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Uncertainty of Aid Inflows and the Aid-Growth Relationship

by

Robert Lensink and Oliver Morrissey

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

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Abstract
This paper contributes to the literature on aid and economic growth. We posit that it is not the level of aid flows *per se* but the stability of such flows that determines the impact of aid on economic growth. Three measures of aid instability are employed. One is a simple deviation from trend, and measures overall instability. The other measures are based on auto-regressive estimates to capture deviations from an expected trend. These measures are intended to proxy for *uncertainty* in aid receipts. We posit that such uncertainty will influence the relationship between aid and investment and how recipient governments respond to aid, and will therefore affect how aid impacts on growth. We estimate a standard cross-country growth regression including the level of aid, and find aid to be insignificant (in line with other results in the literature). We then introduce measures of instability. Aid remains insignificant when we account for overall instability. However, when we account for uncertainty (which is negative and significant), we find that aid has a significant positive effect on growth. We conduct stability tests that show that the significance of aid is largely due to its effect on the volume of investment. The finding that uncertainty of aid receipts reduces the effectiveness of aid is robust. When we control for this, aid appears to have a significant positive influence on growth. When the regression is estimated for the sub-sample of African countries these findings hold, although the effectiveness of aid appears weaker than for the full sample.

Outline

7. Conclusions

I INTRODUCTION

This paper is intended as a contribution to the literature on aid and growth. As such, it is not our intention to offer a comprehensive critique or review of that literature, although we do discuss the most relevant recent contributions. Rather, we wish to draw attention to the potential importance of a previously neglected factor, namely that aid receipts (and capital inflows more generally) tend to be volatile over time. As capital inflows are important determinants of investment decisions, that in turn are influences on growth, such volatility may impact on growth. Similarly, aid is an important component of government revenues therefore volatility of receipts may impact on fiscal behaviour, that in turn may influence growth. Thus, we investigate whether uncertainty associated with (volatility or instability of) the level of aid inflows affects the impact of aid on growth.

Endogenous growth theory, that motivates most recent empirical work, does not provide a *direct* link between aid and growth. Rather, any potential impact of aid on growth is conditional on aid affecting a determinant of growth, such as investment. Moreover, any effects of aid will be influenced, if not determined, by how the aid affects government behaviour. On a related theme, more frequently addressed in the literature, government policy will influence the effectiveness of aid. Most commentators would agree that the effectiveness of aid partly depends on economic policies in the recipient countries. In most studies the implicit approach taken is to argue that recipient governments, by their actual behaviour (fungibility or having inappropriate economic policies), undermine the effectiveness of aid. It is also possible that the effectiveness of aid is affected by donor policies. One candidate is the stability of the donor-recipient relationship, and related to that the stability of aid flows to developing countries. It may well be the case that foreign aid is much more effective when the inflow is expected. Uncertainties with respect to inflows may render aid less effective as investors, confronted with uncertainty, may decide to postpone or even cancel investment decisions. Uncertainty may have similar effects on the investment decisions and broader fiscal behaviour, of governments.

A brief review of the existing literature is presented in Section 2, which elaborates on the issues of most concern to us. The variables we will introduce into the regressions to proxy for uncertainty are measures of aid flow instability. The motivation behind these measures is explained in Section 3. On the one hand, instability (or unpredictable

variability) of inflows will be related to investment uncertainty, and the relationship between aid and investment is crucial to any effect of aid on growth. On the other hand, if aid receipts are highly variable over time this will render it more difficult for governments to manage the budget and establish fiscal stability. Thus, aid instability may have an adverse effect on economic policy. In Section 4 we describe the measures of aid instability and uncertainty that will be used in the empirical analysis. Section 5 presents the econometric results, based on standard Barro (1991) cross-country growth regressions. In Section 6 we present stability analysis to test the reliability of the results; surprisingly, most empirical aid-growth studies fail to present stability tests, including the oft cited studies of Boone (1996) and Burnside and Dollar (1997). Section 7 concludes.

II EMPIRICAL ISSUES IN IDENTIFYING THE IMPACT OF AID ON GROWTH

Evidence on the relationship between aid and growth, or economic performance more generally, is quite important for at least two reasons. First, it contributes to understanding *how* aid impacts on an economy. Second, findings on the relationship will influence aid policy. Clearly, the latter should depend on our understanding of the former. Considerable publicity has been granted to certain studies arguing that aid is ineffective and, at least implicitly, attributing the blame for this largely to recipient governments (e.g. Boone, 1994, 1996). Similarly, the Burnside and Dollar (1997) approach effectively blames recipient governments for not having appropriate economic policies. The view of the World Bank (1998) appears to be that aid is only effective if appropriate policies are in place, and this provides an argument for conditional lending (i.e. the receipt of aid is conditional on agreeing to implement a programme of economic policy reforms). It is worth considering how these studies address the way in which aid impacts on an economy, and how this relates to the prevailing economic policy environment.

The way in which aid impacts on growth, and how policy affects this, is not always explicit in the models. Burnside and Dollar (1997) are quite clear. Aid can be effective if it boosts income and as a result the savings rate is increased; inappropriate government policy can prevent the latter. Hence, aid is only likely to impact on growth if appropriate

policies are in place.[1] Boone (1994) is less clear: the growth model is used to 'motivate' the empirical analysis, but no explicit role for aid in the growth model is introduced. Aid appears as a component of investment in physical capital, and can only contribute to growth through this contribution to investment.[2] In both models, there is an explicit link between aid and investment; inappropriate government policies have an adverse effect because they undermine this link.

The effect of policy on the relationship between aid and growth is by no means clear; an even reading of the evidence suggests that both aid and policy have independent effects on growth. The principal factor determining the impact of aid on growth appears, in many results, to be investment (as implied in the underlying theoretical models). 'Aid impacts positively on investment and therefore on growth … in attempts at explaining how aid impacts on growth, seemingly insignificant results should come as no major surprise when aid impact is conditional on what happens to physical investment and human capital' (Hansen and Tarp, 1999: 30).[3]

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1 The underlying theoretical model is one in which households choose savings and consumption to maximise utility, and savings (investment) is sufficient to maintain the capital-labour ratio in the steady state. The distortionary effects of government intervention are introduced via a tax on (physical and human) capital that creates a wedge between the marginal product of capital and the private return. This tax generates the observed correlation between savings and income: higher taxes reduce savings and investment and thus result in lower income (Boone, 1994). To introduce policy, the tax wedge can be interpreted as a proxy for inappropriate government policies that prevent savings rates from increasing (Burnside and Dollar, 1997).

2 Boone (1994, 1996) tests for fungibility; if some aid is allocated to consumption rather than investment, it cannot have a positive impact on growth. He finds that most aid is allocated to consumption, and concludes that aid is therefore ineffective (in Boone, 1996, the additional inference is that this is because of the political regime). This approach, and hence the conclusion, is potentially misleading. First, much aid is in practice intended for consumption; as this can permit higher savings, such aid can contribute to growth in principle (this possibility was precluded). Second, measured consumption includes investment in human capital; this may often be an intended use of aid, and by increasing the productivity of human capital aid can contribute to increasing growth. This is difficult to validate empirically, partly because it is difficult to identify how much of aid is invested in human capital and partly because one would anticipate long lags between the receipt of aid and any increase in labour productivity.

3 Burnside and Dollar (1997) do not include investment; it is possible that the significant policy terms in their regressions are actually picking up an investment effect. Durbarry *et al* (1998) do not include investment as an explanatory variable but include the various sources of investment funds such as domestic savings and private capital inflows. Results for these variables are mixed.

On balance, there is evidence that aid may be positively correlated with growth, but some controversy regarding how aid interacts with policy. Burnside and Dollar (1997) assert that the positive effect is only observed when appropriate policies are present. Durbarry *et al* (1998) find that the impact of aid on growth is enhanced by, but not dependent on, appropriate economic policy variables.[4] Similarly, Hansen and Tarp (1999) find that the impact of aid on growth arises from a positive impact of aid on investment; while 'good' policy is conducive to growth, it is neither a necessary nor sufficient condition for aid to have a positive impact. One could equally argue that the effectiveness (or choice) of policy may be conditional on aid. For example, governments with a predictable inflow of aid may be better able to achieve macroeconomic stability. To complicate the relationship further, achieving specified macroeconomic targets may be a requirement if the aid inflow is to be predictable, i.e. conditionality introduces a causal link from policy to aid.

If one finds an effect of aid on growth, it is likely that this arose at least primarily through a link between aid and investment (a relationship we test explicitly). However, if one does not find an effect of aid on growth, there are many possible explanations. It may that aid was diverted from intended investment (this could be a rational response to variable capital inflows, or could be 'devious' behaviour by recipients). It may that aid was actually granted for poverty-relief or social sectors, hence not directly intended for investment. It may even be that aid was directed to investment but for some reason (one of which may be poor economic policy) the productivity of investment was low. It may of course, as discussed next, be due to instability in aid flows.

III ON THE IMPORTANCE OF INSTABILITY AND UNCERTAINTY

In the 1980s, largely as a result of the debt crisis, private capital flows to developing countries declined precariously. In that period, it was clear that foreign aid could, in principle, fulfill an important role. From the end of the 1980s onwards, international investors' interest in developing countries seemed to resume, as indicated by the recent surge of bank loans and, especially, portfolio and direct investments. However, this does not make foreign aid irrelevant as the distribution of private capital flows is extremely

4 They also find that there appears to be an optimal aid/GDP ratio, of 40-45%, in terms of the impact on growth; in cases where the ratio is greater or quite low, aid does not appear to have a positive impact on growth. Lensink and White (1998b) obtain a comparable result. Hansen and Tarp (1999) find a positive impact of aid on growth for countries with a ratio below 25%.

uneven, leaving most African countries dependent on foreign aid (Lensink and White, 1998a). This serves to illustrate that aid is only one source of capital inflow and such inflows are variable over time. Our concern, however, is with aid.[5]

We do not provide a theory of the relevance of aid instability, but offer various reasons as to why it is likely to be important. First, we wish to draw attention to effects on investment as being central to the effect of aid on growth. Second, we wish to highlight the importance of uncertainty to investment behaviour. Third, we wish to emphasize that aid has effects as a source of government revenue, and uncertainty regarding such revenue can have important implications.

Capital Inflows, Investment and Growth

We have already noted that in the models of Burnside and Dollar (1997) and Boone (1996), effects of aid (and government policy) on savings/investment decisions are mediators of the impact of aid on growth. Similar results are found in other, quite different, models. Bacha (1990) provides a three-gap model of the macroeconomic effects of capital transfers. Of relevance here, it is noteworthy that fundamental to the effect of capital inflows in relaxing a fiscal constraint on investment is the relationship between public and private investment. Specifically, the elasticity of investment with respect to aid is greater than unity if there is crowding-in (complementarity between public and private investment) but less than unity in the presence of crowding-out. If aid (uncertainty) affects fiscal behaviour it can affect growth both directly through public investment and indirectly through the effect on private investment.

Mosley *et al* (1987) also emphasise the relationship between aid and investment, and especially the interaction of public and private investment. They use a fiscal response model to derive an expression for the impact of aid on growth. Two of the most important determinants of the effectiveness of aid are i) the incentive effects of aid on private investment; and ii) the effect of aid on public investment and how this, in turn, influences private investment. The impact of aid on investment, especially public versus

5 Aid is qualitatively different from other capital inflows, notably because it is to the government and it is aid inflows that are expected to be fungible. The effect of other inflows is picked up by the inclusion of investment in our analysis.

private, is clearly fundamental to the impact of aid on growth. Does uncertainty affect investment?

Uncertainty and Investment

There is a vast literature on uncertainty, investment and economic growth. Most of this is mainly theoretical (e.g. Abel, 1983; Caballero, 1991; Dixit and Pindyck, 1994). There is no doubt that uncertainty (regarding costs or output) affects investment and hence growth. These studies do not, however, consider uncertainty regarding the source of funds for investment. A parallel can be made with the literature on the debt relief Laffer curve (e.g. Borensztein, 1990; Claessens and Diwan, 1990; Krugman, 1988; Sachs, 1989). A high debt burden can be a potent disincentive to investment, especially in the presence of uncertainty about future output (which captures the likelihood of being able to service debts in the next period). Debt relief, a form of aid, can then encourage higher levels of investment. In a similar manner, uncertainty regarding aid receipts (or debt relief) may discourage investment.

Levy (1987) is a particularly interesting study that distinguishes the effects of unanticipated aid on savings (and investment) from the effects of anticipated aid. His results showed that although the propensity to consume out of unanticipated (emergency) aid was not significantly different from unity, the propensity to consume anticipated aid was no greater than 0.4. This is evidence that the stability of aid flows (i.e. the degree to which they can be anticipated) influences the likelihood that they will be used for investment purposes and hence contribute to growth.

Revenue Instability and Fiscal Response

Fiscal response models attempt to address explicitly how aid may alter public sector behaviour, in particular fiscal behaviour regarding taxation and expenditure. Mosley *et al* (1987) and Gang and Khan (1991), picking-up on an earlier paper by Heller (1975), model the public sector fiscal response to foreign aid inflows. In the standard approach, governments maximise their utility by attaining revenue and expenditure targets and aid is treated as exogenous. Franco-Rodriguez *et al* (1998) endogenise aid: governments have a target for aid revenue, and this expected revenue is incorporated into their fiscal planning. That is, when determining revenue and expenditure allocations, aid revenue is taken into account.

Franco-Rodriguez *et al* (1998) estimate their fiscal response model for Pakistan, and find that aid seems to increase investment but to encourage reduced tax effort and greater borrowing. Fiscal response models highlight the fact that aid is a source of government revenue that will influence fiscal behaviour, in particular (for our purposes) public investment decisions. As such, aid is a component of a government's fiscal planning. If revenues are unstable, it is likely that expenditures will be altered and investment is often the easiest expenditure heading to cut in the short-term (i.e. in response to an unanticipated revenue shortfall). A number of recent studies have begun to address the effects of revenue instability.

Bleaney *at al* (1995) examined possible causes of tax revenue instability for African economies both in terms of the underlying structure of their tax systems and the wider structure of their economies. There was significant evidence that sub-Saharan Africa (SSA) had higher tax instability than other groups of developing countries. The evidence pointed consistently to a close link between revenue and expenditure instability over time, suggesting that governments have very limited capacity to maintain expenditures when tax revenues fluctuate. Fielding (1997) conducted a similar analysis, also confining attention to the effect of tax revenue instability on government expenditure (in a sample of 12 SSA countries). The results suggested that most of the variation in expenditure could be explained by variations in tax revenue; debt, interest rates and real depreciation were not consistently significant. Neither of these studies considered aid, an important source of revenue in low-income countries.

Gemmell and McGillivray (1998) present an empirical analysis of instability of aid and other revenue flows for a sample of 48 developing countries. They motivate their concern by invoking consumer theory, noting that consumers are expected to alter their behaviour in the face of inter-temporal fluctuations in income so as to smooth consumption. The authors posit that governments seeking to maximise social welfare could also be expected to alter behaviour when faced with inter-temporal instability in revenue flows. They found that aid is more unstable than other general categories of revenue other than capital revenues, and that aid and tax instability tend to lead to adjustments to deficits rather than expenditures. There was some time series evidence to suggest that increased aggregate

aid inflows 'Granger cause' increased government spending and/or reduced taxation in the following year. Aid instability appears to have effects.

IV MEASURING CAPITAL INFLOW UNCERTAINTY

In the literature on uncertainty, investment and economic growth, the construction of the uncertainty proxy consists of two steps (Bo, 1998). First, a forecasting equation is estimated in order to determine the expected component of the variable under consideration. Typically, the forecasting equation is specified as a first or second-order autoregressive process, possibly extended with a time trend. Second, the uncertainty proxy is derived by calculating the standard deviation of the residuals from the forecasting equation (e.g. Aizenman and Marion, 1993; Ghosal, 1995). Although this literature does not explicitly deal with capital flow uncertainty – they mainly consider demand, cost or policy uncertainty - we follow this approach and measure aid uncertainty by calculating, for each country in the data set, the standard deviation of the residuals of the following forecasting equations:[6]

$$AID_t = a_1 + a_2T + a_3AID_{t-1} + a_4AID_{t-2} + e_t, \quad (1)$$

$$AID_t = a_5 + a_6AID_{t-1} + a_7AID_{t-2} + e_t \quad (2)$$

$$AID_t = a_8 + a_9T + a_{10}T^2 + e_t \quad (3)$$

where *AID* is development aid as a percentage of GDP, *T* is a time trend and e_t is an error term with standard properties. A number of comments are in order. Firstly, one has to select some criteria for getting a real measure of the value of aid inflows. We choose the aid/GDP ratio as capturing the relative importance of aid inflows. It is true that the ratio may reflect changes in GDP with aid constant, rather than changes in aid *per se*. Nevertheless, the ratio does capture the importance of aid. Furthermore, it is standard practice to use the aid/GDP ratio in cross-country growth regressions. We follow this practice in our empirical application, and the motivation of our study is to test for

6 We also estimated (1) for bank lending as a percentage of GDP (*BANKL*) and total private capital inflows as a percentage of GDP (*CAPFL*). As our base model includes investment as an explanatory variable, these are not included in the base regression (otherwise we would have multi-collinearity between investment and the combined sources of investment funds). However, these variables and the associated uncertainty measures, *EBANKL* and *ECAPFL*, are included in the stability analysis.

instability in the aid variable. Consequently, this definition of aid seems the most appropriate for our purposes.

Secondly, we estimate three measures, the first two intending to capture *uncertainty* whereas the third is a measure of instability. A considerable literature has been concerned with export instability (e.g. Love, 1987; Tan, 1983), and has tended to use measures based on deviations around an observed trend or some forecast trend. Measures similar in spirit to (3) have been employed in the literature (Bleaney *et al*, 1995; Gemmell and McGillivray, 1998).[7] This is a descriptive measure of the total amount of instability. Measures (1) and (2) are constructed as measures of unanticipated or unexpected instability. Implicitly, we posit that governments (the recipients of aid) have some form of adaptive expectations. Aid commitments are generally known some years in advance, and one could expect a degree of continuity in donor-recipient relations. Furthermore, recipients exercise some control over the disbursement of aid funds. Thus, knowing past values of aid inflows, recipients should be able to anticipate some variability in aid. Uncertainty is therefore captured by unanticipated aid, as measured in (1) and (2), the former controlling for a time trend.[8]

The preceding argument assumes that the autoregressive form of (1) and (2) is a more appropriate specification of expectations than a deviation from a time trend. By entering each measure into our regressions, we can test this assumption. The above equations are estimated for each country over the sample period (1970-1995) using data from World Bank (1997). We apply the analysis to the entire group of developing countries (N = 75), as well as to the sub-group of African developing countries (N = 36). Following the discussion above, we have two measures of aid uncertainty, *UAIDT*, from (1) and *UAID* from (2), and one measure of overall instability, *AIDI* from (3).

7 Gemmell and McGillivray (1998) measure instability as the standard deviation of *changes* in real aid and tax revenues. As their focus was on fiscal response to instability, this is appropriate. However, the measure does not incorporate expectations, therefore is in the spirit of (3). If the GDP deflator is used to derive real values, the results would be comparable to applying (3) to changes in revenue/GDP ratios.

8 There is no *a priori* reason to prefer (1) to (2). It transpires that the two measures are highly correlated and perform similarly.

V REGRESSION RESULTS FOR THE BASE MODELS

Our approach is in line with the now well-known Barro-type of cross-country growth regressions. Our aim is not to estimate the impact of aid on growth *per se*, but rather to test if aid uncertainty affects the relationship between aid and growth. Consequently, the base model is parsimonious in choice of explanatory variables. A wide range of other explanatory variables that have been suggested as important are incorporated into the stability analyses of the next section (in this way, we explicitly test for omitted variable bias). Two respects in which our formulation differs from that of other contributions deserve comment.

First, we include investment as an explanatory variable. While this is appropriate investment should be a principal determinant of growth, it is problematic as aid and investment may be related. In fact, we demonstrate below that aid is a significant positive determinant of investment. However, as we estimate growth regressions with and without investment, and conduct stability tests, we can demonstrate that aid appears to have an effect additional to the effect through investment. Second, many other studies include policy indicators. Durbarry *et al* (1998), for example, include indicators to control for economic policy whereas Burnside and Dollar (1997) include an interaction term of aid with a policy index.[9] Hansen and Tarp (1999) also include policy variables separately and with an interaction term, and find that 'good macroeconomic policies do affect growth [but] good policy is neither necessary for aid to be effective nor does it enhance the partial effectiveness of aid' (p. 22). On this basis we omit policy variables from our base regression, although they are incorporated into the stability tests.

Two base model regressions are estimated:

$$PCGROWTH = \alpha_1 + \alpha_2 GDPPC + \alpha_3 SECR + \alpha_4 AID + \mu \quad (4)$$

$$PCGROWTH = \alpha_5 + \alpha_6 GDPPC + \alpha_7 SECR + \alpha_8 INVEST + \alpha_9 AID + \mu \quad (5)$$

9 In the former study, the policy variables were generally significant and of the expected sign. In the latter study, however, the policy variables were frequently insignificant when introduced separately. Hansen and Tarp

Where *PCGROWTH* is the per capita growth rate of GDP; *GDPPC* is the initial level of per capita GDP; *SECR* is the initial secondary-school enrolment rate; and μ is an error term with standard properties. *GDPPC* and *SECR* are included in order to come up with a reasonable base model. These variables have been shown to have a robust and significant impact on economic growth, and hence are taken into account in most recent growth regression studies (e.g Sala-i-Martin, 1997a).[10] *GDPPC* is intended to pick up any conditional convergence effect, and the sign is expected to be negative. *SECR* proxies for the initial stock of human development. The sign is expected to be positive.

Many growth regressions show that the investment to GDP ratio (*INVEST*) is significantly related to economic growth (Levine and Renelt, 1992). However, if the investment/GDP ratio is included, the interpretation of a significant coefficient on other variables alters. Once *INVEST* is included, another variable is said to affect growth via the 'level of efficiency' whereas if *INVEST* is omitted it is unclear whether any effect of another variable on growth is via investment or via efficiency (Sala-i-Martin, 1997b). For this reason, we estimate equations in which *INVEST* is included and in which *INVEST* is not included. We estimate the equations for both the entire group of developing countries as well as for the subgroup of African developing countries.

The base model regression results are presented in Table 1. For the full sample, *GDPPC*, *SECR* and *INVEST* are highly significant, with the expected sign; the regression for Africa without *INVEST* performs very poorly (it is effectively meaningless). The results with respect to *AID* are disappointing, in the sense that it is clearly insignificant in all regressions.

(1999) replicate the Burnside-Dollar regressions and find that neither fiscal policy variables nor the aid-policy interaction term are significant. They conclude that the Burnside-Dollar results are not robust.

10 It should however be noted that results are somewhat mixed with respect to the robustness of *SECR*.

Table 1: Base model without uncertainty terms

	1: All	2: All	3: Africa	4: Africa
GDPPC	-0.00016	-0.00015	-0.00032	-0.00094
	(-8.95)	(-5.77)	(-0.86)	(-5.53)
SECR	0.0398	0.0297	0.0610	0.0720
	(3.96)	(3.06)	(2.38)	(5.99)
INVEST		0.124		0.145
		(4.97)		(8.75)
AID	-0.0098	-0.0247	0.0204	-0.0127
	(-0.42)	(-1.63)	(0.83)	(-1.21)
CONSTANT	0.0879	-2.2110	-0.6126	-2.9096
	(0.23)	(-4.14)	(-1.09)	(-5.77)
R^2	0.20	0.41	0.05	0.53
Obs.	75	75	36	36
MDEPV	0.61	0.61	0.07	0.07
SDDEPV	1.69	1.69	1.66	1.66
F	7.25	13.97	1.64	10.97
JB	0.24	4.51	0.17	4.72

Note: dependent variable is *PCGROWTH*. MDEPV = mean of the dependent variable; SDDEPV = standard deviation of the dependent variable; R^2 = adjusted R^2 ; F = F-statistic. The t-values in parentheses are based on White heteroskedasticity-consistent standard errors (this applies to all tables and the stability tests). JB = Jarque-Bera normality test. Obs. = number of observations.

This could lead one to conclude that foreign aid does not matter at all for economic growth. More commonly, one would conclude that the regression is not fully or appropriately specified. One possibility is that uncertainty in aid inflows acts as a constraint on investment, therefore undermines the effectiveness of aid. Another possibility is that aid uncertainty undermines fiscal planning (and may induce budget deficits), and this constrains the effectiveness of aid. A further possibility, of course, is that an important element of unanticipated aid (that generates measured uncertainty) is in fact emergency aid. In this case uncertainty may pick up adverse shocks to the economy. Whilst it is not possible, in the current framework, to distinguish these possible effects (and they are not mutually exclusive), all point to uncertainty of aid inflows as potentially related to the effectiveness of aid. The results including measures of aid uncertainty and instability are given in Table 2 (for all countries) and Table 3 (for the African countries).

The results of this new set of regressions are encouraging. The coefficients on the two aid uncertainty measures (*UAIDT* and *UAID*) are in all cases significant with the expected negative sign. Moreover, when these uncertainty measures are included *AID* becomes significant and positive for regressions with all developing countries (Table 2). A plausible interpretation is that uncertainty of aid inflows has a negative association with growth performance but, controlling for uncertainty, aid inflows have a positive impact on growth.[11] This positive impact of aid holds whether *INVEST* is included or excluded, although the inclusion of *INVEST* reduces the size (and significance) of the coefficient on aid. This suggests that aid, controlling for uncertainty, has a positive impact on growth that operates through investment but also additional to investment (the so-called efficiency effect). We explore this further below. Finally, we can note that the measure of overall instability (*AIDI*) was insignificant and had no effect on the results. This is consistent with the argument that it is uncertainty, i.e. deviations from expected inflows, that are important rather than instability *per se*.

11 Similar results were obtained when alternative sources of capital were introduced (separately). Domestic bank lending was only positive and significant when its uncertainty *EBANKL* (see footnote 6) was included; private capital inflows alone were significant if *INVEST* was omitted, but when *ECAPFL* was added the coefficient was positive and significant in regressions with and without *INVEST*.

Table 2: Base model with uncertainty, All countries

	1	2	3	4	5	6
GDPPC	-0.00017	-0.00016	-0.00017	-0.00016	-0.00016	-0.00015
	(-9.14)	(-6.29)	(-9.15)	(-6.28)	(-8.85)	(-5.71)
SECR	0.0397	0.0313	0.0396	0.0312	0.0398	0.0293
	(4.55)	(3.74)	(4.52)	(3.71)	(3.89)	(3.03)
INVEST		0.1024		0.1033		0.1247
		(4.42)		(4.48)		(4.89)
AID	0.0610	0.0328	0.0593	0.0324	-0.0142	-0.0221
	(2.64)	(1.93)	(2.52)	(1.87)	(-0.41)	(-1.24)
UAIDT	-0.2997	-0.2322				
	(-4.95)	(-3.76)				
UAID			-0.2723	-0.2153		
			(-4.83)	(-3.65)		
AIDI					1.10^{E}+11	-6.88^{E}+10
					(0.27)	(-0.38)
CONSTANT	0.2683	-1.6746	0.2848	-1.6747	0.0906	-2.2302
	(0.83)	(-3.58)	(0.8748)	(-3.60)	(0.230)	(-4.14)
R^2	0.37	0.51	0.38	0.51	0.19	0.40
F	11.96	16.23	12.13	16.68	5.41	11.04
JB	0.44	1.61	0.69	1.41	0.13	4.64

Note: as for Table 1.

Table 3: Base model with uncertainty, African countries

	1	2	3	4	5	6
GDPPC	-0.00045	-0.00094	-0.00045	-0.00095	-0.00032	-0.00095
	(-1.22)	(-5.09)	(-1.21)	(-5.18)	(-0.85)	(-5.41)
SECR	0.06122	0.0708	0.0605	0.0704	0.0611	0.0720
	(2.44)	(5.38)	(2.45)	(5.51)	(2.33)	(5.92)
INVEST		0.1275		0.1276		0.1466
		(7.24)		(7.36)		(8.52)
AID	0.0684	0.0207	0.0666	0.0211	-0.0153	-0.0096
	(2.96)	(1.26)	(2.75)	(1.24)	(-0.43)	(-0.77)
UAIDT	-0.2570	-0.1575				
	(-3.84)	(-2.17)				
UAID			-0.0235	-0.1518		
			(-3.60)	(-2.10)		
AIDI					1.33^{E}+11	-8.85^{E}+10
					(0.29)	(-0.67)
CONSTANT	-0.1896	-2.3745	-.0.1566	-2.34	0.617	-2.9300
	(-0.37)	(-4.75)	(-0.30)	(-4.69)	(-1.07)	(-5.74)
R^2	0.25	0.60	0.34	0.61	0.03	0.52
F	3.90	11.39	4.02	11.95	1.24	8.56
JB	0.01	0.18	0.06	2.70	0.09	5.04

Note: as for Table 1.

Results for the subgroup of African countries (Table 3) are similar. It is still the case that *AID* becomes significant if uncertainty is included for the models without *INVEST*. When we incorporate *INVEST*, however, the aid variable becomes insignificant although the uncertainty measure remains negatively significant. A plausible interpretation is that, in African countries, aid does not have an efficiency effect on growth; any effect of aid is through investment. We find that aid uncertainty has a negative effect on growth, consistent with the argument that uncertainty may constrain investment. Furthermore, the evidence that *AID* is positive and significant when *INVEST* is excluded is consistent with the argument that aid is (at least largely) directed to investment. Indeed, as we control for uncertainty, we can go further and suggest that it is anticipated aid which tends to go to investment (the same finding as Levy, 1987).

It is apparent that the link between aid and investment is itself quite important. Table 4 reports the results from estimating a simple investment equation. The overall performance of the regressions is acceptable. There are noticeable differences in the results for all countries and those for African countries only. If *AID* is included alone, it is not significant in the regression for all developing countries. However, once we control for uncertainty, the coefficient on *AID* is positive and just significant, while the coefficient on *UAIDT* is negative and significant. For African countries only, the coefficient on *UAIDT* is not significant although the inclusion of uncertainty increases the significance of the coefficient on *AID* (which is positive and significant in both regressions). We are not here attempting to estimate the proportion of aid allocated to investment, but merely to demonstrate that there appears to be a positive relationship between aid and investment. Hansen and Tarp (1999: 29), in a more comprehensive estimation, also find evidence that aid is a positive significant determinant of investment, and World Bank (1998: 133) reports evidence that aid has a positive and significant impact on public sector investment.

Table 4: Aid and Investment

	1 All	**2 All**	**3 Africa**	**4 Africa**
GDPPC	-0.00029 (-3.98)	-0.00030 (-4.13)	-	-
TRADE	0.058 (3.53)	0.059 (3.63)	0.146 (3.75)	0.142 (3.62)
MGDP	0.115 (1.70)	0.114 (1.74)	0.257 (3.32)	0.246 (3.24)
AID	0.036 (0.43)	0.220 (1.92)	0.133 (1.92)	0.234 (2.51)
UAIDT		-0.770 (-2.80)		-0.478 (-1.29)
CONSTANT	14.90 (7.82)	15.16 (8.42)	3.446 (1.54)	4.265 (1.82)
R^2	0.32	0.36	0.56	0.57
F	11.44	10.59	19.17	14.68
N	88	88	43	43

Note: Dependent variable is *INVEST*. Per capita GDP (*GDPPC*) was insignificant for the African sample and hence omitted. *TRADE* is openness, *MGDP* is the ratio of money to GDP, a measure of financial development (see Appendix). Other measures of aid instability were included: *UAID* performed similarly to *UAIDT*, *AIDI* was insignificant.

These results support the argument that the impact of aid on growth, or at least a major component of the impact, is via a positive impact on investment. Consequently, we should not be surprised that when investment is included with aid in regressions for all countries (Table 2), the significance of aid falls (but is not eliminated). It appears, nevertheless, that aid has an impact on growth additional to the impact through investment. For African countries, however, there is no support for aid having this additional effect. This is consistent with the view that efficiency, or the return to capital, is lower in African countries.

VI STABILITY ANALYSIS

Following the seminal paper of Barro (1991), there is now a sizeable literature in which economic growth in a cross-section of countries is regressed on a group of explanatory variables. Unfortunately, theory does not provide clear guidance with respect to the explanatory variables that should be taken into account. As a result, many explanatory variables have been included in economic growth regressions, usually reflecting the specific aim of the study or perspectives of the author. A clear drawback is that almost any explanatory variable could be found to have a significant effect whereas the 'truth' is that apparent significance is due to common causalities or spurious regressions. This is most likely if other variables, that are closely related to the variable(s) under consideration, are excluded from the regression.

Our regression results can be challenged as (potentially) subject to such omitted variable bias, and therefore our findings may not be robust. We address this concern by conducting a large-scale stability analysis to test the reliability of the base results. There are several ways in which stability of results can be tested. A very popular method is Leamer's extreme bound analysis (EBA), recently rediscovered by Levine and Renelt (1992). This basically tests whether the variable of interest remains significant when different groups of other variables, drawn out of a pool of variables which could be important, are added to the base model. The variable of interest is not robust when, in *one* of the regressions, the coefficient becomes insignificant. When the 'pool of variables' is very large, and many regressions are required to test the robustness of a particular variable, this test may be too stringent. Sala-i-Martin (1997a, 1997b) suggests an alternative, based on computing the cumulative distribution function from the average coefficient and standard deviation of all regressions with respect to the variable of interest.

We conduct a stability analysis in line with Sala-i-Martin (1997a). The analysis starts by defining the pool of variables out of which the additional variables are drawn. We use the following set of 23 domestic and international macroeconomic variables: an index for civil liberties (*CIVIL),* an index of political rights (*PRIGHTS)*, a war dummy (*WARDUM*), a measure of political

instability (*PINSTAB*), the black market premium (*BMP*), the inflation rate (*INFL*), the standard deviation of inflation (*STDINFL*), the trade to GDP ratio (*TRADE)*, the export to GDP ratio (*EXPGDP*), the deposit rate (*DEPR*), the real interest rate (*RINTR*), the Debt to GDP ratio (*DEBTGDP*), the Debt service to GDP ratio (*DEBTS*), the government budget deficit as a percentage of GDP (*BUDDEF)*, government expenditures as a percentage of GDP *(GOVCGDP*), taxes as a percentage of GDP (*TAXGDP*), the primary school enrolment rate (*PRENR*), the money and quasi-money to GDP ratio (*MGDP*), credit to the private sector as a percentage of GDP (*CREDITPR*) and four foreign capital inflow variables: bank and trade related lending as a percentage of GDP (*BANKL*) and the uncertainty with respect to *BANKL* (*EBANKL*); and total private capital inflow (*CAPFL)* and uncertainty of *CAPFL* (*ECAPFL*).[12]

Next, we determine all possible combinations of three of the 23 variables and perform regressions in which the base variables (equations (4) and (5) with aid uncertainty) are included as well as three additional variables.[13] This implies that, for all base models, 1771 variants (models *j*) are estimated. Per regression, depending on whether *INVEST* is included, eight or nine independent variables are taken into account (the constant; *GDPPC; SECR; INVEST; AID; UAIDT*, or *UAID* and three additional variables from the pool of 23).

For all regressions, coefficients and standard errors for the aid flow and uncertainty variables are obtained. By assuming that the distribution of the estimates of the coefficients is normal and calculating the mean and the standard deviation of this distribution, the cumulative distribution function (*CDF*) can be calculated. More precisely, if b_j is the coefficient for the variable in variant (model) *j*, and s_j is the standard error of the coefficient b_j, we proxy the mean and the standard deviation of the distribution by (for n =1771):

12 We intended to include the real exchange rate. However, we did not have observations for almost half of the (developing) countries in our sample.

13 It is arbitrary to take all combinations of three variables. However, the number of regressions increases dramatically when combinations of more than three variables are used, while combinations of less than three is not satisfactory as then the number of regressors in the equations may become too few.

$$\bar{b} = \frac{\Sigma b_j}{n} \qquad\qquad \bar{s} = \frac{\Sigma s_j}{n}$$

In Table 5, the mean estimate is given in the column 'Coef' and the mean standard deviation in the column 'St. error'. By using a table for the (cumulative) NORMAL distribution, we can calculate which fraction of the cumulative distribution function is on the right or left-hand side of zero. The test statistic used is defined as the mean over the standard deviation of the distribution. In Table 5, *CDF* denotes the larger of the two areas. If *CDF* is above 0.95, we can conclude that the variable under consideration has a robust effect on economic growth. A disadvantage of the Sala-i-Martin test is that it is based on the average values of the coefficient and the standard error. This implies that a variable may satisfy the robustness test yet in a substantial proportion of the regressions the coefficient is insignificant. To address this, we report in the last column of Table 5 the percentage of all regressions for which the variable under consideration is significant (at the 90% level).

Table 5 shows that the results obtained in the previous section are robust when *INVEST* is not included in the model. In general, the uncertainty measure is particularly robust, whereas *AID* is significant in only about 70 per cent of the variants. This is consistent with the evidence that aid has a positive impact on investment. If *INVEST* is included, foreign aid does not have a robust effect on GDP growth, although uncertainty remains quite robust. These results suggest that aid, if one controls for uncertainty, has a robust effect on economic growth via investment. This holds both for the entire group of developing countries, as well as for the sub-group of African countries. An inference is that anticipated aid is invested and therefore contributes to growth. There is no robust evidence that aid impacts on growth via an efficiency effect.

Table 5: Stability Analysis

Countries	Variable	R^2	Coef.	St. Error	CDF	Perc.
Without *INVEST* in base model						
All	AID	0.39	0.0479	0.0230	0.981	0.691
All	UAIDT		-0.2691	0.0690	1.000	1.000
Africa	AID	0.29	0.0662	0.0212	1.000	0.931
Africa	UAIDT		-0.2063	0.0726	0.998	0.952
All	AID	0.39	0.0457	0.0224	0.979	0.685
All	UAID		-0.2451	0.0633	1.000	1.000
Africa	AID	0.30	0.0642	0.0208	0.999	0.936
Africa	UAID		-0.1918	0.0683	0.998	0.961
With *INVEST* in base model						
All	AID	0.53	0.0230	0.0192	0.889	0.343
All	UAIDT		-0.1984	0.0652	0.999	0.986
Africa	AID	0.59	0.0140	0.0183	0.776	0.235
Africa	UAIDT		-0.1087	0.0596	0.966	0.592
All	AID	0.53	0.0230	0.0187	0.891	0.335
All	UAID		-0.1857	0.0604	0.999	0.956
Africa	AID	0.60	0.0158	0.0184	0.805	0.245
Africa	UAID		-0.1128	0.0583	0.973	0.666

Note: The aid variable and related uncertainty proxy appear in the same equation. R^2 : the average adjusted R^2 of all individual regressions for the equation concerned. Coef: the average coefficient for all individual regressions; St. Error: the average standard error for all individual regressions; CDF: the cumulative distribution function (>0.95 signifies robustness); Perc: the percentage of all cases in which the coefficient for aid or the uncertainty measure is significant at the 90% level.

VII CONCLUSIONS

This paper examines a previously unconsidered issue, namely that the effect of aid on growth may depend on uncertainty associated with aid inflows. Our principal concern is that the impact of aid on growth depends fundamentally on the effect of aid on the level and efficiency of investment. Uncertainty of aid inflows can have an adverse effect on the level of investment (especially public investment) and thus on growth. It is possible that uncertainty of aid inflows could also constrain policy. Specifically, aid shortfalls (relative to expectations) could increase the budget deficit (with further adverse effects). More generally, aid is an important component of revenue and therefore affects fiscal behaviour. Uncertainty could therefore have adverse effects on fiscal policy. If aid is tied to policy reform, uncertainty may be increased (if recipients are unsure they will achieve the policy targets required to trigger the release of a tranche of aid).

The literature on aid and growth has become especially concerned with the influence of economic policy on aid effectiveness. Empirical findings that aid is only effective if appropriate policies are in place can be used to support conditional lending, where aid is tied to policy reform (World Bank, 1998). Even if this argument is true, and we have questioned the evidence in Section 2, the implication of conditionality does not follow. There is a considerable volume of literature that questions the efficacy of conditional lending in promoting economic policy reform (e.g. McGillivray and Morrissey, 1999; Mosley *et al.* 1991; White and Morrissey, 1997). It appears reasonable to claim that aid will be more effective under certain policy environments, notably those that are themselves conducive to growth. It is less clear that conditional aid promotes such policy environments. If conditionality leads to greater uncertainty (and/or to lower investment), and there are reasons to believe it does, then it may actually reduce the effectiveness of aid. The links between aid, policy and growth are more complex than simply stating that aid works if the right policies are present.

The empirical analysis of this paper examined the effectiveness of aid controlling for uncertainty of aid inflows. We found that aid uncertainty is consistently and significantly negatively related to growth, and this result is robust. Investment appeared to be the principal determinant of growth and, when included with investment, foreign aid does not have a robust effect on growth. These results suggest that aid, if one controls for uncertainty, has a robust effect on economic growth via the level of investment. This holds both for the entire group of developing countries, as well as for the sub-group of African countries. The results also suggest that a rise in aid uncertainty would negatively affect economic growth. We conclude that predictable aid inflows are important for investment, and thus for economic growth. This suggests that stability in donor-recipient relationships should enhance the effectiveness of aid. Such stability may support the implementation of appropriate economic policies, and these would enhance the impact of aid. More generally, stability in donor-recipient relations render it easier for recipients to predict future aid inflows, and this may permit more investment and better fiscal planning.

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Appendix: List of Variables

AID = development aid as a percentage of GDP
AIDI = foreign aid instability
BANKL = bank and trade related lending as a percentage of GDP
BMP = black market premium, calculated as [(black market rate/official rate)-1].
BUDDEF = overall budget deficits, including grants as a percentage of GDP
CAPFL = total external private capital flows as a percentage of GDP
CIVLIB = index of civil liberties
CREDITPR = credit to the private sector as a percentage of GDP
DEBTGDP = the external debt to GDP ratio
DEBTS = total external debt service as a percentage of GDP
DEPR = the deposit rate (%)
EBANKL = foreign bank lending uncertainty
ECAPFL = total private capital flow uncertainty
EXPGDP = exports of goods and services as a percentage of GDP
GDPPC= GDP per capita in 1970
GOVCGDP = government consumption as a percentage of GDP
INFL = the annual inflation rate
INVEST = average investment to GDP ratio over 1970-1995 period
MGDP = average money and quasi money to GDP ratio over the 1970-1995 period
PCGROWTH = average real per capita growth rate over 1970-1995 period.
PINSTAB = measure of political instability
PRENR = primary school enrolment rate
PRIGHTS = index of political rights
RINTR = real interest rate (%)
SECR = secondary school enrolment rate in 1970
STDINFL = the standard deviation of the annual inflation rate, calculated from the inflation figures
TAXGDP = total taxes as a percentage of GDP
TRADE = exports plus imports to GDP ratio, a measure of the degree of openness.
UAIDT = foreign aid uncertainty
WARDUM = dummy variable with a value of unity for countries that participated in at least one external war during the period 1960-1985, and zero to all other countries.

The source for all variables is World Development Indicators (World Bank, 1997), except for *BMP, CIVLIB, PINSTAB, PRIGHTS* and *WARDUM* that were obtained from the Barro-Lee data set (Barro and Lee, 1994), and the uncertainty measures calculated by the authors. The variables from the Barro-Lee data set refer to averages for the 1970-1990 period. Unless otherwise stated, all other variables refer to averages over the 1970-1995 period.

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Norman Gemmell - development and public sector issues
David Greenaway - trade and development
Ken Ingersent - agricultural trade, economic development
Tim Lloyd - agricultural markets, econometric modelling
Andrew McKay - poverty, peasant households
Chris Milner - trade and development
Wyn Morgan - futures markets, commodity markets
Christophe Muller – microeconometrics, households, health and nutrition
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Geoff Reed - international trade, commodity markets

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David Fielding *(Leicester University)* - investment, monetary and fiscal policy
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Doug Nelson *(Tulane University)* - political economy of trade
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Robert Lensink *(University of Groningen)* – macroeconomics, capital flows
Scott McDonald *(Sheffield University)* – CGE modelling
Finn Tarp *(University of Copenhagen)* – macroeconomics, CGE modelling