

Volatility of Development Aid: From the Frying Pan into the Fire?

ALEŠ BULÍŘ and A. JAVIER HAMANN*
International Monetary Fund, Washington, DC, USA

Summary. — The paper, building on the authors' previous analysis, examines the relative volatility of aid flows into developing countries and their domestic revenue, using new data, and three alternative measures of aid instability (relative volatility *vis-à-vis* fiscal revenue, unpredictability of aid disbursement relative to commitments, and failure of aid to smooth fluctuations in aggregate income). It finds that the volatility of aid flows is still much greater than that of domestic revenue and that this difference is not decreasing. Especially in very poor, aid-dependent countries, this high volatility of inflows makes the macroeconomy hard to manage. Further, the influence of aid has been procyclical and not countercyclical: aid has failed to act either as a stabilizing force or as an insurance mechanism. We argue that, to counter these unwelcome trends, donors need to be able to respond more speedily and effectively to large adverse shocks, and their conditionalities need to become more flexible—possibilities explicitly discussed elsewhere in this Special Section.
© 2008 International Monetary Fund. Published by Elsevier Inc. All rights reserved.

Key words — external aid, ODA, volatility, predictability, developing countries

1. INTRODUCTION

The volatility and unpredictability of aid as a problem of macroeconomic management in low-income countries are receiving increasing attention in academia, as well as among bilateral donors and international financial institutions (IFIs). Birdsall (2004) had recently highlighted the problem in her typology of donor sins—her number 6 is called “stingy and unreliable transfers.” A study by the OECD (2003) identified “uncoordinated donor practices” and “delays in disbursements” as two of the five most burdensome donor practices. In February 2005, Group of Eight (G-8) finance ministers recommended that donors “deliver aid in a more predictable way” (Treasury, 2005).

These coordination problems of development assistance were identified a long time ago—see, for example, Griffin and Enos (1970), Tendler (1975), or Cassen and associates (1986). Donors fail to communicate with each other, move in herds, pumping money into “trendy” sectors or “star” countries, while neglecting others. Brief periods of substantial increases in the volume of aid, measured by overseas development

assistance (ODA), tend to be followed by secular declines. A part of this volatility stems from the fact that donor-specific conditionality may be misdirected. Between the influential Cassen report and the late 1990s, a few major initiatives strived to improve the allocation of aid and incorporate aid better in the context of macroeconomic policies in low-income countries. The major initiatives were the Enhanced Structural Adjustment Facility of 1987, Heavily Indebted Poor Countries (HIPC) Initiative of 1996, and Poverty Reduction Strategy Paper (PRSP) of 1999 (see Appendix I of Bulíř & Hamann, 2006 for institutional details). Each of these initiatives aimed at addressing the above-mentioned shortcomings of development assistance once and for all.

Yet, many in the donor community are more frustrated than ever before by a noticeable lack of coherence in the treatment of low-income country problems—a point recently stressed by Lockhart (2005). Specifically, the implicit goal of consumption smoothing, which could lead to sizable welfare gains in low-income

* Final revision accepted: February 20, 2007.

countries, is not well integrated into the analysis. This will require greater recognition by donors and IFIs of the magnitude of the cost of macroeconomic instability and also of their commitment to make reduced volatility an explicit goal for development assistance. The challenge for IFIs is to improve program design, particularly in the area of contingency planning. For bilateral donors, the challenge implies preventing aid from becoming a source of macroeconomic volatility and allowing a portion of aid to be used explicitly to neutralize other sources of volatility. For their part, aid-recipient countries need to commit to less erratic policy implementation, which could go a long way toward more stable aid disbursements.

This paper updates our previous work on aggregate aid volatility and predictability (Bulír & Hamann, 2003). We have tried to incorporate several suggestions made to us since the publication of that paper, mainly those related to verifying the robustness of our results. Many other useful suggestions, such as breaking down the analysis by the type of donor or the type of aid, have been left out, as we believe that they fall beyond the scope of this paper.

In the remainder of this paper, we outline the problem, describe the data, and analyze in turn three alternative measures of aid instability: relative volatility *vis-à-vis* fiscal revenue, unpredictability of aid disbursement relative to commitments, and failure of aid to smooth fluctuations in aggregate income. We then draw some policy implications.

2. VOLATILITY AND PREDICTABILITY OF AID: WHAT EXACTLY IS THE ISSUE?

The issue of aid volatility did not feature prominently in the literature until fairly recently. Before the 1990s, the debate was centered on the effectiveness of the volume of aid and economists typically looked at aid committed and disbursed over long periods of time.¹ Subsequent research showed that aid was highly volatile, far exceeding that of other macroeconomic variables, such as GDP or fiscal revenue (Bulír & Hamann, 2003; Fielding & Mavrotas, 2005; Pallage & Robe, 2001). Other key findings include the mild procyclicality of aid disbursements (i.e., aid tends to be disbursed mostly in periods when output or domestic revenue are high and held back when domestic economic activity is contracting) and

the fact that aid disbursements are difficult to predict, particularly on the basis of donor commitments (Bulír & Hamann, 2003).

Aid-dependent countries are typically prone to large external shocks and are less able to cope with them, owing to their pervasive liquidity constraints, and the lack of effective countercyclical policy tools. In this context, volatile, unpredictable and procyclical aid can heighten the overall macroeconomic instability, thus detracting from other beneficial effects of aid. Empirical estimates show that the consequences of aid volatility for aggregate growth and consumption are sizable (Arellano, Bulír, Lane, & Lipschitz, 2008; Lensink & Morrissey, 2000; Pallage & Robe, 2003; Torsvik, 2005). Not surprisingly, some of these models also illustrate the substantial potential gains, in terms of the stability of aggregate consumption, of disbursing aid in a stable and predictable manner.

We are aware that aid volatility affects recipient governments' behavior above and beyond the income-to-consumption nexus and that these other factors have not been accounted for in the papers just cited. For example, knowing *ex ante* that aid is going to be volatile, some capital spending may not be started in the first place, skewing the policymakers' decisions. Rather than being treated as a long-term, predictable resource, aid is often treated as a bonanza. Moreover, little is known of the effects of large aid fluctuations on consume, and factor prices, wage levels, and so on.

Experience shows that the adverse characteristics of aid disbursements highlighted above are not easy to correct for various reasons. First, aid volatility reflects deeply rooted problems with the way donor budgets are approved and administered.² Among other things, donor development agencies that make aid commitments are different from those that approve aid funding (parliaments) and disburse aid (ministries of finance). While the magnitude of this disconnect differs from country to country, the problem seems to be widespread.

A second source of aid volatility is conditionality—not only the conditions attached by bilateral donors, but also frequently the requirement that aid-recipients have the “seal of approval” associated with an on-track IMF-supported adjustment program. There are two sides to this issue. From the country's point of view, it means that complying with conditionality is important not only because of the merits of the policies to which conditions

are attached but also because it reduces volatility in aid inflows (Bulír & Lane, 2004).³ From the donors' perspective, there is a tension between the need to ensure that "good policies" are being implemented—donors are accountable to domestic constituencies for the aid funds they disburse—and the negative impact of disruptions in aid disbursements. Thus, for donors conditional aid entails a tradeoff between aid-recipient countries' pursuit of good policies aimed at securing sustainable growth and poverty reduction and the donors' objective of providing a smooth stream of aid that could go a long way toward achieving the goal of consumption smoothing in low-income countries.

Against this background and under the umbrella of the PRSPs, since the late 1990s the donor community and the IFIs have developed a number of initiatives that could be rationalized as attempts at improving the terms of the tradeoff described above by

- improving domestic policymaking processes in aid-recipient countries,
- designing lending facilities better tailored to country-specific realities and based on improved modalities of conditionality,
- providing debt relief, and
- harmonizing donor conditionality.

In this paper, we follow the methodology employed by Bulír & Hamann (2003), with some minor modifications, and extend the series from 1975–97 to 1975–2003. This longer period includes some years since the introduction of the PRSP and allows us to assess whether the PRSP-related initiatives have led to a marked change in the behavior of aid flows.

The results are not encouraging. We continue to find that the volatility of aid is a multiple of that of domestic fiscal revenue. Furthermore, we find little evidence that the relative volatility of aid has decreased recently. Aid commitments are still inadequate predictors of disbursements, particularly for the poorest countries in our sample. As far as macroeconomic shocks are concerned, aid is failing to compensate for negative GDP shocks. For example, countries hit by negative GDP shocks equivalent to 5% or more received a meaningful immediate increase in aid in only a fraction of cases.

We do not test directly how the various initiatives introduced in the late 1990s and aimed at improving donor practices, domestic policy processes, program design, and so on have fared. But we find no *prima facie* evidence that they have had any meaningful impact on how

aid is delivered. We take this to mean that the main underlying causes of aid volatility and unpredictability have not been either confronted or addressed in a systematic manner. Unless this is done, we see little reason to be optimistic about the contribution of the recently created initiatives and lending facilities.

3. DATA AND MEASUREMENT ISSUES

Compared with Bulír & Hamann (2003), we extended the sample, added a few countries, filled some gaps in the coverage of domestic fiscal revenue (see Appendix for a detailed description of all series and their transformations), and tested the robustness of our results using alternative aid definitions and smoothing techniques. Our database contains 76 countries from 1975 to 2003, with both gross and net aid series and domestic revenue series (both tax and non-tax). Given that not all the revenue series are available from 1975, we have an unbalanced panel of observations (see Appendix, Table A1 for data availability). Figure 1 shows the evolution of gross aid, excluding food and emergency aid, and debt relief in our sample countries and Figure 2 shows aid profiles of individual countries.⁴

(a) *Choices, choices...*

The specific definition of aid seems to matter surprisingly little—our results remain robust for every definition of aid we employed. One choice is between gross aid (disbursements) and net aid (disbursements net of repayments). However, net aid measures may be misleading if the recipient country is either in arrears or in the process of rescheduling, as accrual-based debt service does not necessarily reflect actual repayments. A second choice is between a narrow definition (grants and loans, excluding food and emergency aid and debt relief) and broader definitions that include these inflows. The main disadvantage of broader definitions is that the contemporaneous macroeconomic impact of broadly defined aid is more difficult to anticipate. For example, emergency aid is often fully under the control of donors, debt relief may have no impact on the contemporaneous cash flow of the recipient country, and so on. A third choice is about the coverage of donors. While virtually all past analyses employed the OECD's ODA ("official" aid), these series exclude parallel mechanisms of mostly private

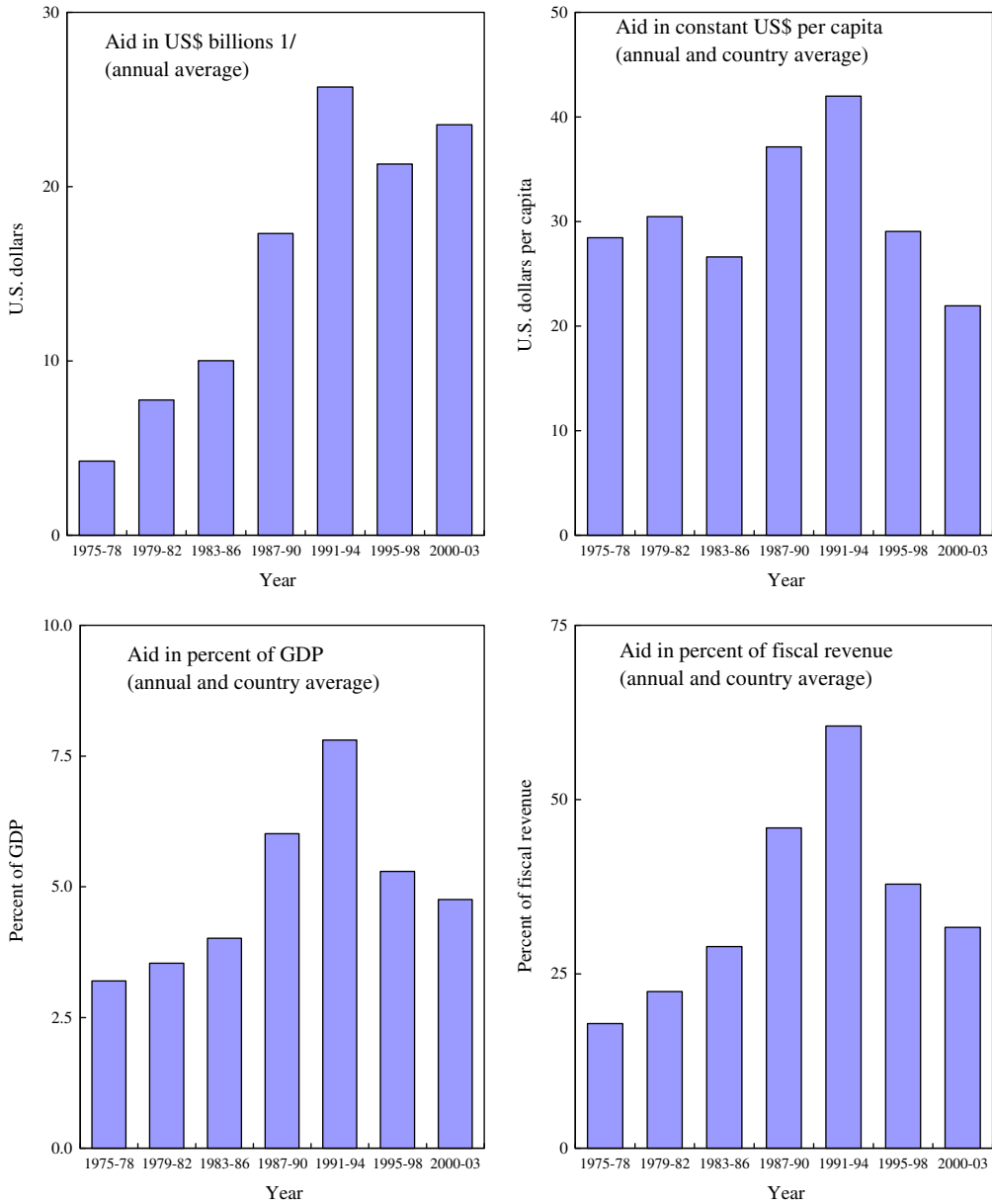


Figure 1. Aid is an important, albeit declining, resource for aid recipients, 1975–2003 (full sample annual averages, $N = 76$; aid includes ODA grants, and disbursed ODA loans, excluding food aid emergency aid and debt relief).

aid that remains outside policy and budget frameworks. We stick with the OECD series primarily because private aid data are spotty. Finally, a choice needs to be made whether to disaggregate aid by its proclaimed use or

not.⁵ Disaggregated data are useful when aid money is not fully or partially fungible, which is often the case. While aware of the potential limitations of aggregate data, in this paper we focus on narrow, aggregate definitions of gross

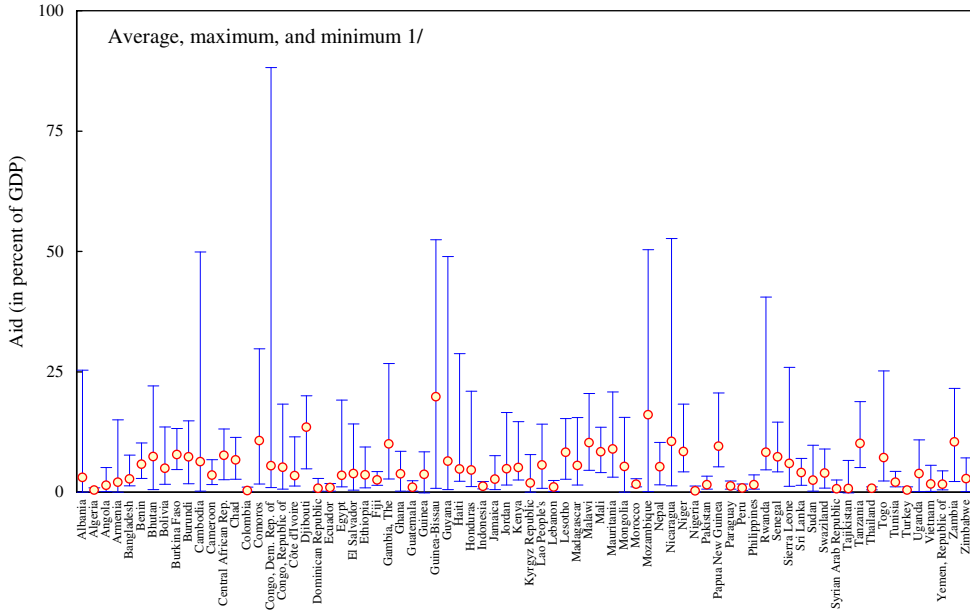


Figure 2. Countries receive unstable aid flows, 1975–2003 (in percent of GDP; circles indicate sample averages of individual countries (mean of 4.9%) and the upper, and lower bars indicate sample maxima and minima (whose averages are 10.5%, and 3.6%, respectively).

official aid. Our results remain broadly unchanged when net aid or broadly defined gross aid is used.

The choice of a common denominator matters more for the statistical measures of relative volatility than the definition of aid. Typically, aid is denominated in US dollars whereas domestic revenue is denominated in local currency units. Comparisons require first expressing both variables in the same currency. As a result, statistical measures of relative volatility are affected by the volatility of exchange rate, whose impact can be very large. To control for the impact of exchange rate volatility, we compute aid and revenue in three different ways: as percentages of nominal GDP, in constant US dollars in *per capita* terms, and as percentages of purchasing-power-parity (PPP) GDP. Arguably, denominating aid and revenue in *per capita* US dollars is preferable if they both were to be spent on tradable goods, whose prices tend to be fixed in US dollars (Bulir & Lane, 2004). In reality, a significant portion of aid proceeds is spent on nontradable goods. More generally, if the objective is to assess the macroeconomic impact of aid, the relevant denominator is the aid-to-GDP ratio. Using

PPP-based series should, in principle, reduce the noise introduced by the volatility of the exchange rate. Henceforth, owing to the lack of an ideal denominator, we use all three transformations as a robustness check.

(b) Data transformations

All transformed aid and revenue series are converted into natural logarithms and de-trended using the Hodrick–Prescott filter. A measure of relative aid volatility is then calculated, Φ , as the ratio of the variances of the filtered series of aid and revenue. ⁶ Φ is a ratio of variances estimated with a common number of observations per country in both the numerator and the denominator and, thus, the statistical significance of sample averages can be assessed using an *F*-test. Additional robustness checks include comparisons of sample averages and medians of Φ across countries and various groups of countries. Finally, we calculate the correlation coefficient of de-trended aid and revenue, which amounts to a test of aid procyclicality as revenues are a strongly procyclical variable.

4. MEASURING THE VARIABILITY OF AID: THREE APPROACHES

In this section, we reexamine the evidence on volatility and predictability of aid since our previous study. As stated earlier, the year 1999 provides a natural breaking point for the analysis as it marks the introduction of the PRSP and related initiatives. By contrasting the pre-1999 and post-1999 periods, we try to answer three questions related to the impact of the new initiatives:

- Does aid continue to be, for the most part, more volatile than domestic revenue?
- Has aid become more predictable (i.e., are aid disbursements more closely related to donor commitments)?
- Are aid inflows related to macroeconomic shocks in the recipient countries?

Despite building on a larger sample and a statistical methodology that focuses on pure volatility of aid and revenue, our findings are very much comparable to those of Bulíř & Hamann (2003). We find no positive impact of the policy initiatives described earlier on the relative volatility of aid. More specifically, we find that aid

- has been much more volatile than domestic revenue (with its volatility increasing recently),
- has remained unpredictable, and
- has not acted as a buffer against GDP shocks.

We hasten to say that this study does not present a counterfactual model of donor behavior in the absence of these initiatives; it could well be that without them aid would have been even more volatile and less predictable. However, we have not been able to identify an *a priori* factor, or set of factors, that could have produced this result.

(a) *Aid volatility and procyclicality*

We find, first, that the volatility of aid is much higher than that of revenue and, second, that the relative volatility of aid increased in the early 2000s as compared to the late 1990s (Table 1). These results are statistically significant and invariant to alternative definitions of aid and de-trending methods.⁷ Given that we are interested in the relative volatility of aid and domestic fiscal revenue, a narrow definition of gross aid—ODA loans and grants, excluding food and emergency aid and debt relief—seems appropriate.

The average volatility of aid relative to revenue (Φ) is about 14 when variables are expressed in percent of GDP and 5 1/2 when expressed in constant US dollars *per capita*. Using medians, which are arguably better statistics in the presence of large outliers, the estimates of the relative volatility of aid are 6 in percent of GDP and 2 1/2 in constant US dollars *per capita*. Furthermore, the relative volatility of aid is the highest in the subsamples of the least aid-dependent countries, defined as having aid-to-revenue ratios of less than 25%.

Instances where aid is less volatile than revenue ($\Phi < 1$) are rare—between one in twenty-five and one in five. We find only three instances in the GDP-based series (Bolivia, Chad, and Comoros), and 16 in US dollar *per capita* series (Angola, Bolivia, Burkina Faso, Chad, Comoros, Ecuador, Guinea-Bissau, Laos, Lebanon, Lesotho, Mongolia, Nigeria, Papua New Guinea, Sudan, Uganda, and Vietnam). Moreover, the results in these countries seem to be mostly driven by relatively unstable revenue rather than relatively stable aid. While the absolute volatility of their revenue series was typically a multiple of the sample median, the absolute volatility of their aid series was broadly comparable to the sample median.

On average, aid has been delivered in a mildly procyclical fashion—the average of individual-country correlation coefficients between aid and revenue is positive, albeit statistically insignificant. In other words, declines in de-trended aid tend to be associated with declines in de-trended revenue, and *vice versa*.⁸ Thus, aid is not only unstable but it also tends to fall when domestic sources of revenue weaken. The overall economic impact of aid flows is lower when these are volatile and procyclical, as they fail to assist in, or even work against, consumption smoothing. The procyclicality of aid has been linked to conditionality by bilateral donors and IFIs, particularly in the face of imperfect information about a country's policy efforts. Donors, who cannot observe directly a country's adjustment efforts, may take observable weak macroeconomic indicators as a signal of poor performance and withhold future disbursements of aid.

The initiatives of the late 1990s do not seem to have lowered the relative volatility of aid. (We take 1999 as an interim period and exclude it from the averages.) Indeed, aid has become more volatile in the late 1990, and 2000s—the post-PRSP period—than in the

Table 1. *Aid is more volatile than revenue and procyclical, 1975–2003 (relative volatility of aid and revenue (Φ), correlation coefficient, and aid-to-revenue ratio)*

	Full sample	Subsample 1 ($A/R < 25\%$)	Subsample 2 ($25\% < A/R < 50\%$)	Subsample 3 ($A/R > 50\%$)
<i>Variables expressed in percent of GDP</i>				
Average	14.2*	21.9*	6.8*	4.8*
Median	6.2*	12.8*	4.6*	3.9*
Frequency indicators				
Sample size	76	40	16	20
Number of countries where $\Phi > 1$	73	40	15	18
Procyclicality of aid	0.04	0.04	0.08	0.02
Number of countries where $\text{corr} > 0$	38	20	8	10
Aid-to-revenue ratio (in percent)	32.8	11.3	37.5	72.2
<i>Variables expressed in constant US dollars per capita</i>				
Average	5.4*	7.9*	2.6*	1.8*
Median	2.5*	3.6*	2.5*	1.4*
Frequency indicators				
Sample size	76	42	21	13
Number of countries where $\Phi > 1$	60	34	17	9
Procyclicality of aid	0.12*	0.03	0.20	0.30*
Number of countries where $\text{corr} > 0$	49	23	15	11
Aid-to-revenue ratio (in percent)	29.6	11.0	38.6	75.1
<i>Variables expressed in percent of PPP GDP</i>				
Average	10.2*	10.4*	10.2*	2.4 na
Median	5.5*	5.8*	3.8*	2.4 na
Frequency indicators				
Sample size	76	66	9	1
Number of countries where $\Phi > 1$	73	63	9	1
Procyclicality of aid	0.00	0.02	-0.23*	0.54 na
Number of countries where $\text{corr} > 0$	36	34	1	1
Aid-to-revenue ratio (in percent)	12.1	8.8	32.0	50.8

Source: Authors' calculations.

All variables are in natural logs and filtered by the Hodrick–Precott procedure. Φ is a ratio of variances.

“*” denotes significance at the 5% level, “na” indicates insufficient number of observations. The null hypothesis is $\Phi \leq 1$. Procyclicality is measured by a Pearson correlation coefficient between de-trended aid and revenue; average of country-specific correlation coefficients. The null hypothesis is $\text{corr}(A; R) = 0$.

mid-1990s—the pre-PRSP period, see Table 2. This result is robust across the three different common denominators used in this paper as well as across averages and medians.

In which countries did aid volatility increase during 2000–03? One would expect that the poorest countries should have benefited from the PRSP-related initiatives the most. In reality, the declines in the relative volatility of aid have been both rare and comparatively small (Haiti or Togo). In contrast, the increases in relative volatility were frequent and large in several sub-Saharan African countries, such as Benin, Lesotho, and Uganda, but also in Western Hemisphere countries, such as Bolivia and El Salvador.

Breaking down our sample into countries that qualified for debt relief under the HIPC initiative and those who did not, we find comparably similar worsening in relative volatility between 1995–98 and 2000–03 in both groups (Table 3). The average Φ s roughly doubled during the last four-year period in both groups, while median Φ s increased in HIPC countries and remained broadly unchanged in non-HIPC countries. Based on this evidence, we would find it difficult to argue that the poorest countries benefited from the PRSP initiative in terms of more stable aid flows.

Figure 3 provides another robustness check of the above results by considering only 50 countries with complete 1975–2003 series and

Table 2. *During 2000–03 aid has been more volatile than ever before (relative volatility of aid and revenue (Φ))*

	Full period	1995–98	2000–03
<i>Variables expressed in percent of GDP</i>			
Average	14.2*	25.9*	50.0*
Median	6.2*	6.8*	9.4*
Frequency indicators			
Sample size	76	76	76
Number of countries where $\Phi > 1$	73	69	72
<i>Variables expressed in constant US dollars per capita</i>			
Average	5.4*	14.7*	22.4*
Median	2.5*	3.1*	4.5*
Frequency indicators			
Sample size	76	76	76
Number of countries where $\Phi > 1$	60	57	63
<i>Variables expressed in percent of PPP GDP</i>			
Average	10.2*	25.3*	49.2*
Median	5.5*	6.7*	8.3*
Frequency indicators			
Sample size	76	76	76
Number of countries where $\Phi > 1$	73	68	71

Source: Authors' calculations.

Notes: "*" denotes significance at the 5% level. The null hypothesis is $\Phi \leq 1$. For the exact starting year for each individual-country series see Table A1.

Table 3. *The patterns of aid volatility in HIPC and non-HIPC countries remain broadly unchanged, 1995–2003 (relative volatility of aid and revenue (Φ))*

	1995–98		2000–03	
	HIPC	Non-HIPC	HIPC	Non-HIPC
<i>Variables expressed in percent of GDP</i>				
Average	26.7	25.3	68.0	33.7
Median	6.1	7.3	9.9	9.4
<i>Variables expressed in constant US dollars per capita</i>				
Average	14.8	14.5	25.6	19.4
Median	2.8	3.8	5.1	3.0
<i>Variables expressed in percent of PPP GDP</i>				
Average	28.8	22.2	71.2	29.4
Median	6.5	6.7	10.1	7.4

Source: Authors' calculations.

Notes: HIPC stands for heavily indebted poor country. We have 36 HIPC countries and 40 non-HIPC countries in our sample.

plotting four-year average and median estimates of Φ s. Thus, unlike Tables 1 and 2, which are based on unbalanced samples, Figure 3 is based on a balanced sample. We find again that, in this sample, the average aid volatility increased in the 2000s after a decline in the late 1990s. The median aid volatility either remained unchanged or increased slightly in the 2000s as

compared to the late 1990s. In other words, while aid volatility changed little for the median country, it increased substantially in a few.

Figure 4 backs up our earlier claim that the increases in the average and median Φ s in recent years are due to more volatile aid. On the one hand, the absolute level of aid volatility (θ^A) increased. On the other hand, revenue vol-

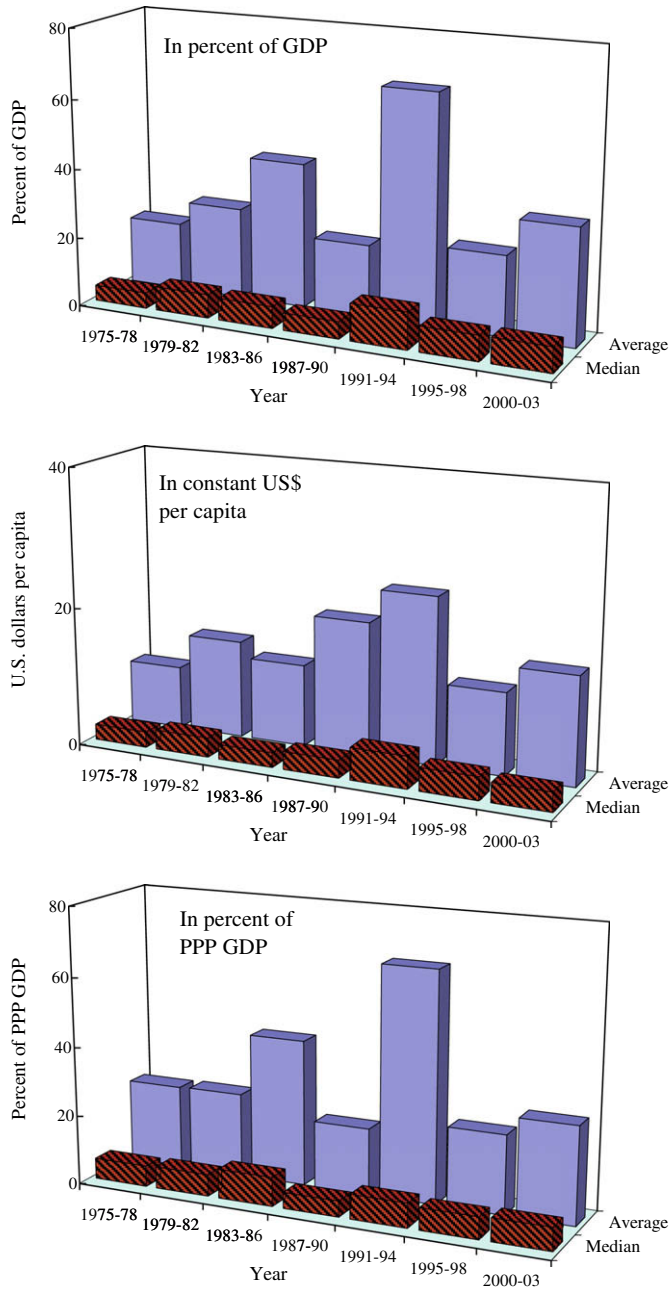


Figure 3. Selected countries: relative volatility of aid and revenue, Φ , 1975–2003 (sample average, $N = 50$). Notes: Only countries with complete series (1975–2003) are used in the calculations and the 1999 observation is dropped from the calculations.

atility (θ^R) either declined or remained broadly stable, depending on the series used. These re-

sults are again robust to all the transformations used regularly in this paper.

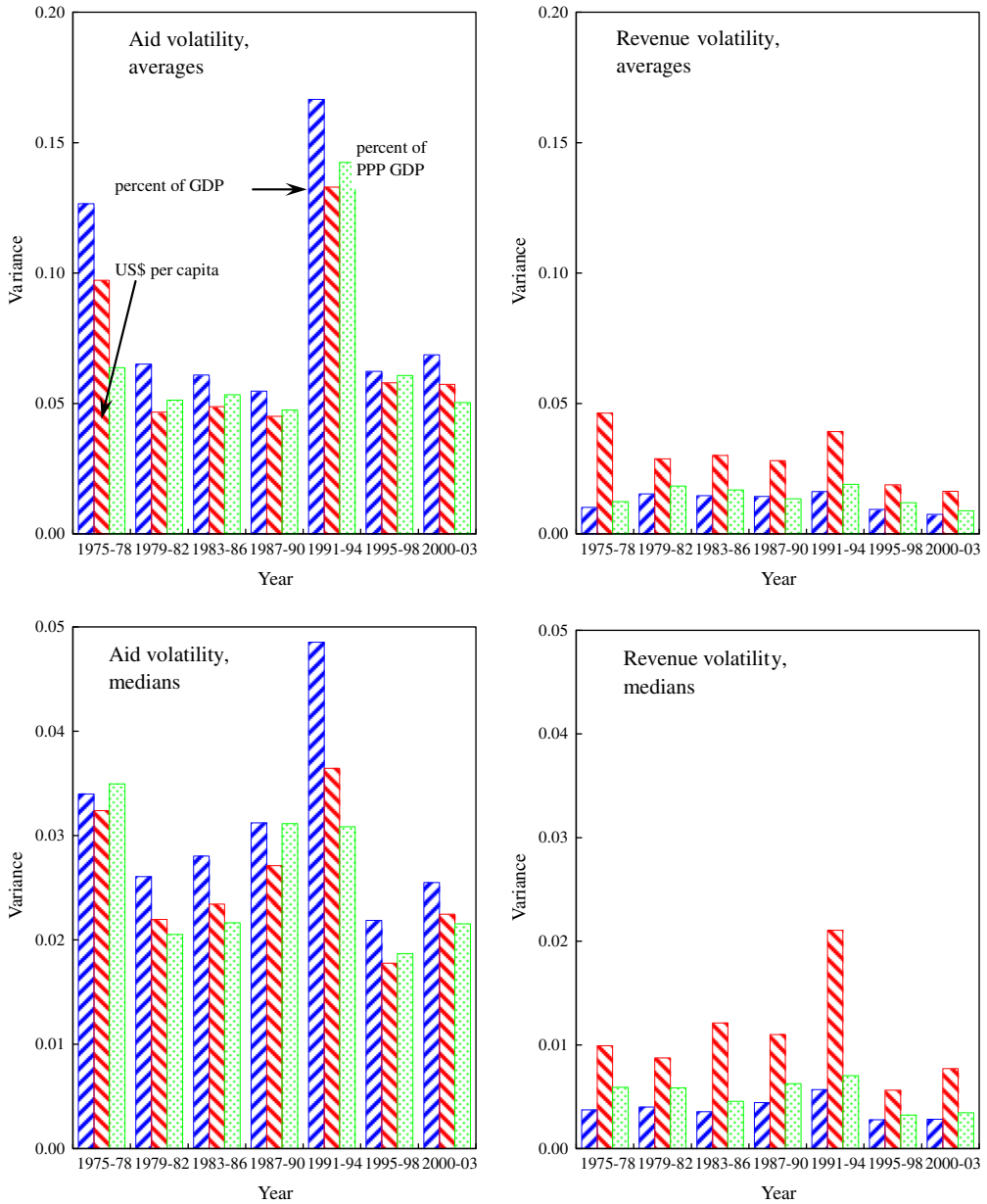


Figure 4. Aid is getting more volatile; revenue remains stable, 1975–2003 (full sample, $N = 76$). Notes: The bars show the sample moments across 76 countries for the selected four-year periods. Volatility is measured by the variance of Hodrick–Prescott filtered series (θ).

(b) Predictability

One could argue that aid volatility would be less of a problem if such volatility were predictable. However, fully anticipated aid would be

still problematic as most aid-dependent countries face serious liquidity constraints. These countries probably would not be able to borrow in capital markets to completely smooth out a volatile pattern of aid disbursements.

Hence, we ask, how reliable are long-term commitments by official lenders?

Unfortunately, no comprehensive database with broadly defined aid commitments and disbursements is compiled. Thus, we rely on commitments and disbursements of long-term loans compiled in the World Bank's *Global Development Finance* database. It is a reasonable, if imperfect, approximation, because (i) most aid-dependent countries cannot borrow on non-concessional terms and (ii) disbursements in the GDF database are positively correlated with ODA loans for most countries in the OECD database. An admittedly rudimentary assessment of predictability based on contrasting these long-term loan commitments and disbursements yields little evidence that predictability has improved recently.⁹ Indeed, on average, actual loan delivery falls short of promises by more than 40%, particularly in the poorest countries.

While the excess of commitments over disbursements declined markedly in the late 1970s and 1980s, this trend disappeared in the 1990s. Indeed, in 2000–03, disbursements fell short of commitments by about one-third (Figure 5, upper panel). In other words, during that period lenders promised, on average, one-half more than they actually disbursed, pushing the commitment-to-disbursement ratio (C-to-D ratio) to its highest level in 20 years. Moreover, we find evidence that the recent increase in the ratio was driven jointly by larger commitments and lower disbursements. During 2000–03 average commitments grew by about 4%, relative to 1995–98, while average disbursements fell by some 5%. (As before, we exclude data for 1999 from our calculations.)

Even more disturbing is the finding that this measure of unpredictability has been negatively correlated with the level of development as measured by GDP *per capita* (using purchasing-power-parity GDP data; Figure 5, middle panel). An increase in constant PPP GDP by US\$ 100 is associated with a reduction of almost 0.2 in the C-to-D ratio, that is, better reliability of commitments. Countries at the upper end of the income scale appear to have received almost as much loans aid as committed, while countries at the lower end of the income scale have received on average only about one-half of commitments. Comparing the 10th, and 90th percentiles of the C-to-D series ordered by GDP *per capita*, the C-to-D ratios for these two percentiles were 2.0, and 1.0, respectively. The difference in aid predictability remains siz-

able even if we compare the 25th and 75th percentiles.

As before, we looked at whether the poorest countries—proxied here by HIPC eligibility—benefited from the PRSP initiative in terms of lending predictability. We failed to find any statistically significant impact. Breaking down our sample into HIPC and non-HIPC countries, and focusing on the 2000–03 period, we find that the negative relationship is similar in both groups of countries (Figure 5, bottom panel). Moreover, the regression slopes are comparable not only to each other in the post-PRSP period (2000–03), but also to the single slope estimated for the full sample period (1975–2003).

The difference in long-term lending predictability between the relatively poorer and relatively richer countries during 2000–03 remains sizable. In non-HIPC countries, which are relatively richer, the median C-to-D ratio was only 1.2 in 2000–03, whereas the median C-to-D ratio in HIPC countries, which are relatively poorer, was 2.0. We interpret these results as suggesting that long-term lending predictability was unaffected by the late 1990's initiatives and that their impact on predictability in the poorest countries was barely noticeable.

(c) *Aid and macroeconomic shocks: beyond procyclicality of aid*

It could be argued that our aid findings—particularly the procyclicality of aid—are not too worrisome if donors deliver aid when it is needed the most; that is, during periods of large, negative GDP shocks.¹⁰ If true, aid would be countercyclical for large negative shocks only and possibly also quite volatile. The advantages of such a scheme are obvious: low-income countries are prone to shocks because their economies are not diversified and are liquidity constrained. In particular, extreme weather fluctuations in many of these countries affect agricultural output and agriculture employs the bulk of the population. Crises in these countries tend to have permanent output consequences as output fails to recover back to the original trend path (Cerra & Saxena, 2005). It would seem logical that these countries would benefit from a fast and massive income-stabilizing mechanism, even if on average aid were to remain unstable.

We fail to find support for the implicit shock-insurance nexus: aid did not compensate for large GDP shortfalls during 1975–2003. We classified the possible outcomes in a matrix

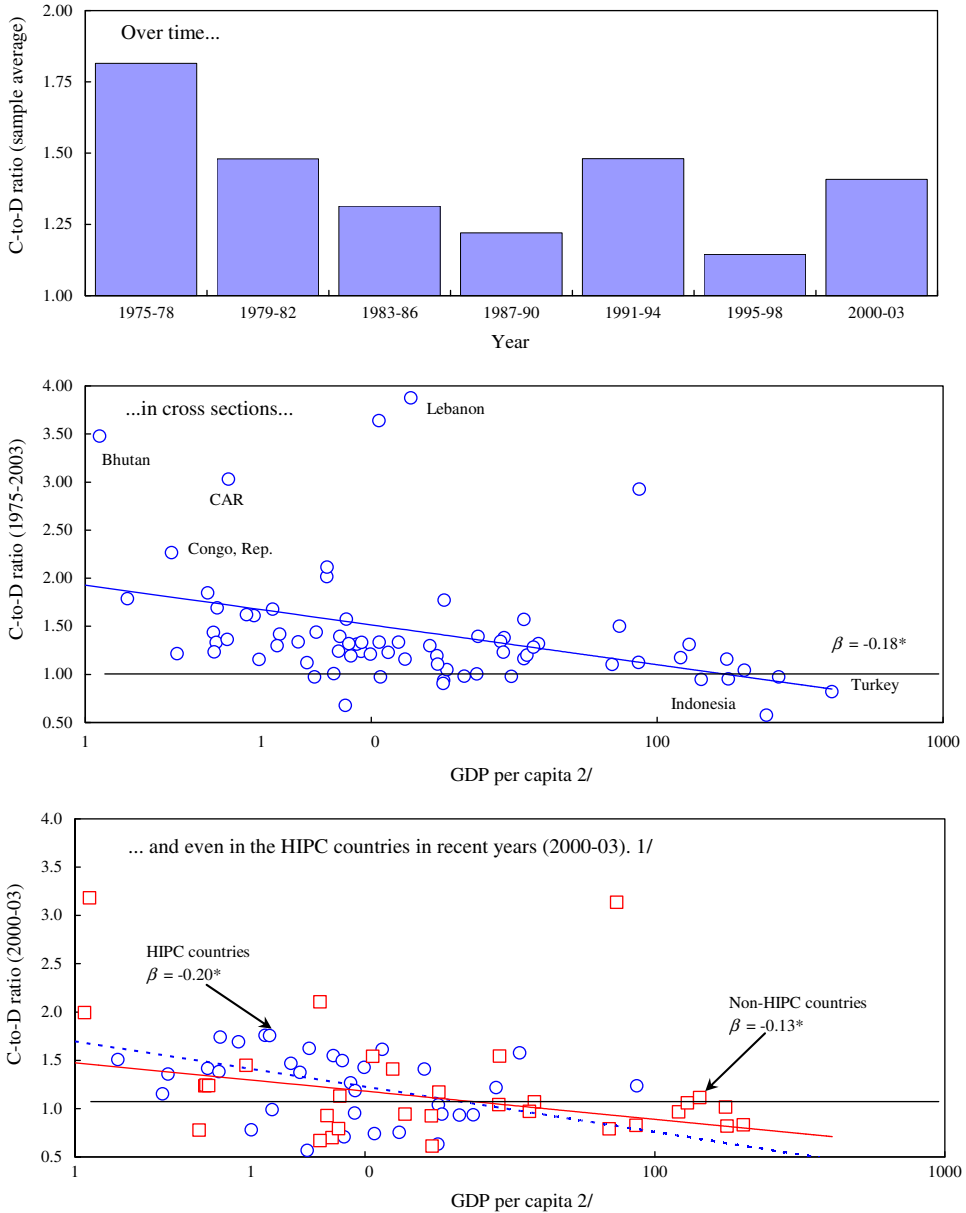


Figure 5. Commitments are poor predictors of disbursements, 1975–2003 (commitment-to-disbursement ratio of long-term loans). Notes 1/ HIPC countries are shown as circles, with a dotted trend line; non-HIPC countries are shown as squares, with a solid trend line. We have excluded the 2001 C-to-D observation for the Central African Republic that was changing drastically the slope of the HIPC-country trend line. All slope coefficients are statistically significant. 2/ In US\$, purchasing parity exchange rate, log scale.

mapping output shocks (increases and decreases in real GDP) and broadly defined aid shocks (increases and decreases in grants, loans, and emergency and food aid in percent of GDP).¹¹ Under the income-stabilizing mechanism, donors would step in with

additional aid if the country is affected by a negative external shock, such as a natural disaster, drought, or sudden terms-of-trade shock. Intuitively, for this mechanism to work, aid would have to be disbursed fast and in direct proportion to the loss of GDP. We focus on that part of the matrix that contains GDP shortfalls and aid changes.

Donors are likely to disburse additional aid only if the income shock was exogenous in nature, as opposed to domestically generated. Aid does not increase during civil war conflicts (e.g., Rwanda or Sierra Leone) or when governments are hostile to donors (e.g., Sudan or Zimbabwe). Thus, rather than using real GDP series, we focused on that part of GDP variability that can be explained by two proxies of external exogenous shocks: terms of trade and agriculture. To this end, we regressed real GDP growth on terms of trade and the share of agricultural output in GDP and used the fitted real GDP growth in our comparisons. See Appendix for additional details.

We found that sizable aid increases—by themselves more frequent than GDP declines—rarely compensate for output shocks. To test for the presence of an implicit insurance mechanism, we compute the number of instances in which there is a coincidence of a decline in the fitted value of GDP growth and a contemporaneous increase in aid. Additional aid equivalent to the GDP shock almost never arrives when the country is hit by a sizable negative shock of, say, 5–10% of GDP (Table 4). These results are unaffected by the choice of the output and aid variables—we obtained

comparable estimates also for the series with GDP *per capita* in constant US dollars and narrowly defined aid.

In those cases where additional aid was disbursed, it typically fell short of the initial GDP decline (results on the diagonal of the matrix). For example, in our sample of 2,010 annual observations, we have six occurrences of fitted real GDP falling by 10% or more. Although we have 27 occurrences of aid increasing by 10 percentage points of GDP, these increases coincided with the GDP shock in one case only (Rwanda in 1994), or 16.7% of all cases. Looking at aid increases of 5 percentage points of GDP, these increases coincided with the 5% negative GDP shocks again in only one case, or 7.1%, and so on. These results are fairly similar for off-diagonal combinations of GDP and aid shocks: the probability of receiving compensating aid in the wake of such GDP shocks was between 5% and 30%. Very few of those coincidences occurred in the 2000s.

Not only does additional aid fail to arrive at the time of the adverse output shock, but it typically does not arrive at all. We tested the possibility of aid arriving late—that is, the coincidence of a negative GDP shock at time t and a positive aid shock in time $t + 1$ —and found that, on average, the probability of delayed aid was substantially smaller than for contemporaneous aid. Even when we considered jointly contemporaneous and lagged aid, the joint coincidence remained well below one-half for most combinations of negative output shocks and additional aid.

Table 4. *Aid has been poor insurance against negative GDP shocks, 1975–2003*

		GDP decline in percent 1/ (number of events)		
		10	5	2 1/2
		(6)	(14)	(39)
Aid increase 2/ (number of events)				
10 (27)	Coincidence 3/	16.7	7.1	5.1
5 (76)	Coincidence 3/	16.7	7.1	7.7
2 1/2 (174)	Coincidence 3/	33.3	21.4	17.9

Source: Authors' calculations.

1/Real GDP regressed on terms of trade and agricultural output.

2/Change in aid disbursements, in percentage points of GDP.

3/Instances in which a given GDP shock (column) coincides with a given increase in aid (row). Expressed as a percent of GDP decline events. Total number of observations = 2,010.

Notes: The interpretation of the first cell in the first row is that out of six cases of annual GDP declines of 10% or more one of these declines (or 16.7%) coincided with an aid increase of 10% or more, of which there were 27 in the sample.

Finally, we find that aid was just as likely to decrease as it was to increase in the wake of a negative GDP shock. For the same distribution of negative GDP shocks as in Table 4, the probability of a cut in aid in the wake of a negative output shock was again between 10% and 20%. The detailed results are available from the authors on request.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The discussion of aid effectiveness has been gradually moving away from narrowly defined measures of success, such as economic growth or poverty head count, to broader ones that encompass other aspects of the well-being of aid-recipients. The issue of the large economic costs associated with macroeconomic volatility in low-income countries and, in particular, the role played by an erratic stream of aid disbursements, is only now starting to be addressed in a systematic manner. Significant work remains to be done in order to understand the real extent of the problem and its key underlying causes.

In this paper, we have reexamined some of the issues taken up in Bulir & Hamann (2003) on the volatility, predictability, and pro cyclicality of aid. The availability of six new years' worth of data allowed us to look closely at whether the way in which aid is disbursed has improved since the late 1990s when various initiatives, anchored in PRSPs, were introduced. These initiatives were expected to lead to better compliance with IMF conditionality and a more predictable and less erratic stream of aid flows into low-income countries. Better compliance with conditionality, along with improved donor practices, should also have led to aid being less procyclical.

The results of our study are not encouraging. The analysis shows that aid has been more volatile than domestic fiscal revenues by a wide margin. We also find little evidence that aid volatility has decreased recently. Aid commitments continue to be poor predictors of disbursements, a problem that is particularly serious among countries with the lowest *per capita* incomes. The results are equally disappointing for the cyclical behavior of aid. We found disbursements to be procyclical on average and, worse, we found strong evidence that aid has failed to play any meaningful role in assisting

countries to cope with large negative income shocks. For example, of the 14 cases of negative GDP shocks of 5% or more, only one benefited from a concomitant increase in aid. Although the paper does not test directly the impact of the above-mentioned initiatives by donors, IFIs, and aid-recipient countries, the results lead us to conclude that the main underlying causes of aid volatility and unpredictability have not been addressed.

Aid has failed to act either as a stabilizing force or as an insurance mechanism. Of course, we do not argue that the sole purpose of aid is to provide either a stable flow of income to poor countries or to insulate them from external shocks. Most likely, some countries may benefit more from a steady flow of aid, while others may benefit more from the shock-stabilizing role of aid. That said, a stable stream of aid is likely to be an improvement over current policies.

This leaves us to ask: What next? In our view, ongoing work on strengthening the role of donors in helping low-income countries should

- give macroeconomic stability the prominence it deserves and make it an explicit goal of development assistance, and
- discuss the various mechanisms through which aid can help achieve this goal. The most obvious way in which donors can foster a more stable environment is to disburse aid in a more stable and predictable manner, in part through flexible use of program/project conditionalities and recognizing the fungible nature of aid. Donors also need to recognize the benefits of disbursing aid in a countercyclical manner: they should strive to find ways to respond more quickly and more efficiently to large adverse shocks.

But the potential for aid to reduce volatility in low-income countries is not confined to changing the time series properties of aid flows. More ambitious targets for reserve accumulation in IMF-supported programs could be formulated, taking into account the extent to which low-income countries are vulnerable to various sources of external volatility, and aid could be used to fund this accumulation. Rules determining the circumstances under which these resources could be used and when they need to be replenished should also be part of IMF-supported programs. Critical for this to work is, of course, an acknowledgment by donor countries (not just donor agencies) of the tangible and meaningful economic gains associ-

ated with the use of aid to help poor countries dampen the destabilizing effects of external shocks.

In closing, we see a strong case for addressing the problems associated with macroeconomic instability in low-income countries in a systematic manner and, in this context, a specific role for aid. Several new initiatives aimed at tackling some of the underlying causes of instability have been introduced recently, including the UK's proposal for an international finance facility (IFF); the March 2005 Paris declaration on aid effectiveness; and the IMF's policy support instrument (PSI) and exogenous shocks facility (ESF) introduced in late 2005. In our view, to be effective, these initiatives must form part of a comprehensive approach that (i) addresses in an integrated manner the various

sources of economic instability in low-income countries, as opposed to a piecemeal approach in which separate lending facilities or assistance mechanisms are activated by specific events; and (ii) allows the use of bilateral aid flows for stabilization purposes.

What can be done until the donor community comes to terms with the use of aid as an explicit "insurance mechanism?" Aid-dependent countries may want to adopt conservative fiscal policies, including strengthening the domestic revenue base, and these should be supported by the international financial institutions. Building in a cushion of international reserves that could be drawn down to compensate for shortfalls in aid or other sources of budgetary revenue is an essential part of this approach.

NOTES

1. The neglect of volatility was not unique to development economics as the link between volatility and growth has been demonstrated only recently by Ramey & Ramey (1995). For a recent empirical study on the link between volatility and growth, see Cerra & Saxena (2005).
2. The following citation exemplifies the vagaries of donor aid budgets: the US administration announced that it would ask Congress for \$1.7 billion in 2004, but it asked for \$1.3 billion. In the end, only \$1 billion was approved by Congress (New York Times, 2005).
3. A part of aid volatility, in particular of project aid, can be explained by institutional quality or economic openness in recipient countries (Fielding & Mavrotas, 2005).
4. For a broader picture of recent aid developments see Gupta, Pattillo & Smita (2006).
5. Fielding & Mavrotas (2005) have documented that the volatility of project (sector), and program (budget) aid differ significantly.
6. The logs eliminate the scale problem present in the series, which would otherwise bias the estimates of Φ downward. For example, given that the absolute level of aid is around one-third of the level of revenue in current exchange rates (Table 1), all else equal, the variances of domestic revenue could then be up to ten times larger than those of aid.
7. Following suggestions by Crowards & Adam (2005), we tested the robustness of our results to changes in aid definitions (gross versus net) and the de-trending methodology. We first reset the parameter λ in the Hodrick–Prescott method from 7 to 100. Second, we applied only first differences to the series instead of using a smoothing technique for de-trending. It turns out that all these estimates of Φ s are quite similar—see Table A2 summarizing Φ s for series in percent of GDP. The detailed results for the alternative denominators are available from the authors on request. Also, it has been argued that (i) the Hodrick–Prescott filter may create spurious serial correlation in de-trended data and (ii) end-period observations have larger mean square errors than observations in the middle of the sample (Cogley & Nason, 1995). We note, however, that series in first differences yield practically identical results as those de-trended with the Hodrick–Prescott filter.
8. This is not a surprising finding. Gupta, Clements, & Tiongson (2004) found that even food aid—which is not included in the aid definition used in this section—is procyclical on average.
9. High, or erratic (or both) levels of commitments to disbursements may reflect a poor record of policy implementation in aid-recipient countries, and this is not being explicitly controlled for in this case. However, our earlier study (Bulir & Hamann, 2003) showed that shortcomings in aid disbursements relative to commitments cannot be explained entirely in terms of compliance with conditionality under IMF-supported programs. Recently, Celasun & Walliser (2005) found

similar results for budgetary aid in eight sub-Saharan countries.

10. Pallage, Robe, & Bérubé (2005) argue that smoothing out the business cycle in low-income countries could be a major contribution of aid.

11. Thus, this aid definition is broader than that used in previous sections. The results for narrowly and

broadly defined aid differ, however, very little as the amount of emergency and food aid is small compared to the GDP shocks.

12. In Bulř & Hamann (2003) we did not take logs, being focused primarily on the absolute size of aid and revenue shocks as relevant for the macroeconomic impact.

REFERENCES

- Arellano, C., Bulř, A., Lane, T., & Lipschitz, L. (2008). The dynamic implications of foreign aid and its variability. *Journal of Development Economics*. doi:10.1016/j.jdeveco.2008.01.005.
- Bulř, A., & Hamann, J. (2006). *Volatility of development aid: From the frying pan into the fire?* IMF Working Paper 06/65. Washington: International Monetary Fund.
- Bulř, A., & Hamann, J. (2003). Aid volatility: An empirical assessment. *IMF Staff Papers*, 50(1), 64–89.
- Bulř, A., & Lane, T. (2004). Aid and fiscal management. In S. Gupta, B. Clements, & G. Inchauste (Eds.), *Helping countries develop: The role of fiscal policy*. Washington: International Monetary Fund.
- Cassen, R., & Associates. (1986). *Does aid work?*. Oxford: Clarendon Press.
- Celasun, O., & Walliser, J. (2005). Predictability of budget aid: experiences in eight African countries. In *Paper presented at the World Bank practitioners' forum on budget support May 5–6, 2005, Cape Town*.
- Cerra, V., & Saxena, S. C. (2005). *Growth dynamics: The myth of economic recovery*. IMF Working Paper 05/147. Washington: International Monetary Fund.
- Cogley, T., & Nason, J. M. (1995). Effects of the Hodrick–Prescott filter on trend and difference stationary time series: Implications for business cycle research. *Journal of Economic Dynamics and Control*, 19(January–February), 253–278.
- Crowards, T., & Adam, C. (2005). *Comments on Bulř and Hamann 'Volatility of development aid: From the frying pan to the fire'*. MAXIMIN (Vol. 2). London: Department for International Development.
- Fielding, D., & Mavrotas, G. (2005). *The volatility of aid*. WIDER Discussion Paper No. 2005/06. Helsinki: UNU-WIDER.
- Griffin, K. B., & Enos, J. L. (1970). Foreign assistance: Objectives and consequences. *Economic Development and Cultural Change*, 18, 313–327.
- Gupta, S., Clements, B., & Tiongson, E. R. (2004). Foreign aid and consumption smoothing: evidence from global food aid. *Review of Development Economics*, 8, 379–390.
- Gupta, S., Pattillo, C. A., & Smita, W. (2006). *Are donor countries giving more or less aid?* IMF Working Paper 06/1. Washington: International Monetary Fund.
- Lensink, R., & Morrisey, O. (2000). Aid instability as a measure of uncertainty and the positive impact of aid on growth. *Journal of Development Studies*, 36, 31–49.
- Lockhart, C. (2005). From aid effectiveness to development effectiveness: Strategy and policy coherence in fragile states. In *Paper prepared for the senior level forum on development effectiveness in fragile states, January 13–14, 2005, London*.
- Birdsall, N. (2004). *Seven deadly sins: Reflections on donor failings*. CGD Working Paper No. 50. Washington: Center for Global Development.
- New York Times (2005). *America's promises*. The New York Times, 28 January 2005.
- OECD (2003). *Harmonising donor practices for effective aid delivery, DAC guidelines and reference series*. Paris: Organisation for Economic Co-operation and Development, Development Assistance Committee.
- Pallage, S., & Robe, M. A. (2001). Foreign aid and the business cycle. *Review of International Economics*, 9, 636–667.
- Pallage, S., & Robe, M. A. (2003). On the welfare cost of economic fluctuations in developing countries. *International Economic Review*, 44, 677–698.
- Pallage, S., Robe, M. A., & Bérubé, C. (2005). The potential of foreign aid as insurance. *IMF Staff Papers*, 53, 453–475.
- Pesaran, H.M., & Pesaran, B. (1997). *Working with microfit 4.0*. Cambridge: Camfit Data Ltd.
- Ramey, G., & Ramey, V. A. (1995). Cross-country evidence on the link between volatility and growth. *The American Economic Review*, 85, 1138–1151.
- Tendler, J. (1975). *Inside foreign aid*. Baltimore: Johns Hopkins University Press.
- Torsvik, G. (2005). Foreign economic aid: Should donors cooperate?. *Journal of Development Economics*, 77, 503–515.
- Treasury, H. M. (2005). *G7 Finance ministers conclusions on development*. London, February 5.
- World Bank (2000). *Small states: Meeting challenges in the global economy*. Report of the Commonwealth 1011 Secretariat/World Bank Joint Task Force on Small 1012 States. Washington: World Bank.

APPENDIX. DATA SOURCES AND TRANSFORMATIONS

Our database covers 76 countries from 1975 to 2003. The data on gross aid disbursements were taken from the publicly available OECD's Development Assistance Committee (DAC) database (<http://www1.oecd.org>). The following series were used: ODA grants, total 201; ODA loans extended, 205; Emergency aid, 216; Development food aid, 213; and Offsetting entries for debt relief, 215. Our narrow definition includes ODA grants, total 201 and

ODA loans extended, 205, while excluding items 213, 215, and 216. Our broad definition includes these items. We tested the robustness of our results also with net aid available from the subscription-based World Bank's World Development Indicators (WDI), code DTO-DAALLDP_1. Commitments and disbursements of long-term loans (excluding IMF disbursement) were drawn from the World Bank's Global Development Finance database (GDF), codes DTCOMDPPGCD and DTDISDLXFCG, respectively. Fiscal data used in the paper—total domestic revenue in

Table A1. *List of countries and sample periods*^a

Country	Years	Country	Years
Albania	1992–2003	Kyrgyz Republic	1993–2003
Algeria	1975–2003	<i>Lao People's Dem. Rep</i>	1975–2003
<i>Angola</i>	1981–2003	Lebanon	1975–2003
Armenia	1994–2003	Lesotho	1975–2003
Bangladesh	1975–2003	<i>Madagascar</i>	1978–2003
<i>Benin</i>	1975–2003	<i>Malawi</i>	1975–2003
Bhutan	1981–2003	<i>Mali</i>	1975–2003
<i>Bolivia</i>	1975–2003	<i>Mauritania</i>	1975–2003
<i>Burkina Faso</i>	1975–2003	Mongolia	1975–2003
<i>Burundi</i>	1980–2003	Morocco	1992–2003
Cambodia	1987–2003	<i>Mozambique</i>	1975–2003
<i>Cameroon</i>	1980–2003	Nepal	1980–2003
<i>Central African Rep.</i>	1980–2003	<i>Nicaragua</i>	1975–2003
<i>Chad</i>	1980–2003	<i>Niger</i>	1975–2003
Colombia	1975–2003	Nigeria	1980–2003
Comoros	1980–2003	Pakistan	1975–2003
<i>Congo, Dem. Rep. of</i>	1980–2003	Papua New Guinea	1975–2003
<i>Congo, Republic of</i>	1980–2003	Paraguay	1975–2003
<i>Côte d'Ivoire</i>	1980–2003	Peru	1975–2003
Djibouti	1980–2003	Philippines	1975–2003
Dominican Republic	1975–2003	<i>Rwanda</i>	1975–2003
Ecuador	1975–2003	<i>Senegal</i>	1975–2003
Egypt	1975–2003	<i>Sierra Leone</i>	1975–2003
El Salvador	1975–2003	Sri Lanka	1975–2003
<i>Ethiopia</i>	1980–2003	<i>Sudan</i>	1975–2003
Fiji	1975–2003	Swaziland	1975–2003
<i>Gambia, The</i>	1975–2003	Syrian Arab Republic	1975–2003
<i>Ghana</i>	1975–2003	Tajikistan	1992–2003
Guatemala	1975–2003	<i>Tanzania</i>	1975–2003
<i>Guinea</i>	1980–2003	Thailand	1975–2003
<i>Guinea-Bissau</i>	1980–2003	<i>Togo</i>	1975–2003
<i>Guyana</i>	1975–2003	Tunisia	1975–2003
Haiti	1975–2003	Turkey	1975–2003
<i>Honduras</i>	1975–2003	<i>Uganda</i>	1975–2003
Indonesia	1975–2003	<i>Vietnam</i>	1981–2003
Jamaica	1975–2003	<i>Yemen, Republic of</i>	1975–2003
Jordan	1975–2003	Zambia	1975–2003
<i>Kenya</i>	1975–2003	Zimbabwe	1978–2003

^a Countries in italics are eligible for debt relief under the HIPC Initiative.

Table A2. *Aid is volatile: never mind the definitions and smoothing techniques*

	All countries	Countries with aid equivalent to at least 50% of revenue
<i>I. Aid definitions (Hodrick–Prescott filter, $\lambda = 7$)</i>		
A. Gross aid, narrow definition (loans and grants)	12.1	5.3
B. Gross aid, broad definition (loans, grants, emergency, and food aid)	12.2	6.2
C. Net aid, WDI definition	13.5	7.7
<i>II. Smoothing techniques (Gross aid; loans and grants)</i>		
A. Hodrick–Prescott filter, $\lambda = 7$	12.1	5.3
B. Hodrick–Prescott filter, $\lambda = 100$	11.5	5.5
C. First difference	11.2	6.3

Source: Authors' calculations.

Notes: Relative Volatility of aid and revenue, in percent of GDP. Results for gross aid and $\lambda = 7$ correspond to Table 1.

local currency—are drawn from the IMF's International Financial Statistics (IFS) and the IMF's regional databases, such as the WETA database for Sub-Saharan Africa. All other series—nominal GDP in local currency and in purchasing power parity terms (PPP), market and PPP-based exchange rates *vis-à-vis* the US dollar, and population—are drawn from the IMF's World Economic Outlook (WEO).

We were able to compile 29 annual observations for 50 countries and 24 annual observations for 18 countries in sub-Saharan Africa, where the revenue series do not begin until 1980 (Table A1). The remaining eight countries are former communist states that started receiving aid only in the early 1990s and whose series are available for the last 9–12 years. Thus, we have a 50-country balanced sample and an unbalanced sample for 76 countries.

We applied the following filters to the universe of aid recipients:

1. Countries were aid recipients during the period under consideration (the minimum number of annual observation is 9 for Tajikistan).
2. To address the small-country bias, only countries with an average population of more than 500,000 were included, eliminating most small island countries (World Bank, 2000).
3. To focus the analysis on countries where aid has some minimal macroeconomic impact, we included only countries where the sample aid-to-GDP ratio exceeds 1%. Thus, we excluded countries that receive either little aid or receive it only sporadi-

cally, such as emerging markets that experienced capital account crises.

4. To concentrate on development aid, we limited our sample to countries with average US dollar GDP per capita incomes below 3,000, which eliminated countries such as Argentina and Brazil.

We transformed the series in the following manner:

1. We downloaded the raw data (aid in US dollars and revenue in domestic currency) and expressed both series in common denominators (percentages of nominal GDP, percentages of PPP GDP, and constant *per capita* US dollars).
2. We took the natural logarithm in order to have both aid and revenue on the same scale.¹²
3. Aid and revenue series were found to be either nonstationary or, in a few cases, stationary around a deterministic trend. Thus, we de-trended the series using the Hodrick–Prescott filter, setting the smoothing coefficient λ at 7 as suggested by Pesaran & Pesaran (1997).
4. We calculated the sample variances of the aid and revenue series, θ^A and θ^R , respectively.
5. A measure of relative volatility was defined as the average of the ratio of these variances, $\Phi = \theta^A/\theta^R$.
6. Relative aid variability was assessed by (i) calculating Φ for each country and (ii) testing the significance of sample averages and medians across countries. Given that Φ is a ratio of variances—estimated with a common number of observations per

country in both the numerator and the denominator—we checked the statistical significance of sample averages using an *F*-test.

7. Aid procyclicality was assessed by the correlation coefficient of de-trended aid and revenue.

In the section titled “Aid and macroeconomic shocks: beyond procyclicality of aid” we focused on that part of GDP variability that can be explained by two proxies of external exogenous shocks: terms of trade and the share

of agriculture in GDP. To this end, we estimated ordinary least squares (OLS) regressions for each country in our sample,

$$\dot{y}_t = \alpha + \beta ToT_t + \gamma A_t + \varepsilon_t,$$

where \dot{y} is the rate of growth of real GDP, *ToT* is the index of terms of trade, *A* is the agricultural output to GDP ratio, and ε is an error term. The fitted values of GDP growth, \hat{y} , were then used in Table 4 in lieu of the actual GDP growth.

Available online at www.sciencedirect.com

