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The Volatility of Aid

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Abstract

Issues related to the volatility of aid flows are now becoming crucial in view of their relevance to the achievement of the Millennium Development Goals. The paper examines aid volatility using data for 66 aid recipients over the period 1973-2002. We improve upon earlier work in this important area by disaggregating total aid inflows into sector and programme aid. In this way we avoid focussing on a single aggregate, unlike most previous studies on aid volatility. We also adopt a different methodology to capture aid volatility. The institutional quality of the aid recipient affects the stability of sector aid but not that of programme assistance. Moreover, more open economies, which tend to be smaller and richer, *ceteris paribus*, are associated with more volatile sector aid flows.

Keywords: aid volatility, aid heterogeneity, project aid, programme assistance, MDGs

JEL classification: F35, O19

1 Introduction

The issue of volatility of aid inflows is now becoming particularly important in view of the ongoing discussion and debate on how to finance the *Millennium Development Goals* (MDGs). Aid volatility, and in particular the unpredictability of aid flows, is of crucial importance for the attainment of the MDGs. Aid volatility and aid predictability issues have also been raised recently within the context of the British proposal for an *International Finance Facility* (IFF), a mechanism to frontload aid flows so that MDGs can be met by 2015.[1] Very recently, aid volatility issues have also been briefly discussed within the context of aid to *difficult partnership countries* (DPCs) in the study by Levin and Dollar (2005). Finally, there has been much recent debate on whether more aid can be spent effectively in developing countries, particularly in sub-Saharan Africa, in view of potential absorptive capacity constraints and diminishing returns to aid.[2] Despite these pressing policy questions, there has been surprisingly little empirical work on the measurement of aid volatility.

Using simple measures of volatility, a few papers[3] find (unsurprisingly) that aid volatility is bad for economic growth, *ceteris paribus*. Indeed, aid volatility (and aid unpredictability) can have important macroeconomic consequences in countries dependent on aid inflows. Lensink and Morrissey (2000) find that aid volatility has a significant negative impact on growth. This effect is robust across different country groups and different specifications in the growth equation. Furthermore, aid flows only have a significant positive effect on economic growth after conditioning on the negative impact of uncertainty. Other studies[4] note that aid is often among the most volatile sources of foreign exchange income.[5] Identifying and dealing with this source of uncertainty is a priority for development planning and the achievement of the MDGs.

The most recent and frequently cited empirical study on the measurement of aid volatility is the paper by Bulíř and Hamann (2003). Using a database covering 72 countries over the period 1975-97, they focus on a comparative analysis of the volatility of aid flows and the volatility of domestic revenue in aid recipients, rather than on the volatility of aid inflows *per se*. Aid flows are more volatile than domestic fiscal revenues and tend also to be pro-cyclical; fiscal planners are highly uncertain of aid receipts, the information content of aid commitments being either very small or statistically insignificant. Finally, there are much larger prediction errors in programme assistance than in project aid, and a stronger tendency to over-estimation.

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1 See Mavrotas (2004) for a detailed discussion and Lin and Mavrotas (2004) for a contract perspective on the IFF. See also Mosley (2004).

2 See de Renzio (2005), Addison *et al.* (2005), Gomanee *et al.* (2003), Foster (2003) and Heller and Gupta (2002) among others.

3 See for example Lensink and Morrissey (2000) and Bulíř and Hamann (2001, 2003).

4 See Gemmell and McGillivray (1998) and Pallage and Robe (2001).

5 The procyclicality of foreign aid implies *inter alia* that aid cannot stabilize fluctuations in consumption.

One drawback of much of the recent work on aid volatility is the use of a single aggregate for aid.[6] In the present paper we measure the volatility of aid inflows by distinguishing between two major types of aid, namely sector-specific aid (i.e. 'project' aid) and non-sector allocable aid ('programme' aid) which together make more than 95 per cent of total aid flows. Distinguishing among different aid modalities is crucial, because different types of aid are likely to have different degrees of volatility.[7] Different aid modalities also have different conditionality – see Killick (2004) and Alesina and Dollar (2000) for a comprehensive discussion.

The purpose of the present paper is to determine the factors driving the cross-country variation in aid volatility. Our approach differs from previous studies in a number of ways. First, we do not treat aid as a single aggregate. Some types of aid (emergency aid and, arguably, programme aid) should exhibit a high degree of volatility, since they are designed to deal with local economic and social crises.[8] Volatility in sector aid, which is designed to promote investment in physical and human capital, is more likely to be detrimental to long-term economic and social development. In this paper, we focus on the volatility of two types of aid: sector aid and programme aid. Together, these two types make up more than 95 per cent of total aid volumes. Second, there has been some concern in the existing literature[9] to ensure that the aid time series in question is stationary, and that the variance measure used to capture volatility is constant over time. For this reason, it is common to use an empirical filter (such as the Hodrick and Prescott (1997) filter) to extract the stochastic trend in the series. However, test statistics reported below indicate that our aid series are stationary. So we will not be filtering out any 'permanent' component in our series. Third, the key volatility concept that we will be using is that of a shock to aid, so we will condition our aid series on an information set of lagged macroeconomic variables. Our volatility measure is the variance of that part of movements in aid that are orthogonal to the information set. Finally, our study extends the period of analysis beyond 1997 up to 2002, incorporating more recent data on aid volatility.[10]

The remainder of the paper is organized as follows. Section 2 deals with methodology and data issues of crucial importance in the present paper. In section 3 we discuss our empirical findings obtained from the estimation of a series of empirical models on the determinants of

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6 It is notable that the frequently-cited study by Bulíř and Hamann (2003) used a single aggregate for aid to measure aid volatility and the distinction between programme and project aid to measure aid predictability *but not* aid volatility.

7 The issue of aid heterogeneity has been discussed recently in Mavrotas (2002a, 2002b, 2003), Cordella and Dell'Ariccia (2003), Mavrotas and Ouattara (2003) and Clemens *et al.* (2004), although not in the context of aid volatility; see also Singer (1965), Cassen (1986) and White (1998) on earlier discussions on the aid heterogeneity issue.

8 Food aid is also characterized by a high degree of volatility that can have important macroeconomic implications since the timing of food aid and its scale could be viewed as an 'automatic stabilizer' for the recipient economy in the sense that when food output in a country falls, government revenues decline and spending increases; monetization of food aid in this case can stabilize flows to the budget in addition to shielding food consumption levels in the country – see Gupta *et al.* (2004) for an insightful analysis.

9 See for example Bulíř and Hamann (2003).

10 Since the measurement of the volatility of domestic revenue and the *relative* volatility of aid (as in the case of Bulíř and Hamann, 2003), is clearly beyond the scope of the present paper, we rather focus on the volatility of aid flows alone.

aid volatility for a group of 66 countries spanning the period 1973-2002. Finally, section 4 summarizes our empirical findings and discusses the broad policy implications of the study.

2 Methodology and data issues

Our data incorporate 66 countries from 1973 to 2002. The data on aid were taken from the OECD's Creditor Reporting System database. This database includes the US Dollar value of annual overseas aid disbursed to individual recipient countries. These aid flows are disaggregated in various ways. Values are reported for different types of aid disbursed, including sector aid, programme aid and emergency aid. Corresponding annual gross national income data are also reported, so aid figures can be expressed as a fraction of income. We make use of data for all those countries in which data are available for the whole sample period for sector aid, programme aid and gross national income. Countries with data for shorter time-spans are excluded, because such data would be inadequate for the time-series analysis described below. None of the countries is a micro-state, so small country bias is unlikely to be a problem.[11]

The basic aid measure that we use for the jth country in year t is:

$$z_{jt}^{i} = AID_{jt}^{i} / GNI_{jt},\ i = \{PROJECT, PROGRAMME\};\ j = 1,\ldots,N;\ t = 1,\ldots,T \qquad (1)$$

where AID_{jt}^{i} measures the disbursement of type-i aid to j in year t, and GNI_{jt} is j's gross national income in year t. All quantities are measured in current US Dollars. We use gross national income instead of gross domestic product because there are a few countries in our data set (for example, Swaziland) for which migrant remittances are substantial relative to domestic production. Donors are likely to regard these remittances as part of the country's resources. It turns out that the distribution of z_{jt}^{i} in most countries is heavily left-skewed, because of occasional donations that are much larger than is typical. A variance-based measure of volatility is more likely to be meaningful if it is taken from a symmetric distribution, so we will use a transformation of z_{jt}^{i} that is approximately symmetrical in the countries in our data set. This is[12]

$$x_{jt}^{i} = \ln(\Sigma_t z_{jt}^{i} / T + z_{jt}^{i}) \qquad (2)$$

11 Only two countries have a 2002 gross national income less than US$500mn. These are the Gambia (US$380mn) and the Solomon Islands (US$240mn). Excluding these two countries makes no substantial difference to our results.

12 The obvious alternative to this is ln(z), but this variable tends to be right-skewed in many countries.

The 66 countries in the data set for which observations of x_{jt}^{i} are available for 1973-2002 are listed in Table 1a. Among the countries in the table there is a wide variation in the importance of aid as a fraction of national income, a point to which we will return later. The table shows that there is a negative correlation between mean total aid flows as a proportion of gross national income and the unconditional variance of x_{jt}^{i}.[13] In order to interpret this phenomenon, it is important to remember that the logarithmic transformation means that x_{jt}^{i} measures the *proportional* (not the absolute) variation in aid flows. The proportional variation is higher among countries where aid flows are typically very small, but where there is occasionally a moderate aid inflow that is very large relative to the average for these countries.

This paper will not deal directly with the analysis of emergency aid. However, Table 1b provides some comparable summary statistics relating to emergency aid in those countries where it has ever constituted more than 1 per cent of national income in a single year. Here there is a weak positive correlation between the volatility measures and aid flows as a proportion of national income. This suggests that the characteristics of emergency aid are rather different from those of sector and programme aid. However, there are too few countries in which emergency aid has been a substantial proportion of national income for us to apply the methodology discussed below to this aid category.

If Dickey-Fuller test statistics (with an intercept but no trend) are computed for x_{jt}^{i} in these countries over 1974-2002, then the average value of the DF *t*-statistic is -3.933 for project aid and -3.376 for programme aid. These figures are large enough to reject the joint null that the series are I(1) (see Im *et al*., 2003). We will proceed on the assumption that x_{jt}^{i} is stationary. The fact that previous authors such as Bulíř and Hamann (2003) have not been able to reject the null of non-stationarity may reflect some aggregation bias in the total aid figures. If there is some heterogeneity in the data generating processes for aid of different types, then stationarity tests for total aid will have low power.

13 The cross-country correlation between the logarithm of the unconditional variance of x^{SECTOR} and the logarithm of average *AID/GNI* is -0.465 (*t* = -4.204). For $x^{PROGRAMME}$ the figure is -0.431 (*t* = -3.822).

Table 1a. Average aid as a fraction of GNI and unconditional aid volatility measures, in per cent

	AID/GNI	$var(x^{SECTOR})$	$var(x^{PROGRAMME})$		AID/GNI	$var(x^{SECTOR})$	$var(x^{PROGRAMME})$
Mexico	0.06	18.54	50.72	El Salvador	4.70	12.54	34.16
Brazil	0.06	9.10	32.65	Botswana	4.73	9.69	35.71
Argentina	0.07	24.89	45.63	Jordan	5.04	12.84	37.14
Trinidad	0.20	16.33	53.85	Egypt	5.24	6.88	26.19
Uruguay	0.21	31.13	43.70	Bangladesh	5.29	5.51	19.14
Chile	0.24	23.79	31.37	Belize	5.33	3.38	15.49
Algeria	0.29	14.23	38.71	Kenya	6.65	16.82	48.16
Colombia	0.34	13.56	17.91	Haiti	7.12	5.35	15.47
Turkey	0.43	12.70	32.55	Sri Lanka	7.16	5.31	7.71
Malaysia	0.58	19.10	44.74	Honduras	7.36	6.63	18.89
Panama	0.86	21.91	45.14	Central African Rep.	7.61	6.60	24.87
Syria	0.89	25.89	39.66	Bolivia	7.69	4.81	30.02
Thailand	0.92	5.48	36.44	Madagascar	7.87	7.63	17.77
India	1.00	4.21	15.90	Nepal	8.15	4.88	27.16
Peru	1.14	8.27	20.34	Ghana	8.21	4.75	22.61
Gabon	1.31	10.38	44.74	Benin	8.42	9.62	21.20
Guatemala	1.37	7.92	30.22	Senegal	8.42	3.97	26.20
Paraguay	1.37	12.50	32.15	Togo	8.74	3.80	17.61
Fiji	1.45	9.37	28.57	Suriname	8.82	9.17	31.52
Morocco	1.46	4.29	16.09	Chad	9.32	29.22	50.36
Dominican Rep.	1.58	7.50	28.09	Niger	9.72	9.72	16.45
Indonesia	1.75	4.86	16.32	Papua New Guinea	10.05	4.69	15.73
Philippines	1.86	7.55	26.09	Burkina	11.36	11.80	20.69

Table 1a continued

	AID/GNI	$var(x^{SECTOR})$	$var(x^{PROGRAMME})$		AID/GNI	$var(x^{SECTOR})$	$var(x^{PROGRAMME})$
Tunisia	2.33	5.20	14.73	Burundi	11.78	2.12	14.39
Costa Rica	2.37	10.62	46.46	Rwanda	11.91	7.62	31.86
Sudan	2.94	15.53	18.74	Mauritania	13.14	3.06	26.44
Pakistan	3.44	5.56	14.63	Mali	13.20	6.61	11.58
Congo Rep.	3.71	9.93	43.01	Sierra Leone	14.41	3.53	11.64
Cameroon	3.79	4.24	31.42	Zambia	14.53	15.06	30.04
Dem. Rep. of Congo	3.83	17.70	30.26	Guyana	16.27	10.31	18.02
Swaziland	3.87	13.10	40.13	Gambia	16.35	17.12	31.20
Jamaica	3.91	12.54	20.35	Solomon Is.	17.53	8.63	26.96
Ivoire	4.08	18.54	50.72	Malawi	17.66	9.92	30.96
mean Africa	*7.90*	*9.96*	*28.15*	*mean Latin America*	*3.38*	*12.89*	*31.53*
mean Asia	*4.37*	*9.11*	*25.92*				
mean of countries with AID/GNI < 5%		*12.65*	*32.39*	*mean of countries with AID/GNI > 5%*		*8.15*	*23.54*

Table 1b. Average emergency aid as a fraction of GNI and its unconditional volatility, in per cent

	Emergency AID/GNI	var(x^{EMERG})		Emergency AID/GNI	var(x^{EMERG})
Guyana	0.06	39.07	Malawi	0.30	33.03
El Salvador	0.14	30.25	Dem. Rep. of Congo	0.33	38.98
Niger	0.16	31.60	Honduras	0.34	43.73
Bolivia	0.17	42.66	Gambia	0.42	37.49
Mali	0.23	37.27	Burundi	1.33	43.57
Chad	0.24	32.85	Rwanda	1.64	42.24
Mauritania	0.28	32.03	Sierra Leone	1.65	45.40

The table reports figures only for those countries in which annual emergency aid has ever been more than 1% of GNI in a single year.

3 Empirical analysis

3.1 Measuring aid shocks

The next step in the analysis is to create a measure of aid shocks. In order to do this, we fit vector autoregression (VAR) for each country of the form[14]

$$\boldsymbol{\beta}_j(\mathrm{L})\,\boldsymbol{x}_{jt} = \boldsymbol{u}_{jt} \tag{3}$$

where $\boldsymbol{x}_{jt} = [x_{jt}^{SECTOR}, x_{jt}^{PROGRAMME}, y_{jt}]'$ and $\boldsymbol{u}_{jt}$ is a vector of independent and identically distributed (i.i.d.) residuals. y_{jt} is the logarithm of GNI_{jt} deflated by the deflator for world aid in the UN data set.

Because in our sample $N > T$, it is not possible to estimate equation (3) for all the countries simultaneously by Seemingly Unrelated Regression Estimator (SURE); the results below are based on Ordinary Least Squares (OLS) regressions for each country separately. Nevertheless, it is of some interest whether the $\boldsymbol{u}_{jt}$ are correlated across the cross-section, that is, whether shocks to aid are correlated across countries. Table 2 provides some evidence on this question. The table reports the average size of the shocks u_{jt}^{SECTOR} and $u_{jt}^{PROGRAMME}$ (in other words, $\Sigma_j\, u_{jt}^{SECTOR}/N$ and $\Sigma_j\, u_{jt}^{PROGRAMME}/N$) for each t. For u_{jt}^{SECTOR} and $u_{jt}^{PROGRAMME}$ individually, the table also reports an F-statistic to test the joint null hypothesis that these averages are all equal to zero. The fact that the null is rejected in both cases indicates some correlation of shocks across countries. However, the common shocks only make up on average about 2-3 per cent of the total shocks to an individual country. The same exercise is

14 In the reported results, the lag order of the VAR is 2 and the sample is 1975-2002. Higher order lags are not statistically significant.

carried out for the variance measures $\ln(\Sigma_j [u_{jt}^{SECTOR}]^2/N)$ and $\ln(\Sigma_j [u_{jt}^{PROGRAMME}]^2/N)$, with similar results. So there is some cross-country correlation in aid shocks, but of a magnitude that is small relative to the variance of each element of $\boldsymbol{u}_{jt}$.

Our main results deal with the cross-country determinants of the variance of u_{jt}^i. The measure of volatility for each type of aid (i) in each country (j) is $\Sigma_t (u_{jt}^i)^2 / T$. Table 3 reports these figures for each of the 66 countries in our data set. As noted in the table, the cross-country correlation of the two aid volatility series (0.626) is significantly different from both zero and unity. So sector aid volatility is positively correlated with programme aid volatility. We shall see some of the reasons for this in due course. Because a large part of the movement in actual aid volumes is unpredictable, there is also a strong cross-country correlation between $\Sigma_t (u_{jt}^i)^2 / T$ and $\text{var}(x_{jt}^i)$. Across the whole sample, the correlation coefficient for sector aid is 0.828; for programme aid it is 0.700.

One might wonder how much of the variance in x_{jt}^i is due to volatility in the denominator GNI_{jt}. If this is an important factor, then our measure will not be a very accurate measure of *aid* volatility. In order to check this, we construct an alternative aid measure $z_{jt}^{i}*$ in which GNI_{jt} is replaced by its (country-specific) Hodrick and Prescott (1997) filter. There is a high correlation between the corresponding transformed series $x_{jt}^{i}*$ and the original x_{jt}^i. For sector aid, the country-specific correlation coefficients range from 0.920 to 0.996; the corresponding figures for programme aid are 0.985 and 0.998. In other words, almost all of the variation in x_{jt}^i is coming from the variation in AID_{jt}^i. In the results reported below we use x_{jt}^i rather than $x_{jt}^{i}*$, but it makes little difference to the results.

Table 2. Annual averages of aid shocks (66 countries)

year	average of sector aid shocks (%)	average of programme aid shocks (%)	average of log squared sector aid shocks	average of log squared programme aid shocks
1975	6.402	-6.058	-4.679	-3.640
1976	-9.962	-10.734	-3.456	-3.576
1977	-0.377	-6.556	-4.399	-3.870
1978	-4.185	-5.721	-4.399	-4.825
1979	2.379	0.727	-4.188	-3.827
1980	-5.013	-1.074	-4.717	-3.729
1981	-3.024	-6.162	-4.292	-3.650
1982	0.458	3.505	-4.685	-3.978
1983	1.601	0.417	-4.970	-3.695
1984	3.226	0.772	-4.193	-3.519
1985	0.906	14.374	-4.354	-3.307
1986	-0.807	3.563	-4.072	-3.707
1987	-5.902	12.369	-4.809	-3.307
1988	5.891	6.226	-4.117	-2.903
1989	7.814	11.291	-3.734	-2.864
1990	-0.408	10.876	-4.104	-3.144
1991	1.007	1.285	-4.390	-3.367
1992	2.474	7.506	-4.333	-2.756
1993	2.422	0.350	-4.194	-3.161
1994	-0.290	-11.521	-4.149	-2.849
1995	0.133	2.790	-4.190	-3.450
1996	-2.019	-2.621	-4.197	-4.045
1997	-4.400	-11.414	-4.222	-3.557
1998	-2.815	-8.895	-4.212	-4.265
1999	-1.415	-4.066	-4.075	-3.649
2000	6.078	4.123	-4.324	-3.470
2001	2.817	2.774	-4.084	-3.614
2002	-2.991	-8.128	-4.659	-3.745
percentage of variation accounted for by year effects	*2.632*	*3.370*	*1.729*	*3.565*
significance of year differences $F(27,1820)$	*1.822*	*2.351*	*1.186*	*2.492*

Table 3. Conditional aid volatility (mean squared regression residuals, $\sum_t [u_{jt}^i]^2/T$)

	sector	programme		sector	programme		sector	programme
Burkina	0.0116	0.0787	Haiti	0.0358	0.0677	Gabon	0.0634	0.3161
Bangladesh	0.0157	0.0203	Papua New Guinea	0.0358	0.0764	Peru	0.0689	0.1200
Senegal	0.0184	0.1112	Ghana	0.0359	0.1961	Solomon Is.	0.0694	0.1340
Madagascar	0.0200	0.1908	Philippines	0.0366	0.0880	Guatemala	0.0728	0.0503
Egypt	0.0202	0.0302	Gambia	0.0408	0.1260	Congo Rep.	0.0751	0.2695
India	0.0205	0.0413	Nepal	0.0413	0.1583	Togo	0.0812	0.1936
Jordan	0.0214	0.0853	Sudan	0.0415	0.0630	Colombia	0.0826	0.0991
Zambia	0.0225	0.1259	Indonesia	0.0440	0.1099	Chile	0.0870	0.1597
Rwanda	0.0238	0.1691	El Salvador	0.0441	0.0576	Paraguay	0.0954	0.2679
Cameroon	0.0248	0.0888	Tunisia	0.0446	0.0561	Turkey	0.0971	0.1163
Pakistan	0.0252	0.0570	Burundi	0.0469	0.1872	Swaziland	0.0996	0.2928
Malawi	0.0264	0.1377	Thailand	0.0474	0.2720	Guyana	0.1017	0.1058
Central African Rep.	0.0286	0.2199	Ivoire	0.0488	0.0971	Algeria	0.1080	0.2192
Morocco	0.0295	0.0880	Costa Rica	0.0509	0.0624	Belize	0.1163	0.3384
Benin	0.0296	0.1168	Dominican Rep.	0.0533	0.1528	Dem. Rep. of Congo	0.1200	0.2438
Sri Lanka	0.0297	0.0374	Fiji	0.0535	0.1931	Trinidad	0.1260	0.4037
Mali	0.0305	0.0694	Brazil	0.0536	0.1755	Mexico	0.1283	0.2841
Mauritania	0.0309	0.1083	Chad	0.0550	0.0650	Syria	0.1388	0.2431
Kenya	0.0327	0.1158	Honduras	0.0552	0.0866	Argentina	0.1390	0.2646
Jamaica	0.0331	0.1122	Suriname	0.0590	0.3346	Panama	0.1511	0.3209
Niger	0.0349	0.0660	Bolivia	0.0621	0.0680	Malaysia	0.1601	0.4062
Botswana	0.0358	0.1700	Sierra Leone	0.0629	0.1338	Uruguay	0.1753	0.2911

Countries are listed in ascending order of sector volatility. The coefficient of correlation of the logs of the two series is 0.626 (t = 6.419).

3.2 Modelling the cross-country variation in aid volatility

The next part of our analysis explores the cross-country variation in the conditional variance of x_{jt}^{i}. We hypothesize that the following factors could affect the uncertainty of aid flows.

1. *The size of aid flows*. Countries with larger average aid inflows are probably receiving aid for a relatively high number of schemes. By the law of large numbers, the proportional variation in the total inflow is likely to be lower. (Unless the shocks to aid coming in on different schemes are perfectly correlated, a larger number of schemes implies a smaller aggregate shock, relative to the average aid volume for the country.) This effect could relate to the total value of total aid inflows, but if the size of individual schemes depends on country size, so individual schemes tend to be smaller in small countries, the relevant measure will be aid inflows as a fraction of national income.

2. *Per capita income*. Richer countries could attract a less stable commitment from donors, and so face more aid volatility. Indeed, we would expect aid to middle-income countries to be more variable than aid to low-income countries since (i) aid flows to middle-income countries are more likely to depend on geo-strategic and political concerns of donors than on goals based on poverty reduction, and these two factors are more prone to change from year to year than recipients' GDP per capita, and (ii) middle-income countries are more prone to balance-of-payments shocks and donors are likely to be more exposed to risk in these countries than in low-income countries (Levin and Dollar, 2005).

3. *Institutional quality*. Countries with higher-quality institutions may be better able to maintain good working relationships with donors, reducing aid volatility.

4. *Policy regime*. Countries with a ‘better’ policy regime (i.e., one more favoured by donors) may attract more aid, but these aid flows may be more volatile. For example, a (permanent) improvement in the policy regime may be rewarded by a temporary increase in aid.

Measurement of (1) and (2) above is relatively straightforward. For each of the 66 countries, we will capture (1) by two variables. The first is $\ln([\Sigma_i AID_{j73}^{i}] / GNI_{j73})$, that is, the log of the ratio of total initial (1973) aid to gross national income. This is abbreviated to $\ln(AID / GNI)$ in the tables below. The second is country size, measured as total initial national income, $\ln(GNI_{j73})$, abbreviated to $\ln(GNI)$ in the tables. Together, the two variables allow for aid volatility to depend on both aid as a fraction of national income, and the absolute size of aid inflows. Initial, rather than average, aid volumes are used because of the potential endogeneity of mean aid flows to their variance. Similarly, *per capita* income is measured as $\ln(GNI_{j73} / POP_{j73})$, where POP_{j73} is the initial (1973) population level reported for country j in the UN dataset. The tables refer to this variable as $\ln(GNI / POP)$.

For measures of institutional quality, we rely on the 2002 World Bank governance indicators reported and discussed in Kaufmann *et al.* (2003).[15] These are scores for: ‘*voice and*

[15] Such indicators are not available all the way back to the 1970s, so we must acknowledge a caveat that there may be some measurement error here.

accountability', '*government effectiveness*', '*regulatory quality*', '*rule of law*' and '*control of corruption*'. We will remain agnostic about which specific measure best captures those institutional factors that make it easier for a donor to deal with a recipient government, and so reduce the volatility of aid flows. As Table 4 indicates, all of the measures are highly correlated with each other in our sample. For this reason we will fit five separate regression equations, each including one of the indicators. The variables are indicated in the tables below by, respectively, *voice*, *effectiveness*, *regulation*, *law* and *corruption*.

Table 4. The correlation matrix for the governance indicators

	voice	*effectiveness*	*regulatory*	*law*
effectiveness	0.6144			
regulatory	0.7078	0.8537		
law	0.6817	0.9054	0.8357	
corruption	0.6057	0.8533	0.7936	0.8790

The policy regime variable could be measured in a number of ways. The results reported below make use of the Dollar and Kraay (2003) openness index, averaged over 1969-99 (the longest available time period). This index, listed as *openness* in the tables below, has the advantage that it has broader country coverage than most others – 63 out of 66 countries in our sample[16] – and that it manifests a reasonably high in-sample variation. By contrast other openness measures, such as the Sachs-Warner index, are zero for most of our countries for most years.

In order to make use of the full sample of 66 countries, we will also fit a regression equation in which *openness* is replaced by a slightly more crude measure of openness: that is, the ratio of the value of total trade to GDP, averaged over 1973-2002 (the longest available time period), taken from the World Bank *World Development Indicators*.

We will also allow for regional variations in the level of aid volatility. Latin America lies mostly in the American sphere of influence, Africa mostly in the Anglo-French sphere of influence. Geo-political factors may impact on donors' aid commitments, so we include a dummy for Latin American countries (LA_j), and a dummy for African countries (AF_j). The cross-country regression specification is then:

$$\ln(\Sigma_t [u_{jt}^i]^2 / T) = \alpha_0 + \alpha_1 \bullet \ln(AID_{j73} / GNI_{j73}) + \alpha_2 \bullet \ln(GNI_{j73} / POP_{j73}) + \alpha_3 \bullet \ln(GNI_{j73}) \quad (4)$$

$$+ \alpha_4 \bullet q_j + \alpha_5 \bullet openness_j + \alpha_6 \bullet LA_j + \alpha_7 \bullet AF_j + v_j$$

16 The exceptions are Sudan, Suriname and the Solomon Islands.

where v_j is a cross-sectional residual and q_j is one of the institutional quality indicators. Note the logarithmic transformation of the dependent variable, which ensures that it is approximately normally distributed in the cross section. This equation is fitted to the smaller, 63-country sample for both types of aid (sector and programme); Table 5 reports these regressions results, from ten regression equations, for two types of aid and five governance indicators. Coefficients significant at at least the 10 per cent level are indicated in bold.

There is a large and statistically significant negative coefficient on (AID_{j73} / GNI_{j73}): the unconditional correlation between aid volumes and our volatility measure evident in Table 1 is also present when volatility is conditioned on other factors. However, our *openness* measure is quite highly (negatively) correlated with $\ln(GNI_{j73})$, so neither the positive coefficient on *openness* nor the negative coefficient on $\ln(GNI_{j73})$ is individually significant in the sector aid volatility equations; nor is (GNI_{j73} / POP_{j73}). It turns out that the regression specification that minimizes standard information criteria – such as the Schwartz-Bayesian or the Akaike information criterion – is the one that omits $\ln(GNI_{j73})$ and (GNI_{j73} / POP_{j73}). Such a specification is reported in Table 6. The *openness* measure is statistically significant in all of the Table 6 regressions, with a coefficient ranging from around 0.35 to 0.40, depending on the governance measure used. This result is consistent with the conjecture that more open economies have more volatile sector aid. More open economies tend to be smaller and richer, *ceteris paribus*, and they also tend to have more variable sector aid flows. The coefficients on all of the governance indicators are significantly negative, with values ranging from –0.2 to -0.35. The largest coefficients and t-ratios are for *voice* and *regulation*, although it would be unwise to try to draw too much from these differences in a small sample.

The *openness* measure is statistically significant in none of the programme aid volatility equations in Table 5; nor does it appear in any regression specification that minimizes the Schwartz-Bayesian or Akaike information criterion. Moreover, none of the coefficients on the governance variables is significantly different from zero. The quality of the recipient's political institutions seems to affect the stability of sector aid, but not that of programme aid. This reinforces the impression that recipients' political institutions and economic policy are not necessarily important factors in the determination of programme aid volatility. Nevertheless, there are significant negative coefficients on $\ln(GNI_{j73})$ and $\ln(AID_{j73} / GNI_{j73})$. On average, large and aid-dependent countries have lower levels of programme aid volatility, as they do of sector aid volatility. This explains the positive correlation between the volatility measures for the two kinds of aid.

Table 7 reports the results from regression equations that replicate those in Table 6, but with the *openness* variable replaced by the share of trade in GDP, for the full 66-country sample. The table shows that the results do not depend a great deal on which measure of openness is used. Coefficient values and levels of significance are very similar.

Table 5. Cross section regressions for conditional aid volatility (63 countries)

Dependent variable: log of mean squared residual from sector aid equation, $\ln(\sum_t [u_{jt}^{SECTOR}]^2/T)$

	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*
intercept	-1.951	*-4.438*	-1.893	*-4.018*	-1.839	*-3.881*	-1.916	*-4.180*	-1.907	*-4.050*
ln(GNI)	-0.066	*-1.235*	-0.066	*-1.158*	-0.081	*-1.413*	-0.055	*-0.987*	-0.061	*-1.059*
ln(GNI/POP)	0.168	*1.002*	0.198	*1.051*	0.181	*0.973*	0.172	*0.977*	0.200	*1.064*
ln(AID/GNI)	**-0.210**	***-3.078***	**-0.205**	***-2.771***	**-0.228**	***-3.133***	**-0.213**	***-2.999***	**-0.207**	***-2.795***
AF	**-0.299**	***-1.855***	-0.258	*-1.490*	-0.218	*-1.281*	**-0.289**	***-1.706***	-0.284	*-1.606*
LA	**0.381**	***2.105***	0.147	*0.757*	0.176	*0.918*	0.273	*1.481*	0.138	*0.709*
voice	**-0.355**	***-3.470***								
law			**-0.217**	***-1.846***						
corruption					**-0.206**	***-1.789***				
regulation							**-0.332**	***-2.585***		
effectiveness									**-0.229**	***-1.853***
openness	0.219	*1.532*	0.192	*1.257*	0.174	*1.135*	**0.258**	***1.711***	0.198	*1.292*
R squared		0.612		0.554		0.552		0.578		0.554
σ		0.431		0.461		0.462		0.449		0.461
Schwartz Criterion		-1.295		-1.157		-1.154		-1.212		-1.158
Akaike Criterion		-1.567		-1.429		-1.426		-1.484		-1.430
Normality ($\chi^2(2)$)		1.106		0.208		0.098		0.442		0.173
Heterosk. (F(12,42))		0.806		0.998		0.854		1.104		1.034
RESET (F(1,54))		0.295		1.379		0.812		1.244		0.882

Table 5 continued

	Dependent variable: log of mean squared residual from programme aid equation, $\ln(\sum_t [u_{jt}^{PROGRAMME}]^2/T)$									
	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*
intercept	-0.389	*-0.677*	-0.374	*-0.648*	-0.356	*-0.615*	-0.381	*-0.660*	-0.377	*-0.655*
ln(GNI)	**-0.153**	***-2.195***	**-0.153**	***-2.184***	**-0.158**	***-2.247***	**-0.152**	***-2.159***	**-0.150**	***-2.139***
ln(GNI/POP)	0.181	*0.827*	0.195	*0.848*	0.192	*0.843*	0.175	*0.787*	0.206	*0.894*
ln(AID/GNI)	**-0.230**	***-2.587***	**-0.228**	***-2.513***	**-0.235**	***-2.640***	**-0.233**	***-2.606***	**-0.226**	***-2.502***
AF	0.052	*0.244*	0.058	*0.273*	0.069	*0.333*	0.063	*0.296*	0.042	*0.196*
LA	-0.073	*-0.307*	-0.135	*-0.570*	-0.128	*-0.545*	-0.103	*-0.446*	-0.146	*-0.612*
voice	-0.087	*-0.652*								
law			-0.066	*-0.456*						
corruption					-0.066	*-0.467*				
regulation							-0.052	*-0.318*		
effectiveness									-0.089	*-0.588*
openness	0.137	*0.731*	0.130	*0.696*	0.124	*0.664*	0.140	*0.738*	0.132	*0.708*
R squared		0.360		0.358		0.358		0.357		0.359
σ		0.563		0.565		0.565		0.565		0.564
Schwartz Criterion		-0.757		-0.753		-0.753		-0.752		-0.756
Akaike Criterion		-1.029		-1.025		-1.025		-1.023		-1.028
Normality ($\chi^2(2)$)		1.746		1.601		1.726		1.580		1.313
Heterosk. F(12,42))		0.586		0.994		0.753		0.721		0.866
RESET (F(1,54))		0.771		1.078		0.861		1.015		1.033

Table 6. Restricted cross section regressions for conditional sector aid volatility (63 countries)

Dependent variable: log of mean squared residual from sector aid equation, $\ln(\sum_t [u_{jt}^{SECTOR}]^2/T)$

	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*
intercept	-2.434	*-12.28*	-2.384	*-11.05*	-2.436	*-11.40*	-2.321	*-10.97*	-2.360	*-10.83*
ln(AID/GNI)	**-0.228**	***-5.411***	**-0.233**	***-5.086***	**-0.239**	***-5.086***	**-0.239**	***-5.390***	**-0.238**	***-5.147***
AF	**-0.282**	***-1.831***	-0.241	*-1.434*	-0.186	*-1.148*	**-0.282**	***-1.732***	-0.269	*-1.560*
LA	**0.483**	***2.942***	0.266	*1.566*	**0.298**	***1.761***	**0.369**	***2.249***	0.255	*1.496*
voice	**-0.350**	***-3.479***								
law			**-0.196**	***-1.800***						
corruption					-0.179	*-1.620*				
regulation							**-0.326**	***-2.657***		
effectiveness									**-0.208**	***-1.843***
openness	**0.364**	***3.418***	**0.350**	***3.847***	**0.333**	***3.731***	**0.398**	***4.339***	**0.353**	***3.871***
R squared		0.599		0.541		0.567		0.539		0.535
σ		0.430		0.460		0.447		0.460		0.463
Schwartz Criterion		-1.394		-1.259		-1.318		-1.256		-1.246
Akaike Criterion		-1.598		-1.463		-1.522		-1.461		-1.450
Normality ($\chi^2(2)$)		0.553		0.076		0.256		0.068		0.023
Heterosk. (F(8,48))		0.600		0.663		0.634		0.630		0.506
RESET (F(1,56))		0.417		0.322		0.599		0.615		0.153

Table 7. Restricted cross section regressions for conditional sector aid volatility using the alternative openness indicator (66 countries)

Dependent variable: log of mean squared residual from sector aid equation, $\ln(\sum_t [u_{jt}^{SECTOR}]^2/T)$

	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*	coeff.	*t*
intercept	**-4.875**	***-10.99***	**-4.809**	***-10.12***	**-4.845**	***-10.09***	**-4.970**	**-10.70**	**-4.908**	**-10.44**
ln(AID/GNI)	**-0.231**	***-5.405***	**-0.243**	***-5.326***	**-0.252**	***-5.391***	**-0.259**	**-5.752**	**-0.259**	**-5.606**
AF	-0.119	*-0.812*	-0.077	*-0.510*	-0.029	*-0.195*	-0.063	-0.434	-0.105	-0.702
LA	**0.572**	***3.500***	**0.381**	***2.368***	**0.417**	***2.601***	**0.507**	**3.169**	**0.377**	**2.385**
voice	**-0.313**	***-3.107***								
law			**-0.223**	***-2.047***						
corruption					**-0.233**	***-2.092***				
regulation							**-0.331**	**-2.859**		
effectiveness									**-0.278**	**-2.519**
trade share	**0.470**	***4.281***	**0.464**	***3.934***	**0.465**	***3.953***	**0.497**	**4.332**	**0.491**	**4.186**
R squared		0.551		0.513		0.515		0.542		0.529
σ		0.445		0.463		0.462		0.449		0.455
Schwartz Criterion		-1.336		-1.254		-1.257		-1.314		-1.287
Akaike Criterion		-1.535		-1.453		-1.456		-1.513		-1.486
Normality ($\chi^2(2)$)		1.687		1.030		0.914		1.124		1.008
Heterosk. (F(8,51))		0.638		0.546		0.566		0.560		0.700
RESET (F(1,59))		0.171		2.395		0.953		2.485		1.900

4 Conclusions and broad policy implications

In this paper we have examined aid volatility using data for 66 aid recipients over the period 1973-2002. Our work improves upon earlier work in this important area by distinguishing total aid inflows into sector and programme aid and by adopting a different methodology in capturing aid volatility. The key volatility concept that we employ is that of a shock to aid, that is, the part of aid flows that is orthogonal to an information set of lagged macroeconomic variables.

We find that sector aid volatility is positively correlated with programme aid volatility. Moreover, a 1 per cent increase in aid as a proportion of GNI is associated with a fall in our conditional sector aid volatility measure of around 0.16-0.17 per cent, and that a 1 per cent increase in *per capita* income is associated with a rise in volatility of around 0.35-0.40 per cent. Similar results appear in the case of programme aid volatility, despite the fact that programme aid is rather more volatile – as we measure it – than project assistance. (However, in interpreting these figures it is important to remember that volatility is measured in terms of the percentage changes in aid flows, not in terms of changes in absolute size, which are asymmetrically distributed.) Furthermore, the institutional quality of the aid recipient seems to promote stability of sector aid. We also find that more open economies, which tend to be smaller and richer, *ceteris paribus*, experience more volatile sector aid flows. Finally, our empirical results indicate that the quality of institutions and the degree of openness in aid recipients are not important factors concerning the volatility of programme assistance.

Our results point to the importance of aid heterogeneity in explaining the volatility of aid inflows. This has crucial policy implications with respect to progress towards achievement of the MDGs, since the differing degrees of volatility would not be apparent if a single aggregate for aid were employed. This is particularly important for aid recipient governments who are attempting to manage aid volatility by some combination of adjustment to tax and spending plans, adjustment of foreign exchange reserves or domestic non-monetary financing.[17] For these countries, improved forecasting of both short-term and medium-term aid is also crucial. (Although in the latter case informal indications from donors are also likely to be essential.) Our results emphasize the importance for donors of speedy implementation of the *Rome Declaration on Aid Harmonization*, which will lead to substantial reductions in aid volatility. More generally, it is imperative that donors explore new sources of financing accompanied by less volatility (for example, the IFF) so that the MDGs can be attained by 2015.

A number of research questions remain unresolved, and could be pursued through a combination of econometric analysis and case-study. Among the more important of these is the impact of the volatility of sector and programme aid on a recipient's budget and on economic growth in low-income countries.

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17 See Bulíř and Lane (2002) and Foster (2003) for a comprehensive discussion.

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