WHAT ARE THE LINKS BETWEEN AID VOLATILITY AND GROWTH?[1]

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ABSTRACT

Recent literature has debated possible adverse impacts of aid volatility on a country's economic performance. Our paper adds to this literature in three ways: First it tests the validity of the aid volatility and growth relationship from various aspects: across time horizons, by sources of aid, and by aid volatility interactions with country characteristics. Second, it investigates the relationship by the level of aid absorption and spending. Third, when examining the relationship between IDA aid volatility and growth, it isolates IDA aid volatility due to the recipient country's performance from that due to other sources. Our findings suggest that, in the long run, on average, aid volatility is negatively correlated with real economic growth. But the relationship is not even. It is stronger for sub-Saharan African countries than for other regions and it is not present in middle income countries or countries with strong institutions.

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INTRODUCTION

Aid volatility is a factor of interest, not only because of its effects on economic growth, but in its own right. Large fluctuations in aid inflows can result in instability of employment, changes in government budgets and uncertainty about the degree to which resources will be utilized in the future. All this has welfare consequences. Hence it is important to understand what (if any) are the costs of such volatility. Aid can be very volatile; it is generally more volatile than many other capital flows or government tax receipts. Bulir and Hamann (2003) find that aid inflows are more volatile than domestic revenues, corroborated by their subsequent study (2008b) as well as Hudson and Mosley (2006). In the similar vein, Pallage and Robe (2001) find that aid is twice as volatile as real output. Whether or not such aid flows are pro- or anti- cyclical, however, remains controversial: Bulir and Hamann (2003) find that aid tends to move in the same direction as GDP and revenues, while Pallage and Robe (2001) show that for African countries aid is procyclical differently from recipients outside Africa.[2]

The causes of aid volatility vary. IMF (2005) finds that aid can be volatile for good reasons, e.g. when responding to exogenous shocks, such as terms of trade or natural disasters. This is especially the case for low-income countries that are

disproportionately prone to exogenous shocks. For example, aid inflows sharply increased to Mozambique in response to floods in early 2000 and to Ethiopia in response to drought in 2002. Volatility may also reflect a recipient country's political status as well as its governance and macroeconomic performance, which are to some extent endogenous to the recipient country's actions (see Appendix I). Here the consequences are less obviously positive. Finally volatility can also be a manifestation of budget cycles in donor economies, which is clearly not desirable from the recipients' perspective.

Recently studies have shed light on the macroeconomic impact of aid volatility but the views diverge. Arellano et al (2005) suggest that a one-standard-deviation increase in aid volatility is associated with a decrease in manufactured good exports by up to four percentage points. Celasun and Walliser (2005) find that unpredicted aid volatility may result in permanent costs in terms of lost output. IMF (2003) and Guillaumont and Chauvet (2001), on the other hand, assert that aid influxes in response to exogenous shocks help cushion some of the adverse impact of the shocks. Prati and Tressel (2006) find that the impact of aid on exports varies by country circumstances. Aid flows during periods of adverse shocks or of reconstruction efforts subsequent to adverse shocks could have positive effects on exports. Lensink and Morrissey (2000) find that, controlling for aid instability, aid itself has positive impact on growth. Hudson and Mosley (2008a) show that aid volatility reduces investment and government expenditure shares. Theoretically, Agenor and Aizenman (2007) develop a model which shows that high aid volatility can induce poverty traps and potentially aggravate the effects of macroeconomic shocks.

The paper adds to the literature on aid volatility in three ways. First, it tests the validity of the aid volatility and growth relationship. We examine the robustness of the relationship from various aspects: across time horizons (1960 through 2000 as well as 1990 through 2000), sources of aid (The World Bank IDA - International Development Association, multilateral excluding IDA, and bilateral) [3], and aid volatility interactions with country characteristics. Second, the paper investigates if the impact of aid volatility varies by recipient countries' monetary and fiscal policy decisions (aid absorption and aid spending). This is in recognition of findings that aid recipient countries can contain the presence of Dutch disease effects of aid by adjusting macroeconomic policies. Prati and Tressel (2006) find that "recipient countries can smooth aid-driven fluctuations of the trade balance and support export levels by adjusting the net domestic assets of the central bank." IMF (2005) notes, "where aid itself is highly volatile, some savings of aid in the form of reserve accumulation may be optimal," (see also Bevan, 2005). Eifert and Gelb (2005) deem a foreign exchange reserve buffer equivalent to about 5 months of imports of most low income countries (LICs) adequate for the observed aid flows and volatility.[4]

Third, the paper looks at the impact of IDA volatility on growth. When examining the relationship, we isolate IDA volatility driven by an IDA recipient country's performance from that arising from other sources. This is an attempt to dig deeper into the question of what types of aid volatility are generally bad. Some IDA donors at donors' meetings in the past stressed that aid volatility that is endogenous to the recipient country's socioeconomic performance is necessary and may even be desirable.

Our findings are as follows. In the long run, aid volatility is on average negatively correlated with economic growth. But this general statement masks a number of qualifications that are even more important. First the relationship is not equally

important across all countries: it is notably stronger in the sub-Saharan African countries than other regions. Second, when looking at the medium run the relationship is not as clearly negative. Third, when aid volatility is categorized by source of aid the relationship holds for multilateral aid but not for bilateral aid. Fourth the long run adverse impact of aid volatility on growth is not significant either for all countries with strong policies and institutions or for middle-income countries. The impact of aid volatility on growth can vary depending on the level of aid absorption and spending. For economies where aid is fully absorbed, aid volatility matters for long-run growth. On the other hand, for those economies with low absorption of aid, the relationship matters not only in the long run but also in the medium run. In economies with full aid spending, aid volatility appears to lead to a negative impact on long run growth, while in those with low spending, the relationship is negligible.

In terms of IDA's aid, the volatility arising from the recipient country's IDA performance does not have a negative causal relationship with economic growth. However, we find that the volatility from other sources can bear negatively on real economic growth in IDA member countries in the medium term. The long run impact is not investigated due to the lack of data availability. This paper is organized as follows: Section II spells out the methodology employed; Section III reports the basic results; Section IV investigates variation of aid volatility impact on growth by aid absorption or spending; Section V explores the relationship between volatility and aid as provided through IDA; Section VI revisits the aid volatility-growth nexus using two-stage least squares with the two-step efficient generalized method of moments; and Section VII concludes.

EMPIRICAL METHODOLOGY

Our analysis follows growth literature in the choice of the dependent and explanatory variables adding an aid volatility measure. To evaluate the link between aid volatility and economic growth over the period 1960-2000, we estimate the following equation based on cross-sectional ordinary least squares (OLS) with heteroscedastic-consistent standard errors:

$$y_i = \alpha + \beta_1 volatility_i + \beta_2 X_i + \varepsilon_i \qquad (1)$$

where y is the average growth rate of real GDP per capita during the period; *volatility* is standard deviation of ratio of aid-to-GDP, IDA-to-GDP, multilateral aid (excluding IDA)-to-GDP or bilateral aid-to-GDP during the given period; X is a set of control variables; i is the country index.

We use data for 95 developing countries over the 1960-2000 period. All variables are averaged over the five time horizons: the 1960-2000, the 1960-1980, the 1970-2000, the 1980-2000, and the 1990-2000 periods. A la Rajan and Subramanian (2005), such time specifications are to cover the long run (30 to 40-year horizons) as well as the medium terms (10 and 20-year) and to grasp a sense of the impact of aid volatility over time.

The control variables we include are as follows:

- Initial real GDP per capita to control for convergence process (Hall and Jones, 1999; Bosworth and Collins, 2003; and Hnatovska and Loayza, 2004);
- Gross capital formation as a share of GDP to capture capital accumulation, including capital accumulated from aid inflows (Barro and Sala-i-Matin, 1995)[5];
- Inflation rate (annual % change of consumer prices) to measure the effect of macroeconomic policies (Bosworth and Collins, 2003);
- Initial period life expectancy at birth to measure initial health conditions (Bosworth and Collins, 2003);
- Average growth, and volatility, of terms of trade to capture external shocks (Rajan and Subramanian, 2005);
- Quality of trade policies (Sachs and Warner index updated by Wacziarg and Welch, 2003);
- Major political instability (measured by the number of revolutions) to control variability of growth as well as aid inflows (World Bank, 2004)[6]; and
- Regional dummies – Sub-Saharan Africa and East Asia Pacific.

Following Burnside and Dollar (2000), we drop outliers in all our cross-section specifications. We follow the Hadi (1992) procedure to identify and eliminate the outliers for each time horizon.[7] Estimates with an exclusion of outliers are justified on the grounds that such outliers bias cross-country regressions (Easterly, 2004).

Using OLS estimations, which, based on the above tests we consider appropriate, we look further into the aid volatility and growth relationship by type of donor. We broadly categorize donors into three: IDA (the World Bank's concessional window), multilateral donors excluding IDA (ML), and bilateral donors (BL). The regression model is the same as equation (1) but the volatility variable is replaced by standard deviation of the IDA-to-GDP, the ML-to-GDP or the BL-to-GDP ratio over the five time horizons.

We then extend our regression analysis to categorical interactions between aid volatility and country characteristics in growth regressions. The objective is to examine if the magnitude and statistical significance of the aid volatility and growth relationship varies by such characteristics as income and institutions. The regression model is

$$y_i = \alpha + \beta_1 volatility_i + \beta_2 volatility_i * characteristics_i + \beta_3 X_i + \varepsilon_i \quad (2)$$

where characteristics are income and institutional development. We group countries by the cross-country ranking for each characteristic: low, medium, and high.

The paper further expands the categorical interactions to the level of macroeconomic policy decisions in aid recipient countries, namely to the full or the low level of aid absorption and aid spending. Section IV discusses how we approximate the level of aid absorption and spending in an economy and shows how the impact of aid volatility on growth differs by macroeconomic policy condition.

We then further drill down on IDA volatility as IDA is a major aid provider to many low-income countries. We examine how IDA's volatility related to performance ("good volatility") relates to growth. Section V lays out the methodology and presents results.

Finally we attempt to take into account the possibility that volatility could be endogenous to growth, using two-stage least squares (IV) with the two-step efficient generalized method of moments (GMM). The IV procedure is to isolate exogenous changes in aid volatility and therefore gauge their causal impact on growth of real GDP per capita. The GMM makes it that variables measured with error tend to have bias toward zero (Wooldridge, 2001). The regression equation is

$$\begin{aligned} y_i &= \alpha + \beta_1 volatility_i + \beta_2 X_i + \varepsilon_i \\ volatility_i &= \gamma IV_i + \mu_i \end{aligned} \qquad (3)$$

where IV refers to a set of instrumental variables for aid volatility. The choice of instrumental variables is based on aid literature. They are the standard deviation of institution quality to capture changes in aid allocations, the standard deviation of terms of trade to capture shocks, and the average of the investment-to-GDP ratio as in Arellano et al. (2005).

AID VOLATILITY AND GROWTH: OLS ESTIMATION

In this section, we look into the cross-country evidence on the aid volatility and growth relationship. We investigate whether the relationship varies across time horizons, sources of aid, and categorical interactions with country characteristics.

Basic Results

Aid volatility tends to be higher in the long run than in the medium run. As annex Table A.1 shows the standard deviation of the aid-to-GDP ratio is about 4.3 during 1960-2000 and 1970-2000 periods. In the medium term, it is 3.7 in 1980-2000 period, and as low as 1.7 during the 1960-1980 period .

The OLS regression results in Table 1A and B indicate that aid volatility is negatively and statistically significantly associated with the real GDP per capita growth in 1960-2000, 1970-2000 and 1980-2000 time horizons. The partial correlation between aid and volatility is given in Figure 1. A substantial fraction of the variation in growth is explained by our core specifications, with R-squared greater in longer time horizons (71 and 67 percent respectively in 1960-2000 and 1970-2000 periods). The coefficient on the aid volatility is negative in all time periods except the 1990-2000 period and statistically insignificant in the two periods - 1960-2000 and 1990-2000.[8]

TABLE 1A. AID VOLATILITY AND AVERAGE REAL GDP PER CAPITA GROWTH IN THE LONG RUN: OLS

	1960-2000	1960-2000	1960-2000	1970-2000	1970-2000	1970-2000
	(1)	(2)	(3)	(4)	(5)	(6)
Aid volatility	-0.101	-0.11	-0.085	-0.086	-0.095	-0.072
	(4.00)***	(4.48)**	(3.19)**	(2.64)**	(2.90)**	(1.95)
Initial GDP per capita	-1.045	-0.979	-1.083	-1.425	-1.353	-1.453
	(6.11)***	(5.26)**	(6.43)**	(6.95)***	(6.34)**	(6.74)**
Gross capital formation	0.136	0.136	0.119	0.123	0.119	0.105
	(7.44)***	(7.90)**	(6.09)**	(5.89)***	(6.26)**	(4.36)**
Inflation (percent)		-0.002			-0.002	
		(1.72)			(2.09)*	
Initial life expectancy	0.057	0.052	0.042	0.081	0.079	0.054
	(4.57)***	(3.64)**	(3.08)**	(4.83)***	(4.44)**	(2.84)**
Average growth of TOT	0.013	0.013	0.013	0.024	0.024	0.024
	(1.81)*	(1.84)	(1.93)	(2.27)**	(2.31)*	(2.31)*
SD growth of TOT	-0.017	-0.018	-0.015	-0.034	-0.034	-0.032
	(2.16)**	(2.21)*	(2.00)*	(2.98)***	(2.99)**	(2.65)**
Trade policy	1.804	1.751	1.623	2.204	2.061	2.129
	(4.19)***	(4.27)**	(3.77)**	(4.46)***	(4.39)**	(4.06)**
Number of revolutions	-0.769	-0.202	-1.093	-0.532	-0.017	-0.944
	(1.59)	(0.37)	(2.25)*	(1.22)	(0.03)	(2.20)*
Sub-Saharan Africa			-0.727			-0.99
			(2.69)**			(2.48)*
East Asia Pacific			0.206			0.112
			(0.77)			(0.34)
Constant	2.658	2.415	4.309	2.951	2.609	5.319
	(1.71)*	(1.61)	(2.95)**	(1.63)	(1.60)	(2.75)**
Observations	78	75	78	82	78	82
R-squared	0.71	0.74	0.74	0.67	0.7	0.7

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

FIGURE 1. PARTIAL CORRELATION BETWEEN AID VOLATILITY AND GROWTH, 1960-2000

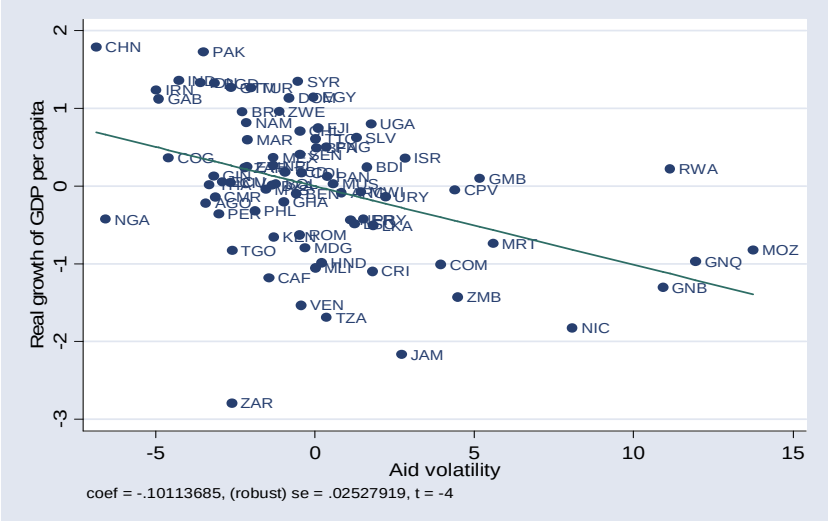


TABLE 1B. AID VOLATILITY AND AVERAGE REAL GDP PER CAPITA GROWTH IN THE MEDIUM RUN: OLS

	1960-1980	1960-1980	1960-1980	1980-2000	1980-2000	1980-2000
	(1)	(2)	(3)	(4)	(5)	(6)
Aid volatility	-0.065	-0.003	-0.058	-0.1	-0.111	-0.084
	(0.98)	(0.03)	(0.83)	(2.03)**	(2.23)*	(1.62)
Initial GDP per capita	-1.216	-1.213	-1.217	-1.188	-1.237	-1.196
	(3.38)***	(2.42)*	(3.26)**	(3.25)***	(3.68)**	(3.26)**
Gross capital formation	0.137	0.138	0.135	0.132	0.123	0.117
	(4.60)***	(3.82)**	(4.03)**	(5.54)***	(5.60)**	(4.61)**
Inflation (percent)		0.002			-0.002	
		(0.21)			(3.07)**	
Initial life expectancy	0.092	0.08	0.079	0.076	0.081	0.052
	(3.47)***	(2.78)**	(2.69)**	(3.12)***	(3.12)**	(1.63)
Average growth of TOT	0.009	0.012	0.009	0.01	0.014	0.011
	(1.61)	(2.16)*	(1.63)	(0.61)	(0.77)	(0.68)
SD of growth of TOT	-0.017	-0.007	-0.015	-0.02	-0.024	-0.019
	(1.74)*	(0.94)	(1.41)	(0.98)	(1.13)	(0.92)
Trade policy	1.679	1.803	1.543	1.554	1.412	1.566
	(2.15)**	(2.18)*	(2.09)*	(2.69)***	(2.47)*	(2.69)**
Number of revolutions	-0.194	-0.394	-0.28	-0.245	0.08	-0.604
	(0.20)	(0.36)	(0.30)	(0.45)	(0.13)	(1.06)
Sub-Saharan Africa			-0.46			-0.791
			(1.12)			(1.26)
East Asia Pacific			0.125			0.265
			(0.27)			(0.66)
Constant	3.304	3.304	4.115	1.893	2.051	3.857
	(1.51)	(1.16)	(1.74)	(0.70)	(0.79)	(1.27)
Observations	65	52	65	86	82	86
R-squared	0.52	0.53	0.54	0.49	0.55	0.51

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

TABLE 1B. (CONT.) AID VOLATILITY AND AVERAGE REAL GDP PER CAPITA GROWTH IN THE MEDIUM RUN: OLS

	1990-2000	1990-2000	1990-2000
	(7)	(8)	(9)
Aid volatility	0.03	0.007	0.04
	(0.46)	(0.11)	(0.66)
Initial GDP per capita	-0.814	-0.992	-0.704
	(1.41)	(2.09)*	(1.23)
Gross capital formation	0.155	0.131	0.136
	(3.58)***	(2.99)**	(3.89)**
Inflation (percent)		-0.003	
		(5.60)**	
Initial life expectancy	0.05	0.068	-0.013
	(1.08)	(1.64)	(0.23)
Average growth of TOT	0.012	-0.001	0.013
	(0.30)	(0.04)	(0.33)
SD of growth of TOT	-0.157	-0.155	-0.159
	(4.23)***	(4.17)**	(4.42)**
Trade policy	1.24	0.733	1.276
	(1.75)*	(1.21)	(1.86)
Number of revolutions	-1.105	-0.413	-1.475
	(2.00)**	(0.76)	(2.32)*
Sub-Saharan Africa			-1.453
			(1.99)*
East Asia Pacific			0.938
			(1.58)
Constant	0.56	3.148	4.36
	(0.13)	(0.81)	(0.99)
Observations	95	91	95
R-squared	0.5	0.59	0.53

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

The inflation rate, a macroeconomic policy variable, enters marginal in explaining growth – coefficient of -0.002 ~3 across different time horizons (Table 1A column (2) and (5) and Table 1b column (2), (5) and (8)). After controlling for regional effects using dummy variables, aid volatility enters significantly only for periods 1960-2000 and 1970-2000. The results show that aid volatility matters for real growth in the Sub-Saharan Africa region but not in the East-Asia Pacific region (Table 1A column (3) and (6) and Table 1B column (3), (6), and (9)).

How important is aid volatility in determining real economic growth in our regressions? As in Arellano et al. (2005), we estimate the quantitative contribution of aid volatility as a product of the coefficient of the aid volatility variable and its standard deviation above and below the mean. Table 2 displays that an increase of aid volatility by one standard deviation is estimated to reduce the real GDP growth rate as much as nearly two percentage points in the medium and the long run: if the 1960-2000 aid-to-GDP ratio is one standard deviation above its mean, the real GDP per capita growth rate is associated with a decrease by 2.12 percentage points.

TABLE 2. HOW IMPORTANT IS AID VOLATILITY IN REAL GDP PER CAPITA GROWTH?

	Change in real per capita GDP growth for a one SD increase in volatility	
Period	Lower bound	Upper bound
1960-2000	-0.01	-2.12
1960-1980	0.00	-0.38
1970-2000	0.00	-1.80
1980-2000	0.00	-2.01
1990-2000	0.00	0.42
Sub-Saharan Africa		
1960-2000	0.00	2.14

As annex Table A.1 shows, a one standard deviation increase in the aid-to-GDP ratio would be a lot – representing anything from a quarter to a third of the inter-period volatility. In this context the magnitude of the impact is relatively modest – a one percent increase in aid volatility, for example would cause a 0.02-0.03 percent decrease in economic growth.

Sources of Aid

In the spirit of Clemens et al (2004) and Rajan and Subramanian (2005), we distinguish the impact of different sources of aid volatility. We disaggregate aid by type of donor: IDA, multilateral excluding IDA, and bilateral. Table A1 gives the data for the three sources. Bilateral aid is most volatile across different time horizons, while multilateral aid (excluding IDA) tends to be least volatile. IDA is least volatile only during the 1960-1980 period.

As for the volatility-growth link, we indeed find that multilateral aid volatility, including IDA, is negatively associated with both medium and long run economic growth, especially the 1960-2000 horizon, while bilateral aid volatility is significant only in the 1980-2000 period at the 5 percent level (Tables 3A-C). Various arguments can be made as to why some categories but not others should affect long-run growth. Rajan and Subramanian (2005) notes that multilateral aid is less explicitly "political" than bilateral aid and should therefore have a different impact.

Interactions with Country Characteristics

Finding the results that continuous interactions of aid volatility with country characteristics are insignificant[9], we allow non-monotonic effects through categorical interactions. The reasoning is that the continuous interactions may impose a monotonically invalid relationship between the aid volatility-growth link and a given characteristic.

Categorical interaction effects are measured through the coefficient on the multiplicative term between aid volatility and the binary variable that indicates each country's grouping. Country characteristics of income as well as institutional quality are considered. For each characteristic, the sample is divided into three groups: low, medium and high. The groupings of income are as defined in Global Development Finance (2005): low refers to low income countries in the sample, medium to lower middle income countries, and high to upper middle income countries. The categories of institutional quality are derived from the cross-country ranking: weak corresponds to the 25th percentile, strong to the 75 percentile of the institution index. The index is a measure of institutional quality used in Bosworth and Collins (2003).

In terms of the level of income, aid volatility has a negative impact on long-run growth only in poor countries (Table 4 column 1). The coefficients of aid volatility for both middle and high-income category countries are negative but not different from zero. Hence it appears that for lower and upper middle income countries, the results negate the causal relationship between aid volatility and long-run growth. An explanation for these results could be that, as countries develop, they have policies and means in place to neutralize the long-run effects of aid volatility on economic growth, a result also found in growth volatility literature (Fatás, 2002).

Regarding institutional quality (Table 4 column 2), our findings negate a significant relationship between aid volatility and growth for countries with strong institutions. The negative relationship between the two holds for countries with weak or medium quality of institutions. As explained above, it is likely that the higher the quality of institutions the better volatility cushioning mechanisms are in place, reducing the long-run impact on economic development.

TABLE 3A. IDA VOLATILITY AND AVERAGE REAL GDP PER CAPITA

	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
IDA-to-GDP volatility	-0.798	-0.882	-0.757	-0.751	-0.269
	(-5.14)	(-0.700)	(-2.910)	(-2.240)	(-0.380)
	***		***	**	
Sub-Saharan Africa	-0.587	-0.426	-0.868	-0.857	-1.192
	(-2.33)	(-0.97)	(-2.14)	(-1.33)	(-1.16)
	**		**		
East Asia	0.048	-0.183	0.040	0.057	0.398
	(0.17)	(-0.44)	(0.12)	(0.14)	(0.78)
Number of observations	76	61	79	83	88
Adjusted R-squared	0.78	0.47	0.72	0.50	0.45

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

TABLE 3B. MULTILATERAL AID VOLATILITY AND REAL GDP PER CAPITA GROWTH

	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
Multilateral aid volatility (excluding IDA)	-0.546	-0.351	-0.462	-0.563	-0.154
	(-3.64)	(-2.100)	(-2.090)	(-1.630)	(-0.270)
	***	**	**		
Sub-Saharan Africa	-0.877	-0.666	-1.144	-1.030	-1.269
	(-3.04)	(-1.38)	(-2.77)	(-1.59)	(-1.4)
	***		***		
East Asia	0.132	-0.054	0.017	0.124	0.410
	(0.49)	(-0.13)	(0.05)	(0.32)	(0.78)
Number of observations	76	56	79	83	88
Adjusted R-squared	0.74	0.49	0.68	0.49	0.45

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

TABLE 3C. BILATERAL AID VOLATILITY AND REAL GDP PER CAPITA GROWTH

	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
Bilateral aid volatility	-0.164	-0.194	-0.168	-0.245	-0.144
	(-1.95)	(-1.150)	(-1.520)	(-2.120)	(-0.950)
	*			**	
Sub-Saharan Africa	-0.959	-0.644	-1.203	-1.146	-1.285
	(-3.28)	(-1.33)	(-2.93)	(-1.79)	(-1.46)
	***		***	*	
East Asia	0.270	-0.036	0.031	0.093	0.399
	(0.9)	(-0.08)	(0.08)	(0.24)	(0.76)
Number of observations	75	59	79	83	88
Adjusted R-squared	0.71	0.49	0.68	0.50	0.45

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

TABLE 4. AID VOLATILITY AND AVERAGE REAL GDP PER CAPITA GROWTH: CATEGORICAL INTERACTION, 1960-2000

	Income (1)	Institutional quality (2)
(a) Aid volatility, low category	-0.095	-0.091
	(-2.810)***	(-2.310)**
(b) Aid volatility, middle category	-0.041	-0.083
	(-0.620)	(-2.270)**
(c) Aid volatility, high category	-0.046	-0.059
	(-0.76)	(-1.250)
Sub-Saharan Africa	-0.514	-0.566
	(-1.75)*	(-1.920)*
East Asia	0.367	0.285
	(1.15)	(0.860)
Number of observations	81	81
R-squared	0.7922	0.7873
Test (p-values)		
H0: Coefficient for the (a) variable = coefficient of the (b) variable	0.0204	0.0361
H0: Coefficient for the (a) variable = coefficient of the (c) variable	0.0179	0.0439

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

AID ABSORPTION OR SPENDING AND GROWTH

In this section we examine the aid volatility-growth link interacted with categories of macroeconomic management of aid inflows: low absorption of aid inflows; high absorption; low aid spending; and high aid spending. This is to account for the macroeconomic impact of aid volatility depending on the policy responses to aid, especially the interaction of fiscal policy with monetary and exchange rate policy (IMF, 2005). Monetary and fiscal policy responses to aid volatility can cause unplanned outcomes of such volatility. For instance Dutch disease can make an impact on long-run growth where the source of growth is the export sector. The transmission channel is thus: a temporary surge of aid inflows causes real exchange rate appreciation and therefore reallocate resources away from tradable sectors. Prati and Tressel (2006) find evidence for the presence of Dutch disease effects of aid in certain conditions. Following Aiyar et al (2005) and IMF (2005), absorption is defined as the extent to which the non-aid current account deficit widens in response to an increase in aid inflows, i.e.

Absorption = Δ non-aid current account deficit/ Δ aid.

This measures to what extent "aid engenders a real transfer of resources through higher imports, or through a reduction in the domestic resources devoted to producing exports. Absorption depends on both exchange rate policy and on policies that influence the demand for imports. The central bank controls the exchange rate through its sales of foreign exchange, while monetary policy can be used to control aggregate demand and the demand for imports" (Aiyar et al 2005, pp. 28-29). Spending is defined as the widening in the government fiscal deficit net of aid that accompanies an increment in aid:

$$\text{Spending} = \Delta\,(G-T)/\,\Delta\,\text{aid}$$

where G is government expenditures and T is taxation. Spending captures "the extent to which the government uses aid to finance its increases in expenditures or a reduction in taxation. Even if the aid comes tied to particular expenditures, governments can choose whether or not to increase the overall fiscal deficit as aid increases. Analyzing spending is important because of the natural focus on the budget as a policy variable, and also because of the importance of tensions between the fiscal policy response to aid and broader macroeconomic objectives with respect to the exchange rare and inflation" (IMF 2005 p.10). IMF (2005) recognizes that these definitions of absorption and spending take into account the fungibility of aid. Categories are determined by each country's absorption/spending ratios. A low level of absorption or spending refers to cases where the ratio is below 20 percent while a high level refers to cases where the ratio is above 80 percent. The results are intuitive. As for aid absorption (Table 5), there is a statistically significant long-run link between aid volatility and growth in economies where aid inflows are highly absorbed (the 1960-2000 time horizon). On the other hand, the medium to short -term link is statistically significant in economies where aid inflows have low absorption (1990-2000 period). The coefficient test results indicate that the coefficients of aid volatility with aid highly absorbed are significantly different from those of aid volatility with aid at a low level of absorption for these two time horizons.

TABLE 5. AID VOLATILITY AND GROWTH: INTERACTIONS WITH AID ABSORPTION

	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
Aid volatility, aid not fully absorbed	-0.066 (-1.9) *	-0.003 (-0.020)	-0.078 (-1.810) *	-0.084 (-1.320)	-0.378 (-3.520) ***
Aid volatility, aid highly absorbed	-0.090 (-3.02) ***	-0.055 (-0.770)	-0.075 (-1.720) *	-0.080 (-1.410)	0.011 (0.180)
Number of observations	81	64	85	86	95
Adjusted R-squared	0.7875	0.6152	0.74	0.56	0.57
Test (p-values) H0: Volatility coefficient for "aid not absorbed" = volatility coefficient for "aid fully absorbed"	0.0115	0.7330	0.1244	0.265	0.0019

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

When aid spending is considered as a country's macroeconomic management of aid inflows (Table 6), the aid volatility-growth link is significant only for the country group with high spending: the volatility coefficient is significantly negative at the 1 percent significance level for the 1960-2000 and the 1970-2000 horizons and at the 10 percent level for the 1980-2000 time horizon. High spending means that the government increases expenditures in response to aid inflows. Hence a likely interpretation of these results is that countries with high aid spending would have fluctuations in spending and thereby would have implications on output.

TABLE 6. AID VOLATILITY AND GROWTH: INTERACTIONS WITH AID SPENDING

	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
Aid volatility, aid not spent	-0.074	0.041	-0.065	-0.045	0.001
	(-1.53)	(0.44)	(-1)	(-0.68)	(0.01)
Aid volatility, aid fully spent	-0.089	-0.074	-0.090	-0.097	-0.001
	(-3.47)	(-1.14)	(-3.45)	(-1.92)	(-0.02)
	***		***	*	
Number of observations	78	63	82	86	95
Adjusted R-squared	0.69	0.5506	0.66	0.48	0.50
Test (p-values) H0: Volatility coefficient for "aid not spent" = volatility coefficient for "aid fully spent"	0.0038	0.3775	0.0041	0.1616	0.9996

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

IDA AID VOLATILITY AND GROWTH

How does IDA aid volatility affect growth? IDA allocations are based on a country's performance, measured by a rating of policy and institutional assessment (CPIA) together with a rating provided in the annual report on portfolio performance and a weight of the governance factor in the CPIA[10]. Performance-based IDA allocation has its justification in the theory of aid absorption: a country with a better quality of institution and policy better utilizes aid for economic growth than others. That is, IDA aid variations are largely endogenous to a recipient country's performance. In the system, however, there are some external events that weaken the performance-based IDA allocation system – such as addressing a post-conflict situations, natural disasters and hikes in oil prices.

In this section, we isolate IDA aid volatility due to variations in IDA performance from that arising from other noises. The isolation procedure is as follows: we regress IDA performance rating with respect to IDA aid volatility by country for the 1980-2000 period. The standard deviation of error terms resulting from the estimation captures the volatility of noises (or exogenous factors for an IDA allocation). This short period is due to the limited availability of IDA performance ratings.

$$IDA_i = \alpha + \beta(IDA\_performance)_i^2 + e_i \qquad (5)$$

where IDA aid volatility for country *i* is a quadratic function of IDA performance and others. A volatility of IDA performance for a country is the standard deviation of its performance during 1980-2000 and during 1990-2000.

This exercise offers us now two variables that approximate sources of IDA aid volatility: one is volatility due to IDA performance and the other is volatility due to other exogenous sources. Having these two volatility variables, we then test the association of these two types of volatility with economic growth, using OLS regressions. All growth control variables in equation (1) are the controls as well in equation (6).

$$y_i = \alpha + \beta_1 IDA\_performance_i + \beta_2 IDA\_exogenous_i + \gamma X_i + \varepsilon_i \quad (6)$$

where IDA performance is the standard deviation of IDA performance by country and IDA_exogenous is the standard deviation of error terms of equation (5).

The results displayed in Table 7 indicate that the negative link between IDA volatility and growth holds only with IDA aid volatility originating in exogenous factors. The link is significant at the 1 percent significance level for both the 1980-2000 and the 1990-2000 time horizons. The coefficients of the IDA performance volatility are negative but are not statistically different from zero. The results suggest an economically meaningful impact of IDA. A one standard deviation of IDA's exogenous volatility is associated with about 2 percent lower GDP per capita growth. This becomes even larger for the sub-Saharan Africa region: nearly 4 percent for the 1980-2000 period.

TABLE 7. IDA PERFORMANCE VOLATILITY AND REAL GDP PER CAPITA GROWTH

	1980-2000	1990-2000
IDA performance volatility	-0.154	-0.194
	(-0.08)	(-1.150)
IDA exogenous volatility	-1.809	-1.222
	(-2.63)***	(-3.000)***
Sub-Saharan Africa	-1.935	-0.644
	(-2.24)**	(-1.33)
East Asia	-0.268	-0.036
	(-0.38)	(-0.08)
Number of observations	48	59
Adjusted R-squared	0.53	0.49

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

AID VOLATILITY AND GROWTH: IV ESTIMATION WITH GMM

In this section, we pursue a GMM approach to estimate the relationship between aid volatility and growth. We follow Arellano et al. (2005) and use the standard deviation of institution quality, the standard deviation of terms of trade to capture shocks, and the average of the investment-to-GDP ratio as excluded instruments. The exclusion restrictions are that the instruments are orthogonal to ε_i in equation (3). Under these

assumptions, the parameters of interest are consistently estimated. Table 8 depicts the regression results.

TABLE 8. AID VOLATILITY AND AVERAGE REAL GDP PER CAPITA GROWTH: GMM ESTIMATION

	1960-2000	1960-2000	1960-2000	1970-2000	1970-2000	1970-2000
	(1)	(2)	(3)	(4)	(5)	(6)
Aid volatility	-0.092	-0.142	-0.007	-0.305	-0.472	-0.402
	(0.140)	(0.127)	(0.171)	(0.295)	(0.389)	(0.436)
Initial GDP per capita	-0.990***	-0.971***	-0.922***	-1.687***	-1.788***	-1.902**
	(0.223)	(0.194)	(0.285)	(0.455)	(0.558)	(0.756)
Gross capital formation	0.135***	0.127***	0.103***	0.116**	0.093**	0.117**
	(0.027)	(0.021)	(0.029)	(0.045)	(0.047)	(0.058)
Inflation (percent)	0.056**	0.045*	0.034	0.050	0.025	-0.000
	(0.024)	(0.026)	(0.022)	(0.046)	(0.064)	(0.053)
Initial life expectancy	0.006	0.008	0.004	0.016	0.024	0.020
	(0.010)	(0.008)	(0.011)	(0.014)	(0.020)	(0.017)
Average growth of TOT	1.955***	1.984***	1.200	2.691***	3.012*	3.082
	(0.517)	(0.508)	(0.834)	(1.001)	(1.582)	(1.887)
SD of growth of TOT	-0.686	-0.072	-1.423**	-0.261	0.470	-0.359
	(0.557)	(0.601)	(0.706)	(0.688)	(1.068)	(1.280)
Trade policy		-0.002*			-0.003**	
		(0.001)			(0.001)	
Number of revolutions			-1.239**			-1.084
			(0.516)			(0.879)
Sub-Saharan Africa			0.413			-0.875
			(0.570)			(1.504)
East Asia Pacific	2.560	2.974	4.505**	7.305	9.441	11.872*
	(2.289)	(1.809)	(2.128)	(5.675)	(6.825)	(7.021)
Constant	2.658	2.415	4.309	2.951	2.609	5.319
	(1.71)*	-1.61	(2.95)**	-1.63	-1.6	(2.75)**
Observations	78	75	78	82	78	82
R-squared	0.71	0.74	0.74	0.67	0.7	0.7

Note: All standard errors are robust - Huber/White/sandwich estimator of variance is used in place of the traditional calculation.
Excluded Instruments: the standard deviation of institution quality, the standard deviation of terms of trade to capture shocks, and the average of the investment-to-GDP ratio. Figures in parenthesis refer to t-statistics. *** significance at the 1% level, ** significance at the 5% level; and * significance at the 10% level.

Comparing the GMM and OLS results, one can notice that they point to same direction in the sense that aid volatility is malefic to growth. Although, the results are not

statistically significant, the point estimated are not very different from those found in the OLS regressions, specially in the 1960-2000 sample. Since GMM estimators are less efficient than the OLS ones under the assumption of exogeneity of the regressors, we conclude that indeed there is a negative relationship between aid volatility and growth for the entire sample.

CONCLUSIONS

The paper started out to see if there was a negative relationship between aid volatility and long-run economic growth. Although we found this negative relationship when looking at the dataset as a whole, the results are much more nuanced at a detailed level. The negative link is not present for middle income countries or countries with strong institutions. Nor is it present in countries where aid is not fully spent. Looking geographically, sub-Saharan Africa appears to have a stronger negative relationship than other regions. Finally the link is ambiguous in the medium term as opposed to the long term. In terms of donor groups, volatility in aid from bilateral donors does not seem to have a long run relationship with economic growth, while that from multilaterals does. It is not clear why this should be so and the results merit some further research. On IDA, the findings are consistent: a negative link with long-run growth. The volatility of IDA disbursement is partly caused by the recipient country's performance and partly by other factors. The study finds that IDA aid volatility caused by country performance does not have a causal relationship with growth while the residual IDA aid volatility does.

In policy terms the results suggest that low- income countries with weak institutions, especially in sub-Saharan Africa, could benefit from reduced volatility of aid or from being better prepared for the volatility that is there. This could be achieved through the use of models that better predict aid flows, by maintaining larger reserves (possibly pooled) and by greater commitment by donors to reduce the gap between commitments and disbursements.

ENDNOTES

[1] The findings, interpretations, and conclusions expressed herein are entirely those of the authors, and do not necessarily reflect the views of the World Bank, its Executive Directors, or the countries they represent. We thank Arvind Subramanian for kindly sharing his dataset; and Norman Loayza and Brian Pinto for their comments. A version of this paper was presented at the UNU-Wider Conference on Aid: Policies, Principles and Performance in Helsinki in June 2006 where useful comments were also received from the participants. All errors are the responsibility of the authors.

[2] See Appendix I and Bulir & Hamann (2003, 2005) and Markandya, Ponczek and Yi (2006)

[3] Fieldings and Mavrotas (2008) show the importance of disaggregating aid when modelling the volatility of aid inflows.

[4] See Eifert and Gelb (2005) for further discussion on a mechanism for managing exogenous volatility of aid flows (i.e., volatility not linked to performance).

[5] Gross capital formation consists of outlays on additions to the fixed assets of the economy plus net changes in the level of inventories. Fixed assets include land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment

purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. Inventories are stocks of goods held by firms to meet temporary or unexpected fluctuations in production or sales, and "work in progress." (WDI, 2006).

[6] We do not control geography, as the channels through which geography relates to growth are part of on-going debate. For instance, Easterly and Levine (2003) find evidence that geography impacts on growth only through institutions, while Gallup et al (1999) show that geography significantly influences growth in GDP per capita from 1965 to 1990.

[7] The Hadi procedure "measures the distance of data points from the main body of data and then iteratively reduces the sample to exclude distant data points" (Easterly et al, 2004, p. 2).

[8] When retaining outliers in our sample, the coefficient of aid volatility is statistically significant only for the 1960-2000 time horizon (results are provided at request).

[9] See the correlation matrix of characteristics in table A2 in appendix II.

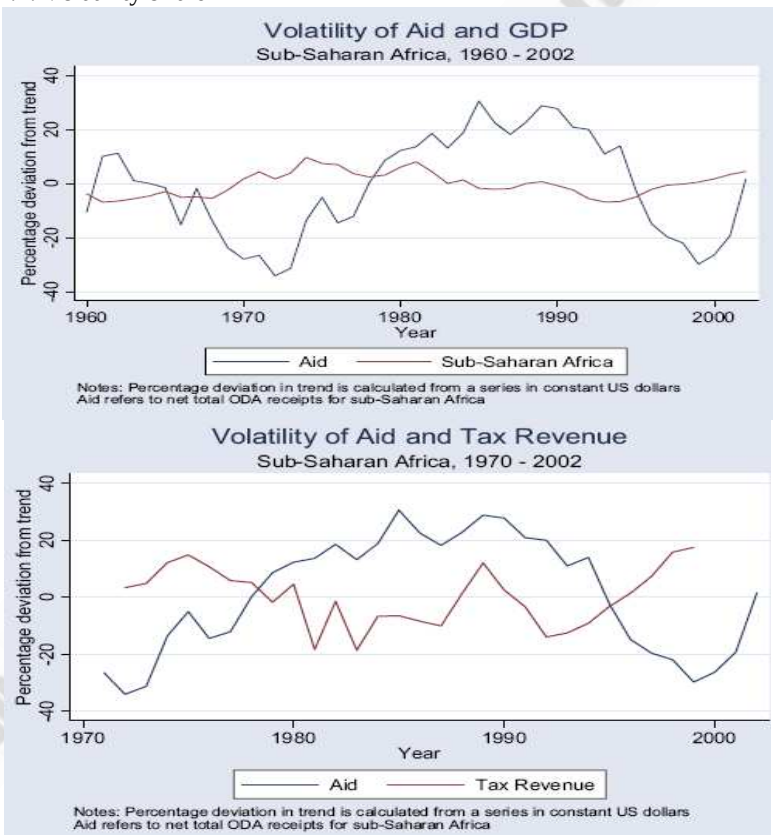
[10] The formulae used in the IDA allocation are as follows: IDA allocation=f(IDA Performance^{2}, GNI per capita$^{-.125}$, Population). IDA performance=(.8CPIA*.2ARPP) + governance factor.

APPENDIX I.

HOW VOLATILE IS AID AND WHAT CAUSES AID VOLATILITY?

Literature suggests that aid is more volatile than other capital inflows, revenue receipts or GDP. Osei, Morrissey and Lensink (2002) find that, for low-income countries in aggregate, ODA was less volatile than other capital inflows (e.g. foreign direct investment) over the 1970 – 97 period, whereas at the individual country level, ODA was much more volatile. For instance, in Indonesia the coefficient of variation is 78 percent of the mean aid inflows. Bulir and Hamann (2003) find large aid volatility in 72 developing countries, with coefficients of variation in the range of 40-60 percent of the mean aid flows, larger than that of revenues. Vargas Hill (2005) also suggests that variation in aid flows is twice as large as the variation in revenue receipts in sub-Saharan African countries (see Figure 1 below for the time trends). Vargas Hill (2005) further presents that the coefficient of variation of net aid disbursements to sub-Saharan African countries is 21 percent, five times as high as their GDP with the coefficient of variation of 4 percent.

Figure A.1. Volatility of aid



Source: Vargas Hill (2005)

Interestingly, these figures suggest potential counter-cyclical property in net aid flows to sub-Saharan Africa: aid flow trends are opposite to the trends of GDP and revenue receipts. This is in contrast to the findings of Bulir and Hamann (2003, 2005): aid tends to move in the same direction as GDP and revenues.

As found by Bulir and Hamann (2003), Vargas Hill (2005) also finds in a case study of Uganda and Zambia over 1993-2000 that failure to meet conditionality is a main cause of aid volatility (Figure A.2). Uganda experiencing aid disbursement problems responded by meeting macroeconomic conditions, in contrast to Zambia which is experiencing program interruptions as a result of failing to do so.

FIGURE A.2. CONDITIONALITY AND AID VOLATILITY

Source: Vargas Hill (2005)

APPENDIX II

SUMMARY STATISTICS

TABLE A.1. SUMMARY STATISTICS

Variable	Number of observations	Mean	Standard deviation	Minimum	Maximum
Period			**1960-2000**		
Aid to GDP	79	3.90	4.28	0.07	20.94
IDA to GDP	75	0.61	0.74	0.00	3.60
Multilateral aid to GDP	74	0.41	0.48	0.00	2.44
Bilateral aid to GDP	74	1.19	1.38	0.00	6.51
Period			**1960-1980**		
Aid to GDP	63	1.91	1.70	0.00	6.06
IDA to GDP	61	0.18	0.24	0.00	1.14
Multilateral aid to GDP	57	0.23	0.30	0.00	1.42
Bilateral aid to GDP	59	0.96	1.25	0.00	6.92
Period			**1970-2000**		
Aid to GDP	83	3.66	4.29	0.04	20.94
IDA to GDP	79	0.62	0.75	0.00	3.60
Multilateral aid to GDP	78	0.41	0.48	0.00	2.44
Bilateral aid to GDP	78	1.19	1.36	0.00	6.51
Period			**1980-2000**		
Aid to GDP	83	3.09	3.66	0.03	20.01
IDA to GDP	80	0.58	0.73	0.00	2.90
Multilateral aid to GDP	78	0.33	0.38	0.00	1.85
Bilateral aid to GDP	73	0.93	1.05	0.00	4.94
Period			**1990-2000**		
Aid to GDP	80	2.52	2.90	0.02	13.67
IDA to GDP	78	0.50	0.62	0.00	2.21
Multilateral aid to GDP	73	0.25	0.30	0.00	1.34
Bilateral aid to GDP	79	0.68	0.73	0.00	3.36

TABLE A. 2. CORRELATION, 1960-2000

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Real per capita GDP growth	1								
SD of aid-to-GDP	-0.37	1							
Initial GDP per capita	-0.02	-0.35	1						
Gross capital formation	0.55	-0.03	0.21	1					
Initial life expectancy	0.45	-0.48	0.58	0.28	1				
Average growth of TOT	-0.07	0.26	-0.12	0.11	-0.22	1			
SD of growth of TOT	-0.17	0.21	-0.06	0.06	-0.15	0.76	1		
Trade policy	0.42	-0.21	0.17	0.11	0.35	-0.24	-0.20	1	
Number of revolutions	-0.34	0.06	0.002	-0.28	-0.16	0.01	0.02	-0.1	1

APPENDIX III.

DATA SOURCE

Variable	Description	source
aid_y	standard deviation of Aid (share of GDP)	WDI
abs	absorption (change in the non-aid current account deficit as a share of the change in aid inflows)	authors' calculation
spnd	spending (the widening in the government fiscal deficit net of aid)	authors' calculation
ry_g	growth rate of GDP per capita (US$ 2000)	WDI
k	gross capital formation (% of GDP)	WDI
yc_penn	Initial period GDP per capita (in PPP terms)	Rajan and Subramanian (2005)
le_wdi	initial period life expectancy at birth	Rajan and Subramanian (2005)
gadp6099	institutional quality	Rajan and Subramanian (2005)
geog6099	geography	Rajan and Subramanian (2005)
cg_i	initial period government consumption as share of GDP	Rajan and Subramanian (2005)
tot_av	average growth of terms of trade	Rajan and Subramanian (2005)
tot_stdev	standard deviation of terms of trade growth	Rajan and Subramanian (2005)
sw1	trade policy	Rajan and Subramanian (2005)
safrica	sub Sahara Africa dummy	Rajan and Subramanian (2005)
east	east Asia Pacific	Rajan and Subramanian (2005)

APPENDIX IV

TEST TO ESTABLISH THAT OLS ESTIMATION IS VALID FOR THIS EXERCISE

Noting the limitations of the use of OLS regressions, such as measurement or endogeneity problems as well as problems of unobservable heterogeneity or omitted variables, we conducted IV estimation. As heteroscedasticity was in fact not present in IV estimations, we employed instrumental variables (IV) estimation in favor of the generalized method of moments (GMM). In the absence of heteroscedasticity, the efficient GMM estimator is no worse asymptotically than the IV estimator. However, it comes at a cost of poor infinite sample performance: as Hayashi (2000) highlights, efficient GMM requires very large sample sizes.

The IV regression model was :

$$\begin{aligned} y_i &= \alpha + \beta_1 volatility_i + \beta_2 X_i + \varepsilon_i \\ volatility_i &= \gamma Performance_i + \mu_i \end{aligned} \qquad \text{(A.3)}$$

where 'performance' is intended to capture a recipient country's level of performance. The variable we choose is the index of institutional development (published by International Country Risk Guide), which helps explain aid volatility but at the same time influences long-run growth via aid volatility (and via other control variables). In selecting the instrumental variable for aid volatility, we focused on variables, based on the aid literature, that are more likely to be exogenous. The choice of performance was based on the finding that volatility in program aid is largely associated with recipient countries' performance. Bulir and Hamann (2003) find that, unlike project aid, IMF program aid influences aid disbursement, and performance-related issues explain about 70 percent of such volatility of program aid. Of course, we acknowledge that performance is not really exogenous to growth.

We conducted the Durbin-Wu-Hausman test after the IV estimations in order to check for endogeneity in the regressions estimated via the instrumental variable. The null hypothesis is that an OLS estimator of the same equation would yield consistent estimates. In other words, endogeneity among the regressors would not have deleterious effects on OLS estimates. As shown in the table below, we failed to reject the null, indicating that endogenous regressor's effects on the estimates are not meaningful and therefore instrumental variable techniques are not required.

We also tested equation (A1) with an instrumental variable of Country Performance and Institution Assessment (CPIA, constructed by the World Bank) and of Performance rating of International Development Association (IDA, that is used in the process of IDA resource allocation to capture the level of performance in IDA countries) for the 1980-2000 and 1990-2000 periods and find the results consistent with those with the ICRG instrumental variable. The reason for the two-period test is because of the limited availability of CPIA ratings, which are available on an annual basis since 1977.

TABLE A.3. ENDOGENIETY TEST FOR VOLATILITY

	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
Durbin-Wu-Hausman test (p-value)	0.195	0.362	0.749	0.766	0.816

Based on these tests we conclude that the ordinary least square (OLS) estimates are both consistent and efficient.

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