developing Countries? The Case of Five African Countries"

02/02 **Mark McGillivray and J. Ram Pillarisetti,** "International Inequality in Human Development, Real Income and Gender-related Development"

02/03 **Sourafel Girma and Abbi M. Kedir, "**When Does Food Stop Being a Luxury? Evidence from Quadratic Engel Curves with Measurement Error"

02/04 **Indraneel Dasgupta and Ravi Kanbur,** "Class, Community, Inequality"

02/05 **Karuna Gomanee, Sourafel Girma and Oliver Morrissey,** "Aid and Growth in Sub-Saharan Africa: Accounting for Transmission Mechanisms"

DEPARTMENT OF ECONOMICS DISCUSSION PAPERS

In addition to the CREDIT series of research papers the School of Economics produces a discussion paper series dealing with more general aspects of economics. Below is a list of recent titles published in this series.

99/1 **Indraneel Dasgupta,** "Stochastic Production and the Law of Supply"

99/2 **Walter Bossert,** "Intersection Quasi-Orderings: An Alternative Proof"

99/3 **Charles Blackorby, Walter Bossert and David Donaldson,** "Rationalizable Variable-Population Choice Functions"

99/4 **Charles Blackorby, Walter Bossert and David Donaldson,** "Functional Equations and Population Ethics"

99/5 **Christophe Muller,** "A Global Concavity Condition for Decisions with Several Constraints"

99/6 **Christophe Muller,** "A Separability Condition for the Decentralisation of Complex Behavioural Models"

99/7 **Zhihao Yu**, "Environmental Protection and Free Trade: Indirect Competition for Political Influence"

99/8 **Zhihao Yu,** "A Model of Substitution of Non-Tariff Barriers for Tariffs"

99/9 **Steven J. Humphrey,** "Testing a Prescription for the Reduction of Non-Transitive Choices"

99/10 **Richard Disney, Andrew Henley and Gary Stears,** "Housing Costs, House Price Shocks and Savings Behaviour Among Older Households in Britain"

99/11 **Yongsheng Xu,** "Non-Discrimination and the Pareto Principle"

99/12 **Yongsheng Xu,** "On Ranking Linear Budget Sets in Terms of Freedom of Choice"

99/13 **Michael Bleaney, Stephen J. Leybourne and Paul Mizen,** "Mean Reversion of Real Exchange Rates in High-Inflation Countries"

99/14 **Chris Milner, Paul Mizen and Eric Pentecost,** "A Cross-Country Panel Analysis of Currency Substitution and Trade"

99/15 **Steven J. Humphrey,** "Are Event-splitting Effects Actually Boundary Effects?"

99/16 **Taradas Bandyopadhyay, Indraneel Dasgupta and Prasanta K. Pattanaik,** "On the Equivalence of Some Properties of Stochastic Demand Functions"

99/17 **Indraneel Dasgupta, Subodh Kumar and Prasanta K. Pattanaik,** "Consistent Choice and Falsifiability of the Maximization Hypothesis"

99/18 **David Fielding and Paul Mizen,** "Relative Price Variability and Inflation in Europe"

99/19 **Emmanuel Petrakis and Joanna Poyago-Theotoky,** "Technology Policy in an Oligopoly with Spillovers and Pollution"

99/20 **Indraneel Dasgupta,** "Wage Subsidy, Cash Transfer and Individual Welfare in a Cournot Model of the Household"

99/21 **Walter Bossert and Hans Peters,** "Efficient Solutions to Bargaining Problems with Uncertain Disagreement Points"

99/22 **Yongsheng Xu,** "Measuring the Standard of Living – An Axiomatic Approach"

99/23 **Yongsheng Xu,** "No-Envy and Equality of Economic Opportunity"
99/24 **M. Conyon, S. Girma, S. Thompson and P. Wright,** "The Impact of Mergers and Acquisitions on Profits and Employee Remuneration in the United Kingdom"
99/25 **Robert Breunig and Indraneel Dasgupta,** "Towards an Explanation of the Cash-Out Puzzle in the US Food Stamps Program"
99/26 **John Creedy and Norman Gemmell,** "The Built-In Flexibility of Consumption Taxes"
99/27 **Richard Disney,** "Declining Public Pensions in an Era of Demographic Ageing: Will Private Provision Fill the Gap?"
99/28 **Indraneel Dasgupta,** "Welfare Analysis in a Cournot Game with a Public Good"
99/29 **Taradas Bandyopadhyay, Indraneel Dasgupta and Prasanta K. Pattanaik,** "A Stochastic Generalization of the Revealed Preference Approach to the Theory of Consumers' Behavior"
99/30 **Charles Blackorby, WalterBossert and David Donaldson,** "Utilitarianism and the Theory of Justice"
99/31 **Mariam Camarero and Javier Ordóñez,** "Who is Ruling Europe? Empirical Evidence on the German Dominance Hypothesis"
99/32 **Christophe Muller,** "The Watts' Poverty Index with Explicit Price Variability"
99/33 **Paul Newbold, Tony Rayner, Christine Ennew and Emanuela Marrocu,** "Testing Seasonality and Efficiency in Commodity Futures Markets"
99/34 **Paul Newbold, Tony Rayner, Christine Ennew and Emanuela Marrocu,** "Futures Markets Efficiency: Evidence from Unevenly Spaced Contracts"
99/35 **Ciaran O'Neill and Zoe Phillips,** "An Application of the Hedonic Pricing Technique to Cigarettes in the United Kingdom"
99/36 **Christophe Muller,** "The Properties of the Watts' Poverty Index Under Lognormality"
99/37 **Tae-Hwan Kim, Stephen J. Leybourne and Paul Newbold,** "Spurious Rejections by Perron Tests in the Presence of a Misplaced or Second Break Under the Null"
00/1 **Tae-Hwan Kim and Christophe Muller,** "Two-Stage Quantile Regression"
00/2 **Spiros Bougheas, Panicos O. Demetrides and Edgar L.W. Morgenroth,** "International Aspects of Public Infrastructure Investment"
00/3 **Michael Bleaney,** "Inflation as Taxation: Theory and Evidence"
00/4 **Michael Bleaney,** "Financial Fragility and Currency Crises"
00/5 **Sourafel Girma,** "A Quasi-Differencing Approach to Dynamic Modelling from a Time Series of Independent Cross Sections"
00/6 **Spiros Bougheas and Paul Downward,** "The Economics of Professional Sports Leagues: A Bargaining Approach"
00/7 **Marta Aloi, Hans Jørgen Jacobsen and Teresa Lloyd-Braga,** "Endogenous Business Cycles and Stabilization Policies"
00/8 **A. Ghoshray, T.A. Lloyd and A.J. Rayner,** "EU Wheat Prices and its Relation with Other Major Wheat Export Prices"

00/9 **Christophe Muller,** "Transient-Seasonal and Chronic Poverty of Peasants: Evidence from Rwanda"

00/10 **Gwendolyn C. Morrison,** "Embedding and Substitution in Willingness to Pay"

00/11 **Claudio Zoli,** "Inverse Sequential Stochastic Dominance: Rank-Dependent Welfare, Deprivation and Poverty Measurement"

00/12 **Tae-Hwan Kim, Stephen Leybourne and Paul Newbold,** "Unit Root Tests With a Break in Variance"

00/13 **Tae-Hwan Kim, Stephen Leybourne and Paul Newbold,** "Asymptotic Mean Squared Forecast Error When an Autoregression With Linear Trend is Fitted to Data Generated by an I(0) or I(1) Process"

00/14 **Michelle Haynes and Steve Thompson,** "The Productivity Impact of IT Deployment: An Empirical Evaluation of ATM Introduction"

00/15 **Michelle Haynes, Steve Thompson and Mike Wright,** "The Determinants of Corporate Divestment in the UK"

00/16 **John Beath, Robert Owen, Joanna Poyago-Theotoky and David Ulph,** "Optimal Incentives for Incoming Generations within Universities"

00/17 **S. McCorriston, C. W. Morgan and A. J. Rayner,** "Price Transmission: The Interaction Between Firm Behaviour and Returns to Scale"

00/18 **Tae-Hwan Kim, Douglas Stone and Halbert White,** "Asymptotic and Bayesian Confidence Intervals for Sharpe Style Weights"

00/19 **Tae-Hwan Kim and Halbert White,** "James-Stein Type Estimators in Large Samples with Application to the Least Absolute Deviation Estimator"

00/20 **Gwendolyn C. Morrison,** "Expected Utility and the Endowment Effect: Some Experimental Results"

00/21 **Christophe Muller,** "Price Index Distribution and Utilitarian Social Evaluation Functions"

00/22 **Michael Bleaney,** "Investor Sentiment, Discounts and Returns on Closed-End Funds"

00/23 **Richard Cornes and Roger Hartley,** "Joint Production Games and Share Functions"

00/24 **Joanna Poyago-Theotoky,** "Voluntary Approaches, Emission Taxation and the Organization of Environmental R&D"

00/25 **Michael Bleaney, Norman Gemmell and Richard Kneller,** "Testing the Endogenous Growth Model: Public Expenditure, Taxation and Growth Over the Long-Run"

00/26 **Michael Bleaney and Marco Gundermann,** "Credibility Gains and Output Losses: A Model of Exchange Rate Anchors"

00/27 **Indraneel Dasgupta,** "Gender Biased Redistribution and Intra-Household Distribution"

00/28 **Richard Cornes and Roger Hartley,** "Rentseeking by Players with Constant Absolute Risk Aversion"

00/29 **S.J. Leybourne, P. Newbold, D. Vougas and T. Kim,** "A Direct Test for Cointegration Between a Pair of Time Series"

00/30 **Claudio Zoli,** "Inverse Stochastic Dominance, Inequality Measurement and Gini Indices"

01/01 **Spiros Bougheas,** "Optimism, Education, and Industrial Development"

01/02 **Tae-Hwan Kim and Paul Newbold,** "Unit Root Tests Based on Inequality-Restricted Estimators"

01/03 **Christophe Muller,** "Defining Poverty Lines as a Fraction of Central Tendency"

01/04 **Claudio Piga and Joanna Poyago-Theotoky,** "Shall We Meet Halfway? Endogenous Spillovers and Locational Choice"

01/05 **Ilias Skamnelos, "**Sunspot Panics, Information-Based Bank Runs and Suspension of Deposit Convertibility"

01/06 **Spiros Bougheas and Yannis Georgellis,** "Apprenticeship Training, Earnings Profiles and Labour Turnover: Theory and German Evidence"

01/07 **M.J. Andrews, S. Bradley and R. Upward,** "Employer Search, Vacancy Duration and Skill Shortages"

01/08 **Marta Aloi and Laurence Lasselle,** "Growing Through Subsidies"

01/09 **Marta Aloi and Huw D. Dixon,** "Entry Dynamics, Capacity Utilisation, and Productivity in a Dynamic Open Economy"

01/10 **Richard Cornes and Roger Hartley,** "Asymmetric Contests with General Technologies"

01/11 **Richard Cornes and Roger Hartley,** "Disguised Aggregative Games"

Members of the Centre

Director

Oliver Morrissey - aid policy, trade and agriculture

Research Fellows (Internal)

Simon Appleton – poverty, education, households
Adam Blake – CGE models of low-income countries
Mike Bleaney - growth, international macroeconomics
Indraneel Dasgupta – development theory
Norman Gemmell – growth and public sector issues
Ken Ingersent - agricultural trade
Tim Lloyd – agricultural commodity markets
Paula Lorgelly – health, gender and growth
Andrew McKay - poverty, peasant households, agriculture
Chris Milner - trade and development
Wyn Morgan - futures markets, commodity markets
Christophe Muller – poverty, household panel econometrics
Tony Rayner - agricultural policy and trade

Research Fellows (External)

V.N. Balasubramanyam (*University of Lancaster*) – foreign direct investment and multinationals
David Fielding *(Leicester University)* - investment, monetary and fiscal policy
Göte Hansson (*Lund University*) – trade, Ethiopian development
Stephen Knowles *(University of Otago)* – inequality and growth
Robert Lensink *(University of Groningen)* – aid, investment, macroeconomics
Scott McDonald *(Sheffield University)* – CGE modelling, agriculture
Mark McGillivray *(RMIT University)* - aid allocation, human development
Doug Nelson *(Tulane University)* - political economy of trade
Shelton Nicholls *(University of West Indies)* – trade, integration
David Sapsford (*University of Lancaster*) - commodity prices
Eric Strobl *(University College Dublin)* – labour markets
Finn Tarp *(University of Copenhagen)* – aid, CGE modelling
Howard White *(IDS)* - aid, poverty