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Aid Absorption and Spending in Africa: A Panel Cointegration Approach

Abstract

This paper focuses on the macroeconomic management of large inflows of foreign aid. It investigates the extent to which African countries have coordinated fiscal and macroeconomic responses to aid surges. In practice, we construct a panel dataset to assess the level of aid 'absorption' and 'spending'. This paper departs from the recent empirical literature by utilising better measures for aid inflows and by employing cointegration analysis. The empirical short-run results indicate that, on average, Africa's low-income countries have absorbed two-thirds of (grant) aid receipts. This suggests that most of the foreign exchange provided by the aid inflows has been used to finance imports. The other third has been used to build up international reserves, perhaps to protect economies from future external shocks. In the long-run, absorption increases but remains below its maximum. Moreover, we also show that aid resources have been fully spent, especially in support of public investment. There is only weak evidence that a share of aid flows have been 'saved'. Overall, these findings suggest that the macroeconomic management of aid inflows in Africa has been significantly better than often portrayed in comparable exercises. The implication is that African countries will be able to efficiently manage a gradual scaling up in aid resources.

JEL Classification: C23, F35, O23, O55

Keywords: Macroeconomic Management, Foreign Aid, Panel Data, Africa

I. Introduction

Foreign aid is often provided with the twin objectives of financing domestic expenditures and increasing the availability of foreign exchange. In Africa's low-income countries, external grants and concessional loans provide crucial resources to support the expansion of public investment programmes – for example, building important socio-economic infrastructure that contributes to fostering economic growth and alleviating poverty. Moreover, these flows provide foreign exchange resources that allow countries to increase imports of capital goods, which stimulate economic output and are often associated with productivity gains.

This paper is mainly concerned with the fiscal and macroeconomic management challenges arising from large foreign aid inflows. For that purpose, we use the analytical framework proposed by Hussain et al. (2009) to investigate whether African countries have pursued a coordinated strategy in terms of their fiscal and macroeconomic responses to large aid inflows. The lack of coordination between the government and the central bank may undermine the effective use of foreign aid resources, often contributing to inflationary pressures, the appreciation of the nominal exchange rate, high interest rates and accumulation of public debt (Buffie et al., 2004).

We construct a new panel dataset for African countries, covering the period 1980-2005. An important emphasis is placed on the definition, source and construction of the main variables. Although the vast literature on the macroeconomic impacts of foreign aid inflows predominantly uses OECD-DAC data on aid, we argue that this is not appropriate. One reason is that donor-reported statistics often overestimate the 'true' amount of aid. For example, costs relating to technical assistance are included in foreign aid statistics even though many of these payments never actually leave the donor country's banking system. Since these activities have

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3 no clear impact on the balance of payments or the fiscal budget, they should not be included in
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5 the analysis. Moreover, off-budgets are not likely to have significant fiscal effects, while
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7 differences in accounting can also lead to data disparities – e.g. calendar versus fiscal year, and
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9 accrual versus cash basis. Therefore, we favour the use of official data from recipient countries
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11 to assess the questions at hand.¹ In this study we use balance of payments data for the
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13 macroeconomic variables and government data for the fiscal variables. The former is reported
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15 in the IMF's Balance of Payments Statistics (BOPS) by the respective central banks, whilst the
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17 latter is reported in the World Bank's Africa Database by World Bank country economists. This
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19 actually entails the construction of two different measures of foreign aid.
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25 This paper also strives to use appropriate panel data methodologies. Despite the popularity of
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27 dynamic panel data (DPD) methods in applied research, these seem to be more suitable for
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29 panels with large N (e.g. countries) and small T (observations through time). For panels that
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31 incorporate both a significant number of cross-sections and annual observations – like this one
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33 – non-stationarity becomes a major concern for inference. Therefore, we use recently developed
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35 methods that have strong foundations in the analysis of time series data, namely, panel unit root
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37 tests, cointegration tests, and efficient estimators for assessing long-run relationships.
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43 The next section provides a brief overview of the literature on the macroeconomic effects of aid.
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45 Moreover, it introduces the analytical framework that provides the background for this study
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47 and presents the few existing empirical results. Section III briefly introduces the empirical
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49 methodologies to be utilised in this study. Section IV explains the construction of the variables,
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51 whereas section V presents the empirical findings. Section VI concludes the paper.
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57 **II. Literature Review**

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60 *The Macroeconomic Management of Aid*

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3 There is a growing literature on the macroeconomic challenges associated with large foreign aid
4 inflows. [White \(1992\)](#) is an important and often cited early contribution. The author critically
5 surveys the debates relating to the impact of aid on domestic savings, the fiscal response, the
6 real exchange rate and ultimately economic growth, thus providing an excellent synthesis of the
7 theoretical and empirical contributions to the topic. The early 2000s witnessed a renewed
8 interest in the topic. The United Nations Millennium Declaration (and the subsequent
9 Millennium Development Goals) provided a development impetus that was quickly followed by
10 promises to increase the availability of external finance to developing countries – in particular
11 to Africa.² Naturally, this led to the revival of many debates concerning the impact of ‘scaling up’
12 aid inflows. The International Monetary Fund took a decisive lead, with publications such as
13 [Isard et al. \(2006\)](#), [Heller \(2005\)](#) and [Gupta et al. \(2006\)](#). These works revisit the main foreign
14 aid debates and provide an overview of current knowledge.

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17 We can subdivide the main issues concerning the macroeconomics of aid into two main areas:
18 (i) the fiscal sphere, which is influenced by recipient governments; and (ii) the monetary and
19 exchange rate sphere, which is usually under the responsibility of central banks. The first
20 incorporates questions about the impact of aid on the size and composition of public spending,
21 domestic revenues, fiscal deficit, debt sustainability and aid dependency.³ This leads to policy
22 decisions such as how much aid the government should spend and whether it should save some
23 of the aid resources (e.g. to smooth the expenditure pattern when resources are scarce). The
24 second area focuses on concerns of exchange rate appreciation, rising price inflation and high
25 interest rates. This often leads to debates about the optimal level of sterilisation (e.g. [Prati et al.,](#)
26 [2003](#)) and effective exchange rate regimes (e.g. [Buffie et al., 2004](#)). Nonetheless, these two areas
27 of interest are interdependent and should be jointly considered. Fiscal decisions crucially
28 depend on macroeconomic circumstances (e.g. the interest rate on domestic public debt), while
29 central bank objectives (e.g. low inflation) are partly influenced by the government’s policy

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3 stance. This interdependence has led to the development of the analytical framework that we
4
5 will now discuss.
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8 9 *Analytical Framework*

10 The starting point of this empirical investigation is the analytical framework proposed by
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12 [Hussain et al. \(2009\)](#). The framework is used to investigate the macroeconomic management
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14 challenges and optimal policy responses to surges in foreign aid inflows. This is a crucial policy
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16 issue for low-income countries, which are considerably aid-dependent and often suffer from the
17
18 volatility and unpredictability of aid flows. Hence, the framework emphasises the need to
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20 coordinate fiscal policy with monetary and exchange rate policy in order to minimise potential
21
22 adverse effects and improve its effectiveness. [Hussain et al. \(2009\)](#) suggest the use of the
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24 following two interrelated concepts: (i) 'absorption', which is defined as the widening of the
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26 current account deficit (excluding aid) due to the aid surge; and (ii) 'spending', which is defined
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28 as the widening of the fiscal deficit (excluding aid) following an aid surge. When we take these
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30 two concepts together, there are four potential scenarios to be considered:
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38 (i) *Absorb and spend aid*. The government spends the extra aid inflow – either through higher
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40 public spending, lower domestic revenue (e.g. cutting taxes), or a mixture of both – while the
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42 central bank sells the foreign exchange in the currency market. The fiscal expansion stimulates
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44 aggregate demand, which in turn contributes to a higher (public and private) demand for
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46 imports. This effect does not create balance of payments problems since the aid inflow finances
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48 the increase in net imports – as more foreign currency becomes available to importers. Hence,
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50 the foreign exchange is absorbed by the economy through the widening of the non-aid current
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52 account deficit ([Gupta et al., 2006](#)). This policy combination leads to aid-financed widening
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54 deficits, while the central bank's balance sheet remains unaltered. However, some real exchange
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56 rate appreciation may take place to enable this reallocation of resources. The choice of exchange
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58 rate regime will affect the mechanism through which the real exchange rate appreciation may
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2
3 occur – nominal appreciation in a ‘pure float’ versus higher domestic inflation in a ‘fixed peg’
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5 (Hussain et al., 2009). This absorb-and-spend combination is often considered to be the ideal
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7 policy response to a surge in aid inflows.
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12 (ii) *Absorb but not spend aid*. The government decides not to spend the aid inflow,⁴ while the
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14 central bank sells the foreign exchange. Foreign aid is thus used to reduce the government’s
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16 seigniorage requirement since it substitutes domestic borrowing in financing the government
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18 deficit (Buffie et al., 2004). Moreover, the central bank sterilises the monetary impact of
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20 domestically financed fiscal deficits (Gupta et al., 2006). This policy scenario usually leads to
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22 slower monetary growth and alleviates inflationary pressures. Hussain et al. (2009) suggest that
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24 this could be an appropriate policy response in countries that have not achieved stabilisation –
25
26 hence facing high domestic deficits and high inflation – or have a large stock of domestic public
27
28 debt. A reduction in the level of outstanding public debt could ‘crowd in’ the private sector (both
29
30 investment and consumption) through its effect on interest rates (Hussain et al., 2009). This
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32 increase in aggregate demand would then feed into higher net imports, which would then be
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34 financed by the additional foreign exchange available in the currency market.
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41 (iii) *Spend and not absorb aid*. The government spends the additional aid inflow (non-aid fiscal
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43 deficit widens), while the central bank allows its foreign exchange reserves to increase. In this
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45 case, the extra foreign exchange is not made available to importers but instead is used to build
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47 up international reserves. This policy response is similar to a fiscal stimulus in the absence of
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49 foreign aid (Hussain et al., 2009). The increase in government spending must be financed by
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51 either: (i) monetising the fiscal expansion (i.e. printing domestic currency), which increases
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53 money supply and therefore inflation; or (ii) sterilising the monetary expansion (by issuing
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55 securities, usually treasury bills), which could lead to higher interest rates and potentially
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57 crowd out the private sector (Hussain et al., 2009). There is no real resource transfer due to the
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59 absence of an increase in net imports. The IMF (2005) argues that this is a ‘common but
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3 problematic response, often reflecting inadequate coordination of monetary and fiscal policies.’
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5 The net effect on the real exchange rate is uncertain: higher (unmet) demand for net imports
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7 contributes to depreciation (via the nominal exchange rate), whilst higher inflation works in the
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9 opposite way.
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14 (iv) *Neither absorb nor spend aid.* The government does not use the additional aid inflow to
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16 widen the non-aid fiscal deficit, while the central bank increases its foreign exchange reserves.
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18 In this scenario, the government ‘saves’ the incremental aid and the availability of foreign
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20 exchange in the currency market is not increased. Once again, this could be a viable (short-run)
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22 strategy if the government needs to retire onerous debts (or smooth volatile aid inflows) and
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24 foreign reserves are at a precariously low level (Gupta et al., 2006). In the absence of a fiscal
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26 expansion, aggregate demand is not affected and there are no pressures on the exchange rate or
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28 domestic prices (Hussain et al., 2009). In the long-run, however, this may not be a politically
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30 viable strategy due to external and domestic pressures.
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36 A final observation is warranted with regard to aid absorption. While the exchange rate regime
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38 may condition the short-term response to aid, in the long-run, countries with different exchange
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40 rate and monetary frameworks may adopt similar policy responses – see IMF (2005). This
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42 supports the main empirical framework proposed by this paper (pooled mean group estimator),
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44 which constrains the long-run impacts to be identical across countries but allows for short-run
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46 heterogeneous effects.
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50 51 52 *Empirical Results*

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54 Hussain et al. (2009) apply the framework described above to five African countries with the
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56 objective of examining their policy responses.⁵ Their methodology requires the choice of two
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58 points in time: a pre-surge period and an aid surge episode. The results suggest that, with the
59
60 exception of Mozambique, foreign aid inflows were not significantly absorbed. In Ethiopia and

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3 Uganda, only 20 and 27 percent of the additional aid was absorbed, respectively. Moreover,
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5 Ghana and Tanzania have not used the extra aid inflow to widen the current account deficit. In
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7 fact, these countries experienced an improvement in the non-aid current account balance. With
8
9 regard to aid spending, the estimate for Mozambique suggests that all aid was 'spent', meaning
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11 that the non-aid government balance deteriorated by the full amount of aid. In Ethiopia,
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13 however, none of the additional aid was 'spent'. In fact, there was an improvement of the non-
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15 aid government deficit, since revenue collection increased by more than the increase in
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17 government expenditures. The conclusion would be that Ethiopia is saving aid resources,
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19 possibly to substitute for domestic borrowing or even to retire public debt. Most of the
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21 additional aid inflows were spent in Tanzania and Uganda, whereas in Ghana most of the aid
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23 resources were saved. As a result of these findings, the usual policy prescription is that African
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25 countries need to significantly improve the management of aid inflows – through better
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27 coordination between the government (e.g. treasury) and the central bank.⁶
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34 Foster and Killick (2006) also follow this approach to explore the consequences of scaling up aid
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36 flows in four African countries: Mauritania, Sierra Leone, Mozambique and Tanzania (the latter
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38 two overlapped with the IMF study). They conclude that aid has been fully absorbed and spent
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40 in Mauritania, whereas in Sierra Leone it has been mostly absorbed and partly spent (54
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42 percent, if debt relief is excluded).
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However, this methodology has a few limitations. For example, the estimates from the
absorption and spending equations will be very sensitive to the point in time in which they are
evaluated. Defining the pre-aid surge and the surge period will be critical for the results and
perhaps the policy conclusions. Moreover, this simple methodology ignores potential dynamic
effects. Absorption and spending may well increase after the surge period (with a time lag).
Finally, one needs to use these concepts with caution, since full 'spending' can be achieved
through a total displacement of domestic revenues, in which case aid flows cause a proportional

decrease in domestic revenues with no increase in government expenditures. The concept does not distinguish between what would be a desired outcome (e.g. increased developmental expenditures), and a potentially perverse effect that increases aid dependency and threatens long-term sustainability. For that purpose, we will also investigate the impact of aid on public investment.

More recently, [Aiyar and Ruthbah \(2008\)](#) have employed a panel econometric approach to investigate these issues in more detail. Their sample consists of annual data for 95 countries covering the period 1970-2004. The aid variable is taken from the World Development Indicators, which is in fact compiled by the OECD-DAC. The authors use a system Generalised Method of Moments (system GMM) estimator to evaluate the level of aid absorption and spending. Table 1 summarises their estimates. Aid absorption is statistically significant in the short-run, with a coefficient ranging for -0.30 to -0.45 . This means that a 1 percentage point increase in the aid-GDP ratio will lead to about a third of a percentage point increase in the non-aid current account deficit (as a share of GDP). The estimates are larger for the African and aid-dependent samples. Moreover, the results for aid spending appear to be stronger than for absorption. This is not an unexpected result, since countries are often criticised for spending more aid than they absorb. The long-run results indicate that aid has a more than proportional effect on the non-aid current account balance and the non-aid government balance. Although there is no impact on the accumulation of international reserves, aid seems to contribute to a modest increase in total domestic investment.

Table 1: Impact of a 1 percentage point increase in the Aid-GDP Ratio

	Full Sample		Africa		Aid Dependent	
	Short-Run	Long-Run	Short-Run	Long-Run	Short-Run	Long-Run
Absorption	0.30***	0.83***	0.41***	1.11***	0.45***	1.13***
Spending	0.56***	1.60***	0.79***	2.14***	0.68***	1.48***
Reserves	0.05	0.05	0.01	0.00	0.06	0.00
Investment	0.14***	0.26***	0.15***	0.26***	0.19***	0.33***

Notes: Aid-dependent countries are those where foreign aid is higher than 10 percent of GDP. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

Source: [Aiyar and Ruthbah \(2008\)](#).

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3 This study will revisit the empirical evidence on aid absorption and spending, with a special
4 focus on low-income countries in Africa. For that purpose we compiled data from several
5 international sources and constructed a new (balanced) panel dataset. Contrary to what is
6 common practice in this field of research, we do not use the OECD-DAC's dataset on aid flows,
7 but instead collect consistent aid data as reported by the recipients. Furthermore, we use
8 alternative panel data methodologies, which we argue are more appropriate to deal with this
9 type of macroeconomic dataset.
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21 **III. Methodology**

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24 This paper uses panel data regression methods to evaluate how African countries have managed
25 foreign aid inflows. We start by using a dynamic panel data (DPD) specification and apply the
26 Blundell-Bond 'system GMM' estimator – as in [Aiyar and Ruthbah \(2008\)](#). The main advantages
27 of these GMM estimators relate to their perceived robustness to heteroscedasticity and non-
28 normality of the disturbances. Moreover, the use of instrumental variables helps address biases
29 arising from reverse causality. However, [Roodman \(2009\)](#) argues that the number (and quality)
30 of instruments generated by difference and system GMM methods can affect the asymptotic
31 properties of the estimators and specification tests. In samples with large T , instrument
32 proliferation can be particularly serious, inducing two main types of problems: (i) overfitting
33 endogenous variables; and (ii) imprecise estimates of the optimal weighting matrix. [Greene](#)
34 [\(2003\)](#) provides another strong criticism. He argues that introducing a lagged dependent
35 variable to an otherwise long-run (static) equation will significantly change its interpretation,
36 especially for the independent variables. In the case of a DPD model, the coefficients on the
37 explanatory variables merely represent the effect of new information, rather than the full set of
38 information that influences the dependent variable.
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Since our dataset includes variables for several African countries over a significant number of
years, we argue that the use of panel cointegration techniques is more appropriate. This is

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3 because the use of panel datasets with these characteristics – large N and large T – presents new
4 challenges to researchers. Panels with a significant temporal dimension are subject to spurious
5 relationships, especially since macroeconomic variables are often characterised by non-
6 stationarity. Cointegration analysis in a panel data setting entails similar steps to those usually
7 employed in time series analysis: (i) unit root testing; (ii) cointegration testing; and (iii)
8 estimation of long-run relationships. The first step requires an assessment of the stationarity
9 properties of the variables. For that purpose, we use unit root tests that assume cross-sectional
10 independence – e.g. Levin et al. (2002), Im et al. (2003), and Choi (2001) – as well as unit root
11 tests that explicitly allow for some form of cross-sectional dependence – e.g. Pesaran (2007).
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25 If the main variables are found to be integrated of order one, then we should use panel
26 cointegration tests to investigate potential long-run relationships. As with unit root tests, some
27 of these tests were developed as extensions of earlier tests for time series data. In this paper we
28 use the cointegration tests proposed by Pedroni (1999, 2004), Kao (1999) and Westerlund
29 (2007).
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39 In the presence of cointegrating non-stationary variables, one would like to efficiently estimate
40 and test the relevant cointegrating vectors. For that purpose, a number of panel estimators have
41 been suggested in the literature. We use the panel dynamic OLS estimator (DOLS) proposed by
42 Kao and Chiang (2000) and the pooled mean group (PMG) estimator for dynamic heterogeneous
43 panels (Pesaran et al., 1999).
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53 **IV. Data**

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55 The data used in this paper was mainly collected from the International Monetary Fund's (IMF)
56 Balance of Payments Statistics (BoPS) and the World Bank's Africa Database. Complementary
57 sources included the United Nations' National Accounts Main Aggregates Database, the IMF's
58 World Economic Outlook (WEO), and the World Bank's World Development Indicators (WDI) –
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3 see Data Appendix. There was a significant effort to construct a balanced panel for all 53 African
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5 countries covering the period 1970-2007. However, data for 1970-1979 is scarce for many
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7 countries, whereas data for 2006-2007 is usually based on estimates or projections. Moreover,
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9 data on aid flows for 2006 often contains outliers due to very large debt relief grants, which
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11 cannot be satisfactorily expunged. Hence, we have built a balanced panel for 1980-2005 for the
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13 macroeconomic variables, while for the fiscal variables we have a balanced panel for 1990-
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15 2005. It should be noted that our aid variables only include grants, due to the lack of data on
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17 concessional foreign loans. Nonetheless, there is a strong argument to separate these since aid
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19 grants and aid loans often have significantly different economic impacts.⁷ Finally, seven
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21 countries had to be excluded from the initial sample. These countries either reached
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23 independence only in the 1990s (Eritrea and Namibia) or lack reliable data (Congo DR, Djibouti,
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25 Liberia, Somalia and Zimbabwe).
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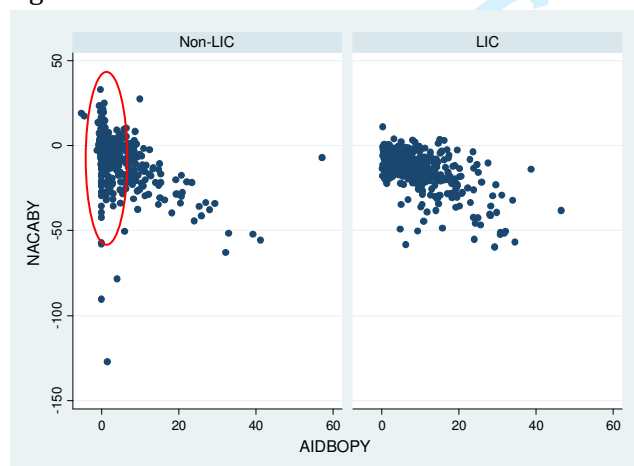
32 The list of variables includes:

33	34	NACABY	Non-Aid Current Account Balance (% GDP)
35	36	AIDBOPY	Aid Grants (% GDP), as reported by the Balance of Payments Statistics
37	38	LTOT	Logarithm of the Terms of Trade
39	40	DRY	Change in International Reserves (% GDP)
41	42	NAGOBY	Non-Aid Government Overall Balance (% GDP)
43	44	AIDGOVY	Aid Grants (% GDP), as reported by the World Bank's Africa Database
45	46	INF	Inflation Rate (CPI, percentage change)
47	48	INVGY	Gross Public Fixed Capital Formation (% GDP)
49	50	BORY	Domestic Financing (% GDP)
51	52		
53	54		
55	56		
57	58		
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Figure 1 and Figure 2 provide pair-wise plots of the main variables of interest. The full sample of African countries is utilised, as well as a sub-sample incorporating low-income countries (LICs) only. The plots confirm the strong negative correlation between foreign aid and the

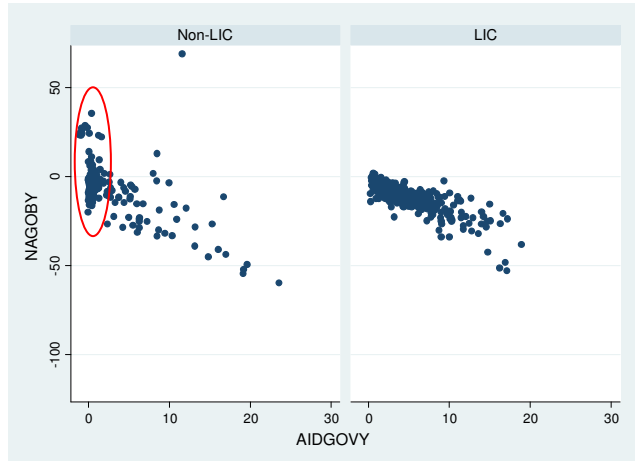
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3 macroeconomic and fiscal balances. This suggests that aid inflows are used, at least to a certain
4 extent, to increase the (non-aid) current account and budget deficits. However, there is an
5 important concern arising from the observation of these graphs. It appears that richer countries
6 may potentially distort the analysis. This is because middle-income countries tend to be less aid-
7 dependent, and therefore the relationship between aid inflows and other economic variables
8 can be significantly weaker. The inclusion of these countries may thus affect the magnitude and
9 significance of the estimated coefficients, leading us to believe that aid absorption and spending
10 is lower than expected. Further plots lead to similar conclusions for reserve accumulation and
11 public investment. Finally, some of the richer countries are (at times) net 'donors', which further
12 complicates the analysis.
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28 Figure 1: Non-Aid Current Account Balances and Foreign Aid



44 Obs.: Excludes Lesotho (LSO)

Figure 2: Non-Aid Government Balances and Foreign Aid



Obs.: Excludes the Republic of Congo (COG)

Table 2 presents pair-wise correlations between the main variables of interest. The results corroborate the decision to exclude middle-income countries from the analysis, as for both macroeconomic and fiscal dimensions the (negative) correlations of the non-aid balances with foreign aid inflows are significantly stronger for low-income countries.

Table 2: Correlations

	ALL		LIC	
	NACABY	AIDBOPY	NACABY	AIDBOPY
1980-2005				
NACABY	1.00		1.00	
AIDBOPY	-0.56	1.00	-0.63	1.00
1990-2005				
NAGOBY	1.00		1.00	
AIDGOVY	-0.72	1.00	-0.83	1.00

For the reasons presented above, this study will continue the analysis for the 25 African low-income countries in the sample. Table 3 presents basic statistics on the main variables.⁸ As expected, both NACABY and NAGOBY have negative means, with fairly low maximums (surpluses). This highlights the importance of aid inflows in balancing these accounts. The average for AIDBOPY is higher than that for AIDGOVY, probably reflecting the presence of 'off-budgets' – i.e. aid flows not recorded in the budget, perhaps due to being implemented by the donor. BORY has a positive (but low) mean value.

Table 3: Basic Statistics

	Macroeconomic Data (1980-2005)					Fiscal Data (1990-2005)					
	Obs.	Mean	SD	Min	Max	Obs.	Mean	SD	Min	Max	
NACABY	650	-12.2	9.6	-59.7	11.1	NAGOBY	400	-11.6	7.4	-53.0	1.9
AIDBOPY	650	7.7	6.5	0.2	46.5	AIDGOVY	400	4.9	3.5	0.2	18.9
LTOT	650	4.7	0.4	2.7	5.8	INF	400	13.4	20.5	-10.9	183.3
DRY	650	-0.5	3.1	-16.0	34.9	INVGY	400	7.6	3.8	1.4	32.2
						BORY	400	0.8	2.5	-6.7	13.8

V. Empirical Results

Panel Unit Roots

We start with the application of panel unit root tests. All test specifications include a deterministic time trend. In the Levin-Lin-Chu (LLC), Im-Pesaran-Shin (IPS) and Fisher-type tests, cross-sectional means are subtracted to minimise problems arising from cross-sectional dependence. The Pesaran test and the versions of the Breitung and Hadri tests used here allow for cross-sectional dependence.⁹ However, this version of the Breitung test requires $T > N$. In the LLC and IPS tests, the Bayesian (Schwarz) information criterion (BIC) is used to determine the country-specific lag length for the augmented Dickey-Fuller (ADF) regressions, with a maximum lag of 3. Finally, the Fisher-ADF and Pesaran's cross-sectionally augmented Dickey-Fuller (CADF) tests include 2 lags.

Table 4: Panel Unit Root Tests

	LLC	IPS	Fisher		Breitung	Hadri	Pesaran	
	t*	W-t-bar	ADF-Pm	PP-Pm	λ	z	t-bar	z
NACABY	-1.20*	-2.56***	0.99**	7.33***	-0.09	16.77***	-1.80	2.76
AIDBOPY	-3.85***	-3.82***	1.49*	7.12***	-1.73**	17.40***	-1.86	2.43
LTOT	-1.09	-2.51***	1.72**	4.87***	-2.10**	19.45***	-1.75	3.03
DRY	-13.25***	-13.87***	4.89***	29.26***	-6.48***	1.68**	-2.98***	-3.58***
NAGOBY	-4.04***	-4.14***	0.88	7.77***	n/a	8.06***	-1.96	1.66
AIDGOVY	-5.44***	-4.19***	3.89***	7.93***	n/a	7.80***	-1.84	2.23
INF	-51.40***	-18.44***	1.65**	6.26***	n/a	6.29***	-0.91	6.85
INVGY	-5.21***	-5.40***	2.47***	6.85***	n/a	6.83***	-1.75	2.68
BORY	-8.53***	-6.90***	1.57*	15.16***	n/a	1.74**	-2.41	-0.60

Obs.: Test results generated by Stata. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

The test results provide mixed evidence on the order of integration of the variables (Table 4).

The LLC test strongly rejects the null hypothesis of unit roots, except for LTOT and NACABY. The

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IPS test rejects the presence of unit roots for all variables. The results for the Fisher-type tests seem to depend on the underlying unit root test chosen. The Phillips-Perron option rejects the null hypothesis for all variables, whilst the ADF alternative presents significantly weaker evidence for some. For example, it cannot reject the presence of unit roots in NAGOBY, and has higher p -values for most variables. The last four columns show the tests that are robust to the presence of cross-sectional dependence. This variant of the Breitung test is only valid for the longer panel ($T > N$). The evidence it provides is mixed, with NACABY appearing to be non-stationary, while the other macroeconomic variables reject unit roots at 5 percent. The Hadri test has a different null hypothesis (stationarity) and provides strong evidence that (at least) some panels have unit roots. This test is an interesting alternative since it challenges the usually strong null hypothesis that all panels have unit roots. Finally, the Pesaran CADF test suggests that all variables have unit roots, except for DRY. The results from the CADF test are robust to the lag structure and specification of determinist components – with the exception of BORY, where a lower lag order (1) suggests that the variable is stationary.

Hence, while the IPS and Fisher-PP test results lead to the conclusion that all variables are stationary, the Hadri and Pesaran tests suggest the opposite (with the exception of DRY for the CADF test). The remaining tests (LLC, Fisher-ADF and Breitung) provide mixed evidence.¹⁰ This observation may lead us to believe that there is some level of cross-sectional dependence affecting the results. Although the cross-sectional averages were subtracted from each series (de-meaning) prior to applying the LLC, IPS and Fisher-type tests,¹¹ there may still be some residual dependence left, which leads to the over-rejection of the null hypothesis of unit roots. Overall, it is fair to conclude that there is (at least) some non-stationarity that needs to be properly addressed.

Cointegration Tests

Despite the fact that (some of) the data is non-stationary, we may still be able to make valid inference if there is a meaningful relationship amongst the variables of interest. This will be the case if we find a linear combination that produces stationary error terms. The table below reports the results from several cointegration tests. The top row describes the variables included in the tentative cointegrating vectors. The Pedroni and Kao tests use the Bayesian information criterion (BIC) to automatically select the appropriate lag length (maximum set to 3). Whilst the Pedroni and Kao tests are based on the residuals of the long-run static regression, the Westerlund test assesses the significance of the adjustment coefficient in the ECM specification. Deterministic time trends are not included in the specifications since these are generally found to weaken cointegration results. This is later supported by their lack of statistical significance in the error correction models. All tests are derived under the null hypothesis of no cointegration.

Table 5: Cointegration Tests

	Statistic	NACABY AIDBOPY LTOT	DRY AIDBOPY LTOT	NAGOPY AIDGOVY INF	INVGY AIDGOVY INF	BORY AIDGOVY INF
Pedroni	Panel- v	0.05	-1.26	-1.04	-0.68	2.22
	Panel- ρ	-3.35***	-9.18***	-2.56***	-0.11	-2.60***
	Panel-PP	-6.58***	-13.69***	-6.86***	-3.06***	-8.60***
	Panel-ADF	-7.12***	-14.02***	-6.89***	-3.55***	-8.05***
	Group- ρ	-2.48***	-7.20***	-0.80	1.34	-1.13
	Group-PP	-8.55***	-15.29***	-8.41***	-3.80***	-9.86***
	Group-ADF	-7.86***	-15.42***	-8.42***	-4.37***	-7.90***
Kao	t	-2.71***	-2.16**	-2.23**	-1.18	-1.93**
Westerlund	Gt	-3.55***	-5.91***	-0.65	0.78	0.96
	Ga	-1.73**	-3.81**	3.97	4.69	3.86
	Pa	-5.20***	-5.58***	0.64	2.13	3.40
	Pa	-5.02***	-6.41***	2.18	2.87	2.86

Obs.: Test results generated by EViews and 'xtwest' Stata module. Panel tests tend to have higher power than Group tests, since pooling increases efficiency. Pedroni's Panel statistics are weighted, as well as (all of) Westerlund's. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

The first column of Table 5 examines a vector of variables that includes the non-aid current account balance (NACABY), foreign aid inflows (AIDBOPY) and the logarithm of the terms of trade (LTOT). With the exception of Pedroni's Panel- v statistic, all tests reject the null hypothesis of 'no cointegration' among the variables. Hence, while unit root tests provided

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3 support for the presence of stochastic trends in the data, cointegration tests suggest that these
4 trends have cancelled each other out – leading to stationary residuals. In practice, this means
5 that these variables have a significant long-run relationship. The second column evaluates
6 whether changes in international reserves (DRY), foreign aid inflows (AIDBOPY) and the terms
7 of trade (LTOT) share a common stochastic trend. Once again, the results strongly suggest the
8 presence of cointegration, but this can be a result of the fact that DRY is a stationary variable –
9 as suggested by most unit root tests.
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20 With regard to the third column, we test whether there is a relationship between the non-aid
21 government balance (NAGOPY), foreign aid inflows (AIDGOVY), and inflation (INF). Here, the
22 four Westerlund statistics and two Pedroni tests do not reject the null. Moreover, the fourth
23 column – which investigates whether public investment (INVGY), aid inflows (AIDGOVY) and
24 inflation (INF) are a cointegrating relation – provides similar results, and so does the last one.
25 Since the fiscal sample is significantly shorter (and in fact $N > T$) it may be that some
26 cointegration tests (especially Westerlund's) have poor power properties. If we set the lag to
27 zero and exclude INF from the fiscal vectors, the majority of Westerlund's tests reject the null,
28 which may highlight the lack of power of the test.
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43 Overall, the results appear to suggest that the variables of interest are cointegrated, which
44 means that we have uncovered meaningful long-run relationships. However, these tests have
45 some limitations. In the presence of cross-sectional dependence/cointegration, the test results
46 may be biased. Moreover, these tests are developed under the assumption that all variables are
47 $I(1)$. If some of the variables are truly stationary (e.g. DRY), inference might be invalid.
48 Nonetheless, the next section may provide further evidence of cointegration if, as expected, the
49 error correction terms are statistically significant.
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Specification and Estimation (Long-Run)

We now use panel data estimation methods to investigate, amongst other things, the impact of foreign aid inflows on the non-aid current account balance and the non-aid government overall balance. Our empirical specifications are similar to [Aiyar and Ruthbah \(2008\)](#), but do not include time-invariant country-specific control variables. Hence we have the following (static) long-run specification:

$$y_{it} = \alpha_i + \beta_1 AIDY_{it} + \beta_2 x_{it} + \varepsilon_{it}$$

where y_{it} includes the non-aid current account balance (NACABY), accumulation of international reserves (DRY), non-aid government overall balance (NAGOBY), public investment (INVGY) and domestic financing (BORY) – all expressed as a share of GDP. $AIDY_{it}$ is the relevant foreign aid variable, whilst x_{it} is a control variable: the logarithm of the terms of trade (LTOT) in the macroeconomic specifications and inflation (INF) in the fiscal specifications. Potential reverse causality between the fiscal variables and inflation is addressed in some of the empirical methodologies utilised. The estimates for β_1 contain information about the impact of aid on y_{it} .¹²

The panel data analysis is conducted for the 25 African low-income countries in our sample. The tables below report the results from a number of alternative estimation methods. The aim is to analyse the robustness of the results to different empirical strategies. We start by applying the popular system GMM (SYS-GMM) estimator in the context of a (fixed-effects) lagged dependent variable model. In comparison with the OLS (OLS-FE) and difference GMM (DIF-GMM) alternatives, this estimator is likely to minimise the bias and inconsistency associated with the presence of a lagged dependent variable. However, given the relatively large T in this study, we argue that a methodology based on the time series properties of the data may provide more efficient estimates of the coefficients of interest. Therefore, we use the dynamic OLS (DOLS) approach and the maximum-likelihood estimates (MLE) for the error correction model. The DOLS methodology entails the estimation of the static long-run relation augmented by leads and

lags of the first-differenced explanatory variables. We chose to include two leads and two lags in the specification, and report robust standard errors. This strategy improves the efficiency of the long-run estimates, but does not provide much guidance on short-run behaviour. Therefore, we also use Pesaran's pooled mean group (PMG) estimator, which uses the panel extension of the single-equation autoregressive distributed lag (ARDL) model. It can be shown that the ARDL has an error correction representation, which is a particularly convenient feature for aiding economic interpretation. We are then able to efficiently estimate the long-run relationships whilst providing information about short-run behaviour (e.g. contemporaneous impacts and speed of adjustment to equilibrium). Another advantage is that while the long-run coefficients are assumed to be homogeneous (i.e. identical across panels), the short-run coefficients are allowed to be country-specific (heterogeneity). This methodology is appropriate for non-stationary panels where N and T are relatively large. For example, Pesaran et al. (1999) apply their approach to two empirical examples with the following dimensions: (i) $T=32$ and $N=24$; and (ii) $T=17$ and $N=10$. We also estimate a mean group (MG) alternative, which allows the long-run parameters to vary, and then test the PMG's poolability assumption through a Hausman test. Finally, we also report the dynamic fixed-effects (DFE) estimator, which assumes short- and long-run parameter homogeneity.

Table 6: Estimation Results for NACABY

	SYS-GMM NACABY	DOLS NACABY	DFE D.NACABY	PMG D.NACABY	MG D.NACABY
C	16.01	12.57	5.86	-3.11***	3.00
AIDBOPY	-0.43***	-0.86**			
LTOT	-3.66*	-3.80			
NACABY(-1)	0.62***		-0.31***	-0.40***	-0.64***
D.AIDBOPY			-0.63***	-0.63***	-0.76***
D.LTOT			0.32	1.14	-0.51
Cross	25	25	25	25	25
Time	25	21	25	25	25
Hausman					0.93
<i>Long-run</i>					
AIDBOPY	-1.13***	-0.86**	-0.76***	-0.62***	-0.96**
LTOT	-3.66*	-3.80	-5.28**	0.31	-2.88

Obs.: Robust standard errors. Coefficients in *italic* are calculated from the estimation output. SYS-GMM generates 327 instruments for 625 observations. The speed of adjustment for SYS-GMM equals one minus the coefficient on the lagged dependent variable (0.38). The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

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5 We start by investigating the relationship between foreign aid inflows (AIDBOPY), the logarithm
6 of the terms of trade (LTOT) and the non-aid current account balance (NACABY) – Table 6. In
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8 the SYS-GMM, the estimated coefficients of the explanatory variables are usually taken to
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10 represent short-term impacts, whilst long-run impacts are approximated by the short-term
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12 coefficient divided by 1 minus the coefficient of the lagged dependent variable. The results
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14 suggest that an increase by 1 percentage point in the aid-GDP ratio leads to an immediate
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16 deterioration of the non-aid current account balance by about 0.4 percentage points.
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20 Alternatively, we could say that about 40 percent of the aid inflow is being absorbed in the
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22 short-run (see Berg et al., 2007). In the long-run, its impact increases to around –1.1 percentage
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24 points (full absorption). The second column reports the dynamic OLS (DOLS) specification,
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26 which only provides information on the long-run. The coefficient is also significantly high (–
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28 0.86), suggesting almost full absorption. The last three columns provide the dynamic fixed-
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30 effects (DFE), pooled mean group (PMG) and mean group (MG) estimates. Whilst the PMG
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32 constrains the long-run coefficient to be identical across countries (homogeneity), the MG
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34 allows the long-run effects to be country-specific (and reports the averaged responses). The fact
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36 that the error correction term (coefficient on the lagged dependent variable) is statistically
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38 significant provides further evidence of the existence of a long-run relationship. Moreover, its
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40 magnitude for the MG (–0.6) suggests that more than half of the equilibrium error is corrected
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42 in one year, whilst for the other methods adjustment towards equilibrium appears to be slower.
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44 The short-run aid impact estimate is –0.6 for the PMG and the DFE, and –0.8 for the MG, whilst
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46 the long-run impacts vary between –0.6 and –1.0. On average, these results suggest that around
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48 two-thirds of foreign aid is absorbed in the short-run, with a modest increase in the long-run.
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50 The SYS-GMM seems to underestimate the short-term impact of aid and overestimate its long-
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52 run effect.
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To test the validity of the pooling assumption and decide on the preferred specification (PMG versus MG) we undertake a Hausman test. The test assesses whether the differences in long-run coefficients are not systematic (null hypothesis), and follows a chi-square distribution with two degrees of freedom. Given that the test does not reject the null (supporting long-run homogeneity), preference should be given to the PMG since it is more efficient (less parameters to estimate). Overall, the terms of trade do not appear to be statistically significant.

Table 7 reports a potential association between foreign aid inflows and the accumulation of international reserves (DRY). Overall, there is little support for a long-run relationship between the variables. In fact, the significance of the error correction term alone (in MG) suggests that DRY is self-correcting, hence stationary, corroborating the conclusions from unit root tests. However, there is some evidence of significant short-run effects. According to the PMG and MG estimates, an increase by 1 percentage point in the aid-GDP ratio will lead to an increase in the accumulation of international reserves of around 0.3 percentage points (a minus sign indicates increase) – i.e. 30 percent of aid is used to build up international reserves. Central banks may adopt this strategy to protect their economies from future external shocks or even to smooth the availability of foreign exchange in an environment of volatile and unpredictable aid inflows. The lack of significance in the short-run coefficient in the DFE equation is probably due to the invalidity of the pooling assumption.

Table 7: Estimation Results for DRY

	SYS-GMM DRY	DOLS DRY	DFE D.DRY	PMG D.DRY	MG D.DRY
C	-5.48	-2.91	-1.34	0.37***	-1.28
AIDBOPY	0.00	0.13			
LTOT	1.05	0.28			
DRY(-1)	0.08		-0.89***	-0.86***	-0.97***
D.AIDBOPY			-0.06	-0.27***	-0.31***
D.LTOT			0.26	-0.64	-0.92
Cross	25	25	25	25	25
Time	25	21	25	25	25
Hausman					0.17
<i>Long-Run</i>					
AIDBOPY	0.00	0.13	0.01	-0.11***	-0.11
LTOT	1.14	0.28	0.18	-0.04	-0.39

Obs.: Robust standard errors. Coefficients in *italic* are calculated from the estimation output. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

We now turn to the second main empirical question (Table 8). In this case, we are trying to uncover the relationship between the foreign aid inflows (AIDGOVY), inflation (INF) and the non-aid government overall balance (NAGOBY). In the short-run, the SYS-GMM, DFE and PMG estimators show that an increase by 1 percentage point in the aid-GDP ratio leads to a proportional deterioration of the non-aid government balance (full spending). Moreover, inflation has a small negative impact on the government balance.¹³ In terms of its long-run impact, aid inflows contribute to a relatively large (more than proportional) widening of the public deficit (around -1.5 percent). This may be due to a possible positive correlation between aid grants (AIDGOVY) and external loans to the government (either concessional or commercial). With regard to inflation, the long-run coefficients are around -0.1. Once again, the Hausman test favours the utilisation of the PMG approach over its less restrictive alternative. The error correction term is statistically significant and relatively large, suggesting a fast adjustment to long-run equilibrium.

Table 8: Estimation Results for NAGOBY

	SYS-GMM NAGOBY	DOLS NAGOBY	DFE D.NAGOBY	PMG D.NAGOBY	MG D.NAGOBY
C	2.92***	1.60	-2.06***	-2.83***	-2.18**
AIDGOVY	-1.03***	-1.74***			
INF	-0.04***	-0.13***			
NAGOBY(-1)	0.35***		-0.63***	-0.61***	-0.81***
D.AIDGOVY			-1.04***	-1.03***	-1.31***
D.INF			-0.03**	-0.06**	-0.06**
Cross	25	25	25	25	25
Time	15	11	15	15	15
Hausman					0.92
<i>Long-Run</i>					
AIDGOVY	-1.58***	-1.74***	-1.50***	-1.32***	-1.74***
INF	-0.06***	-0.13***	-0.06***	-0.02*	-0.03

Obs.: Robust standard errors. Coefficients in *italic* are calculated from the estimation output. Dropping INF altogether makes the MG short-run aid coefficient fall to -1.2, and both PMG and MG long-run aid coefficients to converge around -1.55. The DFE, DOLS and SYS-GMM results are not significantly affected. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

We now assess the impact of foreign aid inflows (AIDGOVY) on public investment (INVGY) –

Table 9. In terms of the short-run impacts, the estimation methods indicate that an increase by 1

percentage point in the aid-GDP ratio leads to an increase of about 0.4 percentage points in the public investment ratio. This impact rises up to around 0.7 percentage points in the long-run. The MG procedure fails to find a robust association between the two variables, potentially due to the fact that when T is small the lagged dependent variable bias leads to the underestimation of their true values. The PMG performs better because this bias is reduced by the pooling assumption, which causes an upward bias (Pesaran et al., 1999). Since it requires the estimation of fewer parameter coefficients, it is less onerous on the degrees of freedom – MG requires the estimation of 48 extra parameters.¹⁴ Pesaran et al. (1999) also note that the MG can be quite sensitive to outliers. Their impact is more severe than on the PMG, probably due to the use of un-weighted averages. The extra column reports the results for the MG excluding the inflation variable, which is insignificant. The results are now in line with the other methodologies.

Table 9: Estimation Results for INVGY

	SYS-GMM INVGY	DOLS INVGY	DFE D.INVGY	PMG D.INVGY	MG D.INVGY	MG D.INVGY
C	2.12***	4.16***	1.75***	1.35***	3.10***	2.31***
AIDGOVY	0.35***	0.65***				
INF	0.01	0.03				
INVGY(-1)	0.47***		-0.39***	-0.39***	-0.57***	-0.51***
D.AIDGOVY			0.37***	0.35***	0.27***	0.36***
D.INF			0.01	0.01	0.02	
Cross	25	25	25	25	25	25
Time	15	11	15	15	15	15
Hausman					2.27	
<i>Long-Run</i>						
AIDGOVY	0.66***	0.65***	0.58***	0.73***	0.17	0.60**
INF	0.02	0.03	0.01	0.04***	0.04	

Obs.: Robust standard errors. Coefficients in *italic* are calculated from the estimation output. Dropping INF altogether makes the PMG long-run aid coefficient increase to about 1. The results for DFE, DOLS and SYS-GMM are not significantly affected. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

Finally, Table 10 looks at the potential impact of foreign aid inflows on domestic financing (BORY). The results do not seem to support a long-run relationship between the variables, since the coefficient in the DFE is barely significant and not statistically significant for the remaining regressions. However, SYS-GMM and DFE estimates suggest a short-run impact of -0.15. This indicates that a small share of aid inflows may be used to reduce domestic public debt. However,

this relation may be concealed (in the PMG and MG) by the time aggregation of the variable. If quarterly data were available, this relationship may have been stronger, as many countries use this strategy to mitigate the impact of unpredictable aid inflows. For example, when aid flows fall below the average, governments borrow to finance planned expenditures; when aid flows are above the average, government repay the loans. Nonetheless, the yearly data does not reveal a considerable impact.

Table 10: Estimation Results for BORY

	SYS-GMM BORY	DOLS BORY	DFE D.BORY	PMG D.BORY	MG D.BORY
C	1.56***	0.96	1.36***	0.90***	0.32
AIDGOVY	-0.15***	0.02			
INF	-0.01	-0.01			
BORY(-1)	0.13		-0.82***	-0.84***	-0.95***
D.AIDGOVY			-0.15**	-0.23	-0.09
D.INF			-0.01	0.03	0.04
Cross	25	25	25	25	25
Time	15	11	15	15	15
Hausman					0.70
<i>Long-Run</i>					
AIDGOVY	<i>-0.17</i>	0.02	-0.13*	-0.02	-0.17
INF	<i>0.01</i>	-0.01	-0.01	-0.01*	0.04

Obs.: Robust standard errors. Coefficients in *italic* are calculated from the estimation output. Dropping INF altogether does not significantly affect the results (even for DFE). The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

Table 11 provides a summary of the impacts of foreign aid inflows on the macroeconomic and fiscal sphere. Starting with absorption, the results suggest that foreign aid inflows have had significant short- and long-run impact on the non-aid current account balance (NACABY). The short-run results for the SYS-GMM are significantly lower than the other empirical methods, possibly due to a downward bias induced by the presence of the lagged dependent variable. Overall, it seems that around two-thirds of the aid flows are used to increase the (non-aid) current account deficit, most likely through making foreign exchange available to domestic importers of goods and services. In the long-run, the impact of aid is significantly higher for the SYS-GMM, which even suggests full absorption. The PMG coefficient is lower than that of the DFE and MG, but on the whole the evidence points to a high level of absorption. With regard to the accumulation of international reserves (DRY), the fixed-effects models do not reveal a

significant short-run impact, while the heterogeneous alternatives suggest that about one-third of the foreign exchange provided by aid transfers is kept as central banks' foreign reserves. In the long-run, only the PMG appears to indicate a statistically significant effect, albeit lower than the short-run impact. In light of the PMG and MG results, and bearing in mind the macroeconomic identity below, there is only weak evidence that aid flows are 'exiting' through the capital account (capital outflows), as the sum of the (short-run) impacts on DRY and NACABY is approximately 1.¹⁵

$$AIDBOPY = \Delta RY - (NACABY + NAKABY)$$

The implication is that short-run aid absorption in African countries is higher than previously suggested by Berg et al. (2007) and Aiyar and Ruthbah (2008). Moreover, aid resources are also found to be used (in the short-run) to build up international reserves, perhaps to strengthen the capacity to weather external shocks.

Table 11: The Impact of Aid Inflows

	SYS-GMM	DOLS	DFE	PMG	MG ¹
<i>Short-run</i>					
NACABY	-0.43***	n/a	-0.63***	-0.63***	-0.76***
DRY	0.08	n/a	-0.06	-0.27***	-0.31***
NAGOBY	-1.03***	n/a	-1.04***	-1.03***	-1.31***
INVGY	0.47***	n/a	0.37***	0.35***	0.36***
BORY	-0.15***	n/a	-0.15**	-0.23	-0.09
<i>Long-Run</i>					
NACABY	-1.13***	-0.86**	-0.76***	-0.62***	-0.96**
DRY	0.00	0.13	0.01	-0.11***	-0.11
NAGOBY	-1.58***	-1.74***	-1.50***	-1.32***	-1.74***
INVGY	0.66***	0.65***	0.58***	0.73***	0.60***
BORY	-0.17	0.02	-0.13*	-0.02	-0.17

Obs.: ¹ The MG results for INVGY exclude inflation. The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

Turning to spending, the empirical results imply that aid inflows have had large short- and long-run impacts on the non-aid government balance (NAGOBY). In fact, aid is fully spent in the short-run. This means that the full amount of aid is used to either (i) boost public expenditures; (ii) reduce taxes; or (iii) a mixture of both. Full spending is not compatible with the hypothesis

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3 that governments 'save' aid resources to pay government debt (either domestic or foreign). In
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5 the long-run, the impact on NAGOBY grows to about 1.5, a more than proportional impact. This
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7 finding is similar to that of [Aiyar and Ruthbah \(2008\)](#). This may either be a symptom of aid
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9 illusion, or the consequence of a positive correlation between aid grants (AIDGOVY) and foreign
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11 loans. With regard to government investment (INVGY), about a third of aid resources are used
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13 to finance public investment programmes (in the short-run), rising to two-thirds in the long-
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15 run. However, the SYS-GMM short-run coefficient is notably higher. Finally, only the fixed-
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17 effects models uncover significant short-run impacts on domestic borrowing (BORY), even
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19 though these are comparatively smaller than those for other variables. There is little evidence
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21 supporting a long-run relationship between aid and domestic financing. These results can be
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23 analysed with the support of the following fiscal identity (budget constraint),
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$$30 \quad AIDGOVY = (INVGY + CY - TY) - (BORY + LY)$$

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33 where *CY* stands for public recurrent spending, *TY* for domestic revenue, and *LY* for external
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35 lending (including concessional loans). Bearing in mind the caveat of potential endogeneity
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37 (although addressed by GMM and DOLS estimators), we may argue that the short-run impact on
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39 public investment is somewhere between one-third and one-half of the aid inflow, leaving about
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41 two-thirds or one-half for either increasing recurrent expenditures or lowering domestic
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43 revenues (e.g. taxes). In fact, recurrent spending is the most obvious candidate, since it often
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45 includes several development-related activities (e.g. health staff wages, textbooks, etc.). In the
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47 long-run, the impact of aid on public investment increases to two-thirds.
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54 Further to these economic observations, the empirical results may also provide some
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56 information about the 'small sample' behaviour of the estimators. As the temporal dimension
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58 (*T*) increases, the downward bias induced by the lagged dependent variable tends to decline
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60 and even OLS-FE may become consistent. However, these performance gains are likely to be

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3 higher/faster for the ECM models. This may explain why, in the macroeconomic sample, the
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5 SYS-GMM short-run coefficients are significantly lower than in the other approaches.¹⁶
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7 However, the SYS-GMM is likely to outperform the ECM approach in shorter panels (small T),
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9 such as the fiscal sample. In fact, the short-run coefficients are now higher than those for the
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11 PMG and MG – with the exception of NAGOBY, which are similar. Hence, it appears that the
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13 downward bias is stronger in the SYS-GMM estimator in the macroeconomic sample ($T=26$),
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15 whilst the bias is larger for the ECM-type models in the fiscal sample ($T=16$). This implies a
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17 trade-off between these different methodologies.
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23 On the whole, our preferred model is the PMG estimator for two main reasons. Firstly, it
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25 appears that its estimates remain robust in the shorter panel, as opposed to those from the MG.
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27 This robustness may be explained by the fact that imposing parameter homogeneity often
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29 causes an upward bias (in absolute terms) in the lagged dependent variable (Pesaran et al.,
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31 1999). Hence, the potential downward bias induced by small T may actually be reduced or even
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33 cancelled out. It can be seen that, in general, the absolute magnitude of the estimated error
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35 correction coefficients follow the sequence $MG > PMG > DFE$. Moreover, the MG is also more
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37 sensitive to outliers. Secondly, the PMG assumptions are more appealing in economic terms. We
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39 allow heterogeneity in the short-run responses and the speed of adjustment to equilibrium,
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41 while constraining the long-run relationships to be the same. This is an appealing middle
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43 ground between the strong pooling assumptions of the DFE (and indeed GMM) estimator and
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45 the flexibility of the MG estimator.
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52 However, we should bear in mind the weaknesses of the empirical analysis presented here. The
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54 results from our estimation strategies (including the system GMM) may be sensitive to the
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56 presence of cross-sectional error dependence. If T was significantly larger than N (which
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58 unfortunately is not our case) we could model and test the cross-correlation of the error terms
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60 through seemingly unrelated regressions (SUR). Nonetheless, we can test the assumption of

cross-sectional independence with the Breusch-Pagan LM test statistic and Pesaran's (2004) CD statistic (Table 12). The LM test follows a chi-square distribution with $N(N-1)/2$ degrees of freedom but requires $T > N$, whilst the Pesaran test is asymptotically normal. For both tests we use the DFE specification presented above. Although the results from the LM statistic strongly reject the hypothesis of cross-sectional independence, the CD statistic provides much weaker evidence of violations. We recall that the LM statistic relies on large T and small N and thus may not perform well when both dimensions are of similar magnitudes. In fact, the computations were just about possible for the macroeconomic sample, where $T=26$ and $N=25$. Thus, we may argue that there is only weak evidence that the assumption of cross-sectional dependence of the error structures is violated by the data, and thus the empirical estimates are not likely to be significantly biased. Furthermore, panel estimators that are robust to cross-sectional dependence are only at an embryonic stage – e.g. see recent literature on 'common correlated effects' estimator (Kapetanios et al., 2009).

Table 12: Cross-Sectional Independence Tests

DFE model	NACABY	DRY	NAGOBY	INVGY	BORY
	AIDBOPY	AIDBOPY	AIDGOVY	AIDGOVY	AIDGOVY
	LTOT	LTOT	INF	INF	INF
Breusch-Pagan LM statistic	395.88***	366.76***	n/a	n/a	n/a
Pesaran CD statistic	1.83*	2.24**	1.69*	-0.89	-0.26

Obs.: Tests results generated by the Stata's 'xttest2' and 'xtcsd' modules. CD test results based on DOLS regressions do not reject independence, except for the INVGY equation at 10 percent, whilst the LM statistic cannot be computed (even for the macroeconomic sample). The asterisks represent significance at the 10 percent (*), 5 percent (**), and 1 percent (***) confidence levels.

Finally, the estimates only represent country averages. Policy responses may vary from country to country, and therefore this analysis does not preclude the use of other methodologies to unveil country-specific macroeconomic responses.

VI. Conclusion

This paper revisits the issue of the macroeconomic management of large aid disbursements. For that purpose, we constructed a new panel dataset to investigate the level of aid 'absorption' and

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3 'spending' in Africa's low-income countries. Our results suggest that, in the short-run, recipient
4 countries have absorbed about two-thirds of the aid inflow, using them to increase the non-aid
5 current account deficit. Moreover, around one-third of the foreign exchange provided by these
6 inflows has been used to build up international reserves. In the long-run, absorption of foreign
7 exchange appears to increase further without reaching its maximum (full absorption). In terms
8 of 'aid spending', recipient countries appear to have fully spent the amount of aid, using it to
9 increase the non-aid government deficit. In particular, a substantial percentage of these inflows
10 went to finance public investment expenditures. There is only weak evidence that some aid
11 flows have been 'saved', i.e. used to substitute for domestic borrowing.
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25 These results challenge some of the conclusions from [Aiyar and Ruthbah \(2008\)](#), namely that
26 short-run absorption is usually low, with aid exiting through the capital account. This may be
27 due to the use of inappropriate measures of aid flows (e.g. donor reported statistics) or the
28 application of a methodology that neglects the time series properties of the data (i.e. non-
29 stationarity). However, we corroborate their result that spending is higher than absorption,
30 which represents an injection of domestic liquidity in the recipient country.
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41 Overall, our findings suggest that the macroeconomic management of aid inflows in Africa has
42 been better than often suggested in comparable exercises. The policy implication is that African
43 countries will be able to effectively manage a gradual scaling up in aid resources. Nonetheless,
44 recipient countries have not followed the textbook 'absorb-and-spend' scenario, often suggested
45 as the optimal policy response to an aid surge. Instead, countries have adopted a slightly more
46 prudent approach: fully spent but only partly absorbed the aid inflows. Central banks have
47 therefore used a proportion of the aid resources to boost international reserves, most likely to
48 protect their economies from external shocks or to smooth the availability of foreign exchange
49 in an environment of volatile and unpredictable aid inflows.¹⁷ Taking into consideration their
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3 external vulnerability, this appears to be a sensible (short-term) strategy. Moreover, the lack of
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5 full absorption in the long-run may also reflect a positive effect of aid on export performance.
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10 Finally, a limitation of this study relates to the potential cross-sectional dependence of
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12 macroeconomic panels. This is a growing area of research and therefore our results could be
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14 revisited once new empirical methodologies become accessible to researchers.
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Appendix A: Data Appendix

The table below presents the main variables and data sources used in this study. Variables originally expressed in local currency units (LCU) were converted to US dollars (USD). The corresponding amount of aid grants is deducted from CAB and GOB to obtain NACAB and NAGOB. Most variables are subsequently divided by GDP, with the suffix Y added to the name of the variable.

Table 13: Data Sources

Variable	Definition	Main Source
AIDBOP	Total Grants (USD)	BOPS
AIDGOV	Total Grants (LCU)	AfDI
BOR	Domestic Financing (LCU)	AfDI
CAB	Current Account Balance (USD)	BOPS
DR	Change in International Reserves (USD)	BOPS
ER	Exchange rate (period average)	IFS
GOB	Overall Budget Balance (LCU)	AfDI
INF	Inflation Rate (CPI, percentage change)	WEO
INVG	Gross Public Fixed Capital Formation (LCU)	AfDI
LTOT	Logarithm of the Terms of Trade Index (2000=100)	WDI
Y	Gross domestic product (USD)	UNStats

Notes: AfDI Africa Development Indicators, BOPS Balance of Payments Statistics, IFS International Financial Statistics, WDI World Development Indicators, WEO World Economic Outlook. Other sources were also used to construct a balanced panel (e.g. Global Development Finance).

Appendix B: Country-Specific Estimates

We now estimate country-level regressions and compare the results with the country-specific estimates reported in IMF (2005) and Hussain et al. (2009). Since the samples for absorption and spending only include 26 and 16 time observations, respectively, these results should be interpreted with caution. These estimates are far less robust than our panel analysis (especially individual DOLS), and should only be taken as indicative. Moreover, the heterogeneous short-run effects from the PMG estimator are also reported.

Table 14: Country-Specific Results (Impact of Aid)

	Absorption (NACABY)					Spending (NAGOBY)				
	IMF	PMG SR	ECM		DOLS LR	IMF	PMG SR	ECM		DOLS LR
			SR	LR				SR	LR	
Ethiopia	-0.20	-0.47	-0.73	-2.50	-0.73	<i>0.14</i>	-0.55	-0.32	-0.68	3.76
Ghana	1.82	-0.03	0.12	-0.25	2.06	-0.07	-0.70	-0.31	-0.38	0.21
Mozambique	-0.66	-1.38	-1.33	-1.60	-1.53	<i>-1.08</i>	-1.51	-1.77	-2.60	-4.70
Tanzania	1.05	-1.55	-1.82	-4.76	-3.57	-0.92	-1.76	-4.26	-2.71	-4.97
Uganda	-0.28	-0.79	-1.22	-1.77	-1.44	-0.75	-1.53	-1.79	-1.86	-2.22

Obs.: The IMF values are recalculated and estimates in italic indicate that the original publication truncated them (i.e. bound them to the interval -1 to 0). The estimates in bold are statistically significant. DOLS regressions include only 1 lead and 1 lag to reduce estimated parameters.

The results appear to suggest that absorption and spending are quite high for Mozambique, Tanzania and Uganda. In fact, most estimates point to (more than) full absorption and spending in both the short- and long-run. The estimates for Ethiopia and Ghana exhibit higher standard errors, hence we are not able to accept them as statistically significant. Nonetheless, most of their values are higher than the estimates of Hussain et al. (2009).

Table 15: Absorption and Spending

	Absorption (%)					Spending (%)				
	IMF	PMG SR	ECM		DOLS LR	IMF	PMG SR	ECM		DOLS LR
			SR	LR				SR	LR	
Ethiopia	20	47	73	100	73	0	55	32	68	0
Ghana	0	3	0	25	0	7	70	31	38	0
Mozambique	66	100	100	100	100	100	100	100	100	100
Tanzania	0	100	100	100	100	92	100	100	100	100
Uganda	28	79	100	100	100	75	100	100	100	100

Obs.: Values are truncated.

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¹ This approach may also have its limitations, as recipients may under-report the total amount of aid. Nonetheless, we still believe that this data is superior to the data reported by donors.

² These were embedded in the 2002 Monterrey Consensus – an outcome of the United Nations International Conference on Financing for Development – and the 2005 Gleneagles G8 summit.

³ For a useful review of this literature see [McGillivray and Morrissey \(2001\)](#).

⁴ It is assumed that neither public spending is increased nor revenues lowered (through tax cuts), which means that aggregate demand remains unchanged. However, a 'balanced budget' approach (i.e. a combination of higher/lower spending and taxes that leaves the non-aid fiscal deficit unchanged) is compatible with this result and can have significant impact on aggregate demand via the fiscal multiplier.

⁵ The same results can be found in [IMF \(2005\)](#).

⁶ [McKinley \(2005\)](#) suggests that countries may not fully spend aid inflows due to a 'fear of inflation', while a 'fear of appreciation' hampers full absorption by the central bank.

⁷ In practice, we allow 'aid loans' to remain lumped with foreign non-concessional loans.

⁸ Not surprisingly, the full sample shows lower absolute averages and higher standard deviations for the aid variables.

⁹ The robust versions of the Breitung and Hadri tests are implemented by the new STATA command 'xtunitroot.'

¹⁰ The LLC and IPS tests require N to be relatively smaller than T , which is not the case here.

¹¹ For each time period, the mean of the series (across panels) is calculated and then subtracted from the observations.

¹² The PMG methodology, for example, requires that foreign aid is exogenous. This may not constitute a major concern since our aid variable only includes aid grants. Aid loans (e.g. IMF lending) tend to be more responsive to domestic conditions (e.g. balance of payments crisis and fiscal imbalances).

¹³ There might be concerns of reverse causality (e.g. higher fiscal deficits causing higher inflation), since only the first two methodologies provide corrections for endogeneity. However, an increase in the non-aid fiscal deficit does not necessarily translate into an increase in money supply. It can be covered by the additional aid inflow, which appears to be the case. Moreover, the coefficients are almost identical to those from SYS-GMM.

¹⁴ The two long-run coefficients of the explanatory variables are now allowed to vary, i.e. $(25-1)*2 = 48$.

¹⁵ Note that an increase in DRY means a fall in international reserves.

¹⁶ We have also estimated OLS-FE and DIF-GMM for the lagged dependent variable model, and the results indicate that these estimators tend to underestimate both short- and long-run impacts in relation to SYS-GMM.

¹⁷ [Buffie et al. \(2004\)](#) suggest that a 'managed float' is the most attractive approach to manage shocks to aid inflows, therefore arguing that African central banks have been correct to intervene in the foreign exchange market.

ISSUE RAISED	MEASURES TAKEN AND COMMENTS
<p>“First to acknowledge more clearly the data limitations. The use of recipient sources for aid data is new and worth reporting, but it introduces other potential problems, since poor countries often under report aid flows, or are unable to measure aid that is unrecorded and outside the budget or private aid flows that still affect the macro economy. In some cases these flows can be significant. Moreover, the impact of debt relief agreements on official measures of current account and fiscal deficit may also be potentially problematical with structural breaks possible many of the reported series. Excluding concessional loans from aid data raise issues that could be explored.”</p>	<p>A footnote was added to acknowledge the data limitations – namely the possible under-reporting by recipients.</p> <p>However: (i) the paper argues that off-budgets do not directly affect fiscal decisions, so we think it is preferable to include only those flows reported by the central government; (ii) private aid flows are not relevant to this study since we focus on official (government-to-government) transfers; (iii) we excluded the year 2006 from the sample due to large debt relief grants; (iv) the paper considers the implication of excluding concessional loans from our aid variable.</p>
<p>“Second, the paper gives the impression that spending and absorption is always the goal. While that may be the case for some donors who want to show a tangible result, in practice money is fungible and many countries over this period were seeking to raise their reserves, and bring their external and domestic balances onto a more sustainable footing. It would be surprising if there was a one to one correspondence between aid and absorption. These could be explored.”</p>	<p>The text was revised to incorporate this observation.</p> <p>It is often argued that the ‘absorb-and-spend’ scenario is the ideal policy response (textbook case). However, the paper also highlights that other scenarios can be desirable, depending on a country’s circumstances: not spending if “the government needs to retire onerous debts (or smooth volatile aid inflows)” or not absorbing if “foreign reserves are at a precariously low level”. In fact, the conclusions point to a more prudent approach, whereby part of the foreign exchange has been used to build up international reserves. Hence, we agree with the comment and believe that the paper reflects this view.</p>
<p>“General comments: The paper is a bit long and would need reducing to between 20-30 pages. There are sections in the paper, which in my view, are irrelevant and could be removed. For example, in the literature review section, too much detail is provided on studies that can be found in the public domain. Surely, any interested reader could locate these papers, as long as the reference is provided. I suggest that the authors summarize the main findings in these papers, in relation to the current study. Along the same lines Table 2 to 5 are not necessary. They can be summarized. Also the numbers of Tables in the paper will have to be reduced. There are 20 tables altogether. One would expect</p>	<p>The length of the paper was significantly reduced. The Literature Review and Methodology sections were significantly summarised, and the number of tables substantially reduced.</p>

between 4-8 tables generally.”	
“The section on the methodology is also long and would need summarizing. Most of these econometrics techniques have been widely exposed so there is no need to describe them into too much detail, albeit an intuition behind their application and how they improve previous technique can be provided. The same applies to the appendix section. Page 14 to 19 should be reduced considerably.”	The Methodology section was dramatically reduced. The respective Appendix was also deleted.
“Data: the data section does not explain how the data was constructed . Also an appendix (table) should give exact detail of the data sources and definition.”	A Data Appendix is now included.
“Results: The title of the paper indicates the use of cointegration technique, yet estimates based on GMM are also derived. I think these results should be removed or the authors should provide a justification as to why these results are included here . Also, with regard to the fiscal variables the period covered is 1990-2005. The authors argue that similar period length is used by Pesaran et al (1999) for a cointegration analysis. However For small T, all of the estimators (group-specific, MG, PMG, and fixed-effects) are subject to the familiar downward bias on the coefficient of the lagged dependent variable (see Pesaran et al 1999 p.630). So perhaps the authors should use an alternative estimator for the fiscal variable as the period covers is short.”	The GMM analysis serves two main purposes: (i) to make this study comparable to Aiyar and Ruthbah (2008), thus highlighting the importance of better data sources; and (ii) to provide a comparative methodology (to panel cointegration), especially in light of the shorter time span (T) in the fiscal regressions. These arguments are included in the text. In fact, the second part of the referee’s comment is the actual justification for including the GMM results.
“There is a related literature that the authors have failed to review. for example the fiscal response literature which has looked at how aid affects fiscal aggregates. It would be a good idea to summarize the findings in these studies, as they are relevant to the present paper.”	A footnote was included to point the reader to a good survey of the fiscal response literature. Although we acknowledge the importance of this literature, we believe that including a summary would not help the flow of the paper.
“It would also be a good idea to strengthen the policy implications of the findings of the paper.”	The Conclusion of the paper was improved in order to strengthen the policy implications.
“The authors mention on Page 41 last paragraph “This may be due...that neglects the time series properties of the data ”. An explanation is warranted for this statement, i.e. in what ways the time series properties improve on the findings of existing studies.”	The paper argues that GMM estimates might be inefficient since non-stationarity and the proliferation of instruments become serious problems when the time dimension is significant ($T > 10$). Hence, we argue that panel cointegration methods are more appropriate for these macroeconomic datasets.

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<p>“Limitations and direction for future research should also be outlined in the conclusion.”</p>	<p>The limitations of this study include the potential cross-sectional dependence of the panel. This is a growing area of research and therefore these results could be revisited once these methods become available to researchers. This is now mentioned in the Conclusion.</p>
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