UNITED NATIONS UNIVERSITY

UNU-WIDER
World Institute for Development Economics Research

Working Paper No. 2011/04

Aid Supplies Over Time

Accounting for Heterogeneity, Trends, and Dynamics

Sam Jones*

January 2011

Abstract

The recent financial crisis has rekindled interest in the foreign aid supply behaviour of bilateral donors. Using the latest data covering the period 1960-2009, this paper examines how such behaviour is related to domestic factors. Based on a simple empirical model, a distinction is made between long-run supply trends and short-run dynamics, which motivates use of error correction methods. Panel econometric techniques are employed that are consistent in the presence of parameter heterogeneity and cross-section dependence. Results support the error correction framework, but point to very substantial heterogeneity between countries. There is also good evidence that donor behaviour continues to evolve over time. As such, past trends in aid supplies are unlikely to provide a good guide to those of the future.

Keywords: foreign aid, bilateral donors, panel data, error correction, heterogeneity

JEL classification: F35, C23, F42

*University of Copenhagen, email: sam.jones@econ.ku.dk

This study has been prepared within the UNU-WIDER project Foreign Aid: Research and Communication.

UNU-WIDER gratefully acknowledges the financial contributions to the research programme by the governments of Denmark (Royal Ministry of Foreign Affairs), Finland (Ministry for Foreign Affairs), Sweden (Swedish International Development Cooperation Agency—Sida) and the United Kingdom (Department for International Development—DFID).

ISSN 1798-7237 ISBN 978-92-9230-367-9

Acknowledgements

Thanks for very useful comments to Channing Arndt, Finn Tarp and the participants of the annual workshop of the Danish Graduate Progamme in Economics (November 2010), as well as the participants of the DIIS Conference on the financial crisis and developing countries (October 2010). The usual caveats apply.

Figures and tables appear at the end of the paper.

UNU World Institute for Development Economics Research (UNU-WIDER)
Katajanokanlaituri 6 B, 00160 Helsinki, Finland

Aid supplies over time: Accounting for heterogeneity, trends and dynamics

1 Introduction

The supply of foreign aid is most often considered from the perspective of recipients. Who receives aid, how much and for what kinds of activities has generated a huge literature, much of it critical. Substantially less analysis has been devoted to quantifying supply-side factors that influence either the long-run level or shorter-run dynamics of aid disbursements made by individual donors. Nevertheless, this question has received renewed attention. The financial crisis of 2008/09 stimulated numerous warnings that aid flows were likely to fall as macroeconomic conditions in donor countries worsened and fiscal costs mounted. For example, Roodman (2008) calculated that after the Nordic financial crisis of 1991, aid from Norway, Sweden and Finland fell by 10 per cent, 17 per cent and 62 per cent respectively (measured from peak to trough and adjusted for inflation). Similar concerns prompted Laurie Garrett of the US Council on Foreign Relations to warn: "As the global marketplace retrenches, there is great danger that the poorest billion people will be abandoned, their hopes for escaping poverty and disease forgotten by all but themselves." (Garrett 2009: 2).

The objective of this paper is to take a careful look at the past relationship between economic conditions in donor countries and their supply of foreign aid. Building on the contributions of previous studies, which show significant relationships between domestic economic factors and aid disbursements, this study addresses some of the main gaps in the literature. In particular, descriptive evidence suggests that aid supply relationships have dynamic properties and are heterogeneous – both between countries and over time. Previously, lack of adequate data has limited our ability to study these characteristics. However, moderately long time series data is now available for at least twenty of the largest OECD donors, covering a maximum span of 1960 to 2009 (yearly). As such, econometric techniques can be used which are consistent in the face of slope heterogeneity and non-stationarity. These are derived from country-specific estimates of aid supply behaviour, which are of interest in themselves.

The rest of the paper is structured as follows: Section 2 motivates the analysis of aid supply behaviour, drawing inspiration from a descriptive analysis of the historical data. It also provides a review of the existing literature on the determinants of aid supplies, indicating gaps that have not been addressed. In response, Section 3 proposes a simple conceptual framework from which an empirical model is derived. Section 4 discusses appropriate panel data methods to test this model, giving particular attention to challenges of parameter heterogeneity, non-stationarity and cross-section dependence.

Section 5 presents the results – encompassing evidence on the long-run trends in aid supplies (§5.1), their dynamics (§5.2) and their interpretation (§5.3). The main findings each represent new contributions to the literature. They include evidence for substantial heterogeneity between countries in their aid supply behaviour, the evolution of donor behaviour over time (e.g., due to the end of the Cold War) and the merit of distinguishing between long- and short-run determinants of aid supplies. These insights suggest that aid supplies are more complex and ambiguous than previously appreciated, thereby reducing the confidence we can have in our ability to predict future trends from those of the past. Section 6 concludes.

2 Background and motivation

A small number of previous studies explore the determinants of either the level of or changes in the aggregate supply of aid. These broadly fall into one of two categories. The first group of studies explore the large and persistent differences in donors' aid effort, typically defined as the foreign aid to domestic income ratio (alternatively, aid supply per capita). These show that much of these differences are attributable to fixed factors including historical relations and cultural preferences. Macroeconomic variables, such as the domestic income level or the government's fiscal position also appear to be important long-run influences on aid supply levels. The findings of these studies are broadly coherent and appear to fit the data well. For example, Round and Odedokun (2004) estimate a panel fixed effects model of the Aid/GDP ratio which is able to account for over 80 per cent of the variation in the ratio around its global mean. Similarly, Chong and Gradstein (2008) employ data from the World Values Survey, as well as standard macroeconomic indicators, to identify factors which affect support for foreign aid within the electorate of donor countries. Based on the their full specification, 65 per cent of the variation in aid disbursements is accounted for by donor fixed effects and a further 31 per cent is explained by their other chosen explanatory variables – donor income, government behaviour and political leaning.

The second category of studies seeks to account for aid dynamics, particularly the response of aid supply to domestic macroeconomic shocks. A leading contribution in this regard is Pallage and Robe (2001), who investigate the cyclicality of aid from both a donor and recipient perspective. This line of enquiry has received renewed attention in the wake of the recent financial crisis, focussing on what tends to happen to aid budgets when donors face financial sector problems. Following Roodman (2008), various studies have quantified both country-specific and cross-country responses to such shocks. Dang *et al.* (2009) estimate that real aid disbursements tend to fall by up to 25 per cent in response to systemic banking crises relative to a 'no crisis' counter-factual. Similarly, Frot (2009) finds that aid tends to decline by 13 per cent in response to a financial crisis, or 5 per cent per annum. Thus, a proximate motivation for the present study is the passage of time. Disbursement data is now available up to and including 2009, which covers a period of substantive macroeconomic shocks in donor countries. This represents an informative window on aid supply behaviour, providing an opportunity to update past estimates of the (domestic) determinants of aid and examine the accuracy of predictions about what would happen to aid in the wake of the crisis.

Despite the above findings, there are remaining gaps in the literature. These directly inform the three main areas where this paper makes a contribution. The first of these is to differentiate between long- and short-run determinants of aid supplies. Both determinants are relevant but for different reasons, meaning that there is no reason to expect them to be the same *a priori*. As indicated by the first category of previous studies, long-run determinants are likely to be rooted in a small number of slowly moving domestic factors. For instance since the early post-war period, when foreign aid became established as an instrument for promoting economic development, donors have made various commitments to donate a fixed share of their national income in aid. For example, as Clemens and Moss (2007) document, the World Bank's Pearson Commission, concluded in 1969, recommended that bilateral donors increase net aid disbursements to 0.7 per cent of gross national product by at least 1980. Exhortations to achieve this figure have been repeated in various multilateral settings such as General Assembly resolutions and the UN's 2002 International Conference on Financing for Development held in Monterrey, Mexico. Recently, aid targets have gained renewed force from public pledges to increase foreign aid (or meet existing aid targets), such as those made at the 2005 Gleneagles G8 and Millennium +5 summits. Admittedly, despite such good intentions, aid targets seem to have operated more as a lobbying tool. Clemens and Moss (2007) argue that, at best, rich countries have agreed to gradually move towards the 0.7 per cent goal, rather than attain it within a specific time frame. Even so, the persistence of the concept of aid supply targets suggest there are deep, long-run domestic influences on aid supplies.

At the same time, short-run aid dynamics are likely to be determined by a host of other factors – domestic or global. Country-specific studies indicate the importance of idiosyncratic local (political) factors in explaining changes in aid supplies. For example, among other things, Fleck and Kilby (2010) find that the War on Terror has driven a large increase in US foreign aid disbursements, but also has reduced the weight given to needs in the allocation of aid to core recipients. This echoes the cross-country work of Boschini and Olofsgand (2007), who find that the end of the Cold War led to a significant global reduction in bilateral aid supplies, but also that donors were not equally affected by these geopolitical events. Recent global trends may also weaken the impact of short-run domestic factors on aid supplies. The Paris Declaration, for example, identifies improvements in the delivery of aid as critical for enhancing aid effectiveness, thereby suggesting that recipient- as opposed to donor-country circumstances should drive aid disbursements.

The previous point signals the second contribution – taking heterogeneity between countries and over time seriously. Past studies studies typically employ (static) fixed effects panel estimators, imposing a restriction of homogeneous slope parameters. A brief review of the historical behaviour of bilateral aid flows suggests this assumption may be strong which has implications for the consistency of econometric results (see Section 4). Figures 1 to 4 plot real bilateral aid flows by country in billions of USD, grouping donors by size (see Appendix B for details on variables and data sources). They indicate very substantial differences in aid behaviour between countries, in terms of both absolute levels and trends. For example, while some donors have consistently increased their aid budgets (e.g., Norway), others display prolonged episodes of either cuts or surges in real disbursements (e.g., Italy; Finland). Country-specific studies also remark on the 'individuality' of specific donors. For instance, Bertoli *et al.* (2008) highlight the distinct behaviour of Italian aid disbursements compared to its peers, as well as the heterogeneous time series behaviour of aid disbursements (to GDP) across donors. Similarly, Hallet (2009) identifies large differences between donors in the extent (if any) to which they cut aid in response to a domestic recession, in turn suggesting that results for the 'average' donor should be interpreted with care.

The figures confirm substantial short-run heterogeneity in terms of responses to macroeconomic shocks. Corresponding to the financial crisis, virtually all countries in the sample faced a severe economic slowdown in 2008 and 2009. However, while some of the smaller donors cut aid disbursements, this was not the case for most of the larger donors.[1] In fact, many of these countries continued to increase disbursements in real terms. As the five largest donors account for around 65 per cent of total bilateral aid (compared to less than 2 per cent represented by the smallest five), 2009 saw a real increase in total bilateral aid of around 14 per cent (or 0.13 log points).

Additionally, the figures indicate that aid is unlikely to be mean reverting for most countries; or, in the minimum, it is highly path-dependent. Ignoring potential heterogeneity, if aid is not a stationary process then it is unclear whether standard fixed effects (within) estimators, which rely on variation around a unit-specific mean for identification, capture anything meaningful (Smith 2001). Even if the variables exhibit cointegration, then results must be interpreted with care in order to differentiate between long-run and dynamic parameters. Consequently, the time series properties of the data must be investigated in order to establish the suitability of chosen empirical techniques.

To underline this point, the dynamic properties of aid are expected to be material due to the way in

[1] Although some of the recent resilience in aid flows may be due to increases in aid to fragile states such as Iraq and Afghanistan, this does not appear to be a single determining factor. For example, aggregate net aid figures for 2008 excluding disbursements to to Iraq, Egypt, Israel increased by 5.6 per cent versus 9 per cent before these exclusions. (Country-specific disbursement data is not available for 2009).

which aid decisions are made. As noted early on by Mosley (1985), aid outflows are dependent on government budget processes which are both path dependent and temporally lagged – i.e., aid disbursements in year t largely reflect the information set and budget allocation at $t-1$. As a result, aid flows are likely to exhibit state dependence, meaning that past realizations of aid have a direct and independent effect on current realizations. Multi-year aid commitments and long-term diplomatic relationships, in which aid often plays a role, also suggest state dependence may be material, meaning that serial correlation of (estimated) error terms cannot be dismissed as only a problem for the standard errors. Despite the relevance of including dynamics, many previous studies propose static models for aid supply behaviour. Where studies include a lag of the dependent variable in the explanatory model (e.g., Boschini and Olofsgand 2007; Mold *et al.* 2010), a significant coefficient bounded between zero and one typically is found, supporting the state dependence thesis. Thus, the third contribution of this paper is to address the time series properties of the data in a rigorous and consistent way.

Before proceeding, some disclaimers are necessary. This paper does not address questions regarding where aid is allocated or whether it is effective.[2] Thus, no assumptions are made about how changes in aggregate aid supplies are likely to affect recipient countries or sectors. Additionally, no attempt is made to analyse trends in aid supplied by non-DAC donors (such as China and India), philanthropic organizations, vertical funds (e.g., The Global Fund) or multilateral institutions. These are only excluded for reasons of clarity and length, not because of irrelevance.

3 Conceptual framework

Taking guidance from the previous section, it is helpful to start with a clear conceptual framework for donor aid supply decisions. The core assumption of the proposed model is that, over the long-run, donors seek to meet a target level of real aid. This target largely reflects various long-run or fixed factors, as described in the literature (see Section 2). Nevertheless, the aid target is allowed to vary over time, for example being subject to a time trend as well as certain macroeconomic factors. Although the chosen target can be understood as a stabilizing force or attractor in aid supply decisions, there is considerable scope for fluctuation around the target due to random error as well as unanticipated macroeconomic events. These lead countries to deviate temporarily from the target supply ratio. However, in the event of a deviation from the aid target at time $t-1$, adjustment toward the target is expected to occur in time t but is likely to be incomplete and is potentially subject to new shocks. These assumptions are not chosen for their convenience. A somewhat similar approach is found in Mosley (1985), who postulates that while donor countries may have a "desired" level of foreign aid giving, which reflects domestic incomes and perceptions of aid quality, actual disbursements will deviate from this level due to local budgetary pressures and the behaviour of other donors.

The heterogeneity and time-varying nature of long-run aid targets is explicitly embedded in the proposed model, as is the possibility for short-run variation around these trends. Aid targets are set on a country-specific basis and include time-varying components, denoted by the vector z, and a unit-specific trend. For now, the aid target will remain in general form, denoted by the function $\tilde{\theta}_i(z_t, t)$. Consequently, a very simple model for actual real net disbursements, denoted by $\tilde{a}$, for country i at time t is:

$$\tilde{a}_{it} = \tilde{a}_{i,t-1} \left(\frac{\tilde{\theta}_i(z_t, t)}{\tilde{a}_{i,t-1}} \right)^{\alpha_i} \cdot \tilde{\epsilon}_{it} \tag{1}$$

where it is assumed that $\alpha \geq 0$, and $\tilde{\epsilon}$ represents an unknown general error term, about which no

[2] For a recent empirical analysis of the aggregate long-run evidence see Arndt *et al.* (2010).

assumptions currently are made. Note that the model encapsulates two special cases of aid supply behaviour. If $\alpha = 0$ then aid supplies follow a random walk and the proposition that they are driven by a long-run target does not hold. If $\alpha = 1$ then aid supplies are always equal to the target plus error.

In order to take the model to the data, some transformations and elaborations are necessary. Taking logs, such that $a \equiv \ln(\tilde{a})$, yields a dynamic linear specification:

$$a_{it} = (1 - \alpha_i)a_{i,t-1} + \alpha_i \theta_i(z_t, t) + \epsilon_{it} \tag{2}$$

which, in turn, can be stated in error correction form:

$$\Delta a_{it} = \alpha_i \Delta\theta_i(z_t, t) - \alpha_i[a_{i,t-1} - \theta_i(z_{t-1}, t-1)] + \epsilon_{it} \tag{3}$$

Next, it is necessary to make some assumptions about the nature of the aid target $\theta_i(z_t, t)$ and the error term. With respect to the former, a simple linear specification is chosen that incorporates country-specific fixed effects and a quadratic time trend. Namely:

$$\theta_i(z_t, t) = \mu_i + \gamma_i y_{it} + \delta_{i1} t + \delta_{i2} t^2 \tag{4}$$

which in the case of $\gamma_i = 1$ is equivalent to a time-varying target aid to income ratio. With respect to the error term, much of the recent literature concerning the impact of the financial crisis on aid supplies can be understood as attempts to isolate factors which lead donors to vary aid disbursements over the short-term. In equation (3) such factors are hidden in the error term. Making them explicit, one can assume that the (log) error term is a linear function of additional variables, denoted by the vector x plus mean zero random error. Giving this a dynamic structure yields: $\epsilon_{it} = \sum_{j=0}^{J} x'_{i,t-j}\beta_j + \eta_{it}$. Thus, re-specifying equation (3) to incorporate these two extensions we have a more general error correction model:

$$\Delta a_{it} = \lambda_{1i} + \lambda_{2i} t + \lambda_{3i}\Delta y_{it} - \alpha_i[a_{i,t-1} - \{\mu_i + \gamma_i y_{it} + \delta_{i1}(t-1) + \delta_{i2}(t-1)^2\}] + \sum_{j=0}^{J} x'_{i,t-j}\beta_j + \eta_{it} \tag{5}$$

where the first three parameters are composites from previous equations, i.e.: $\lambda_{1i} = [\mu_i + \alpha_i(\delta_{i1} - \delta_{i2})]$, $\lambda_{2i} = 2\alpha_i\delta_{2i}$ and $\lambda_{3i} = \alpha_i\gamma_i$.

A few aspects of equation (5) are worth highlighting. Filling a gap in the literature (see Section 2), there is now an explicit distinction between long-run and short-run determinants of aid supplies. Long-run determinants are given by the levels terms inside the square brackets, which represent the deviation of actual aid from its target at $t - 1$. Aside from error correction, short-run movements around this relation are driven by the difference term, the vector x and random noise. This distinction between the timing of effects is important because unconstrained linear estimates of equation (5) or its autoregressive distributed lag equivalent would yield coefficients that are composites of the long-run and short-run parameters. State dependence of aid is incorporated via a lag of real aid on the RHS. Also, changes in GDP potentially exert an immediate impact on aid supplies, via the first difference term, as well as a lagged impact via changes to the target level of aid at $t - 1$. Thus, if a financial shock is included as an element of x, then this specification allows one to distinguish between direct effects and indirect effects via income or other elements of x.

4 Empirical methods

Before turning to the results, it is necessary to reflect on appropriate methods. As already indicated, there are at least three material challenges – (i) heterogeneity in relationships between countries and over time; (ii) the time series nature of the data; and (iii) covariance between units over time. These are discussed in turn.

The potential existence of heterogeneity in economic relations is often discussed in cross-country work, leading to warnings against using pooled estimation results to inform country-specific policy. While this is correct, heterogeneity is not merely a secondary concern. It has implications for the choice of estimation strategy. Lee *et al.* (1997) show that standard panel estimators incorporating fixed effects and/or instrumental variables will be inconsistent under slope heterogeneity. Similarly, Haque *et al.* (1999) show that neglect of heterogeneity and dynamics generates misleading inferences about the determinants of savings behaviour across countries.[3] For moderately large panels in both dimensions N and T, a useful approach is the mean group estimator of Pesaran and Smith (1995), which is the simple average of unit-specific OLS coefficients and is an unweighted version of the random coefficients approach due to Swamy (1970). Although this approach is consistent under a wide range of conditions, it may be inefficient and biased in small samples. Indeed, Mark and Sul (2003) warn against the small sample fragility of single equation estimators, arguing in favour of aggregate (pooled) panel approaches. These concerns are relevant here as the number of countries is modest (N=20), meaning that cross-section averages may be vulnerable to outliers. Consequently, rather than making a prior decision, the empirical approach will be to compare results from a range of panel estimators that make differing homogeneity assumptions (to be tested) and which take identification from either the within- or between- dimensions of the data. Additionally, the stability of coefficients over time will be examined by running estimates on different temporal subsets of the data.

With respect to the second challenge, in order to avoid spurious results it must be established whether the levels relations (equation 4) are stationary. This is necessary due to the nature of the real aid and GDP series. Table 1 explores this further, giving results of country-specific ADF unit root tests (including a constant and trend term) for these two variables. The cells of the respective columns report the probability associated with the null hypothesis that the variable contains a unit root. The vast majority of these are greater than 0.10, meaning that the null cannot be rejected. The final two rows of theses columns implement the simple panel unit root tests proposed by Maddala and Wu (1999), where the null hypothesis remains that *all* panels contain a unit root. These remain insignificant at the 5 per cent level, indicating that these series are not (individually) trend stationary.[4]

Nevertheless, following equation (4), it is plausible that a linear combination of the variables on the form of $a_{it} = \theta_i(z_t, t)$ is stationary. This hypothesis of cointegration can be tested in various ways, depending on the degree of homogeneity imposed on the long-run relations between countries. In the spirit of Engle and Granger (1987), a two-step approach is adopted. First, the long-run relations are estimated, testing for cointegration at the panel- and unit-specific levels. Second, the dynamic model (equation 5) is run, inserting lagged values of the estimated residuals from the first step as the error correction term. The potential existence of cointegation, however, raises the additional problem of the appropriate number of cointegrating relations. *A priori* one expects that national income is (strictly) exogenous to aid. Nevertheless, to correct for any potential bias from the endogeneity of GDP, a Dynamic OLS (DOLS) estimator is used (Stock and Watson 1993), which is asymptotically unbiased and normally distributed even in the presence of endogenous regressors. Here, this amounts to adding $k = 1$ leads and lags of the

[3]As Pesaran and Smith (1995) argue: "aggregating or pooling dynamic heterogenous panels can produce very misleading estimates ... [meaning] that the common assumption of homogeneity in dynamic models is far from innocuous." (p.102). For further discussion of appropriate estimators in heterogeneous (dynamic) panel settings also see Coakley *et al.* (2006); Pesaran (2006).

[4]This finding is not unique. Bertoli *et al.* (2008) report that unit root tests applied to various measures of the Aid/GDP ratio are unable to reject the null of of a unit root. Note that a variety of (more sophisticated) panel unit root and cointegration tests are also available; however, these are generally not applicable as the panels are unbalanced and the number of panels is modest.

differenced RHS variable (real GDP) to the specification, estimated either on a panel basis (see Mark and Sul 2003) or separately for individual countries.

The third challenge refers to correlation between units in cross-section, which would violate the classical regression assumption of unit independence. Although time dummies are often used to address such effects, a simple and preferable alternative is the common correlated effects (CCE) approach of Pesaran (2006). For the mean group estimators this involves augmenting the model specification with (weighted) averages of the dependent and independent variables and is consistent under both heterogeneity and cross-sectional dependence. This approach is advantageous as it economizes on degrees of freedom and avoids the problem of missing time dummies that can arise in the unbalanced panel case (as here). Moreover, these additional regressors can be added to aggregate panel specifications, possibly allowing for different degrees of homogeneity in the factor loadings.

5 Results

5.1 Long-run trends

Table 2 presents results for estimates of the long-run relationship between aid and the proposed aid target equation. Columns (1) to (4) take identification from within-group variation, based on standard fixed effects panel estimators. Column (1) is the basic specification with two-way fixed effects (time and country), column (2) adds the panel dynamic OLS (PDOLS) regressors, column (3) includes additional CCE regressors, and column (4) incorporates both the PDOLS and CCE terms. The results are broadly similar, especially for the coefficients on the log. level of real GDP which capture the income elasticity of aid. However, introduction of the CCE terms, which are inverse population-weighted cross-section averages of aid and GDP at time t, alters the direction and magnitude of the time coefficients both with and without the PDOLS terms. In the former case, these dynamic terms are jointly insignificant whilst all other terms remain essentially unchanged. Hausman tests to compare these different estimates (not reported) reject the null that there are no significant differences between column (4), assumed to be consistent but potentially inefficient, and each of the estimates in columns (1) to (3). However, this is largely due to differences in sample size. When the same estimates are restricted to the smaller subsample as per column (4), one cannot reject the Hausman test null for the panel CCE estimates of column (3), implying they are consistent. Therefore, this is the preferred pooled estimator.

Moving to the mean group (MG) estimators, the DOLS terms are also redundant once the CCE terms are already added (not reported). Thus, only results for the MG estimators including the CCE terms are reported, the unweighted version of which is the preferred estimator from the Monte Carlo simulations of heterogeneous panel data described in Coakley *et al.* (2006).[5] Both the weighted and unweighted results (columns 5 and 6), broadly support the pattern of the within estimators. For the 'average' country one finds a strictly positive income elasticity of aid. The mean aid term remains highly significant, suggesting that cross-section dependence is material in the sense that the contemporaneous aid efforts of other donors affects individual aid decisions. An important difference however, is that the quadratic time trend has shifted to an inverted-U shape, indicating the possibility of downward bias from the pooled estimates due to slope heterogeneity (as per Lee *et al.* 1997).

The MG estimates confirm very substantial heterogeneity between countries, shown visually in Figures

[5] Following these authors and Pesaran (2006), a consistent non-parametric estimator of the asymptotic variance of the unweighted MG estimator is used here as follows: $Var(\hat{\beta}_i) = \sum_{i=1}^{N}(\hat{\beta}_i - \bar{\beta})^2/[N(N-1)]$

1 to 4. The Swamy estimator (column 5) incorporates a natural Hausman-type test of a null hypothesis of slope coefficient homogeneity between countries, which is easily rejected ($\chi^2_{114} = 10840$). Table A.I summarises the country-specific OLS estimates (each incorporating the CCE terms). Three main points stand out. First is the variability in the overall goodness-of-fit of the specification between countries, given by the R-squared statistic, ranging from under 60 per cent in the cases of Belgium and Italy to over 95 per cent for the Nordic donors, among others. This is revealing in itself. A stronger goodness-of-fit is indicative of more stable and, thus, predictable aggregate aid disbursements viewed retrospectively over the long-run, which is likely to have a first order relation to the variability of disbursements at the country-level.[6] Second, the estimated income elasticities of aid span a very wide range, being negative or insignificantly different from zero in numerous cases (e.g., UK and Italy) to positive and significant in others (e.g., Ireland, Sweden). Third, the quadratic time trends also differ substantially, not only in size but also in their overall direction. For some of the larger donors the shape of the trend is U-shaped, reflecting a declining long-run trend to real aid (especially as a share of GDP) which has only been reversed very recently. Simply put, long-run tendencies in aid supplies are extremely heterogeneous, supporting the application of the Pesaran and Smith (1995) MG estimator.

It remains to determine whether these estimates are spurious. Considering the non-stationarity of both aid and GDP at the country-level, tests for cointegration must be applied. Although debate persists regarding the most appropriate of these, at the panel-level the computationally straightforward Dickey-Fuller (DF) tests set out in Kao (1999) are employed and reported in Table 2.[7] The preferred DF_γ statistics reject the null hypothesis of no cointegration for all the estimators excluding those which do not adjust for common effects (i.e., columns 1 and 2). Nevertheless, considering the finding of material cross-country heterogeneity, it is meaningful to examine cointegration on a country-by-country basis, based on the underlying equations used to derive the MG results (column 5, Table 2). Three different tests are summarised in the final four columns of Table 1. The first is based on Johansen's vector error-correction model and identifies the number of cointegrating equations (CEQs) by minimizing the Hannan and Quinn information criterion (Gonzalo and Pitarakis 1998).[8] Second, the stationarity of the residuals estimated from the country-specific long-run equations are tested using individual Dickey-Fuller tests; relevant t-statistics are reported, t_R. Third, cointegration is verified from an error correction representation where the table reports the t-statistic, t_E, on the lagged error correction term in a simple form of equation (5). The final column of the table reports the number of times that the null of cointegration is rejected from these three tests.[9] The vast majority of countries reject at least two of the tests (and only one country, Spain, none of them), confirming the overall message that the long-run equation estimates are not spurious, at least once the CCE terms are included.

[6]The poor performance of Italy as a donor has been remarked elsewhere (e.g., Bertoli *et al.* 2008). There are also interesting correspondences between the ranking of countries according to the regression R-squareds and the Center for Global Development's Commitment to Development Index see `http://www.cgdev.org/section/initiatives/_active/cdi/`.

[7]For more advanced treatment of cointegration tests in the panel context see Persyn and Westerlund (2008); Banerjee (1999). Due to the unbalanced nature of the present dataset, however, tests proposed by these authors cannot by implemented in a straight-forward manner. For instance, the group-mean tests developed by Westerlund (2007) generally reject the null hypothesis of no cointegration for a non-zero fraction of the panel when the dataset is restricted to a balanced subset of panels. Results available on request.

[8]This approach is used as it least sensitive to the relatively small number of observations available for certain countries; thus fewer countries have 'missing' results compared to alternative tests based on the Johansen procedure.

[9]Asymptotic critical values for the two t-statistics are $t_R < -3.8738$ and $t_E < -3.7782$ based on the methods set out in MacKinnon (1996) and Ericsson and MacKinnon (2002) respectively, calculated using software available on MacKinnon's personal webpage `http://econ.queensu.ca/faculty/mackinnon` that takes into account the number of cointegrating variables, deterministic terms and the quadratic time specification.

5.2 Short-run dynamics

Table 3 reports alternative estimates of the dynamic model, based on the error correction representation given by equation (5). Following the two-step procedure, estimated residuals from alternative long-run estimates are employed as the error correction terms (lagged). Results from a variety of different estimators are reported in order to verify the degree of sensitivity to pooled versus MG estimation, as well as to the use of residuals (error correction terms) derived from the range of results reported in Table 2. Variables employed to represent short-term 'shock' influences on aid disbursements follow the existing literature (see Section 2). For instance, Dang *et al.* (2009) find a significant relationship between aid disbursements and the government fiscal balance, unemployment rates and banking crises. Various CCE-type terms are also added – namely, the average (log.) growth rates of upper and lower income countries, the contemporaneous cross-section average change in aid disbursements and the percentage point change in the share of countries in the globe with competitively elected legislatures ('democracies').

The chosen specification includes only one variable in lagged form, the error correction term. Thus, all shock terms enter at time t only. This is primarily to conserve degrees of freedom, particularly for the estimators derived from country-specific estimates. To account for potential serial correlation in errors at the panel level, however, column (1) of Table 3 employs a Prais-Winsten panel estimator which adjusts for panel-specific autocorrelation and contemporaneous cross-panel correlation.[10] This specification employs the residuals estimated from the preferred long-run pooled estimates (Table 2, column 3) to define the error correction term and incorporates both 5-year period and country dummies. Objections may be raised, however, that this will be inconsistent if changes in GDP (ΔGDP) are endogenous. Consequently, panel instrumental variables techniques are employed – column (2) runs a two-stage least-squares within estimator, where ΔGDP is instrumented by its second and third lagged levels. To address both omitted dynamics and endogeneity concerns, column (3) runs the Arellano-Bond GMM estimator (Arellano and Bond 1991), which incorporates one lag of the dependent variable (not reported; highly insignificant) and treats ΔGDP as endogenous. Columns (4) to (6) apply the MG estimators described previously – column (4) is the Swamy weighted estimator and defines the error correction term from the residuals derived from the estimates in column (5) of Table 2; column (5) is the unweighted MG estimator, where the error correction term is generated from the residuals from the averaged estimates in Table 2 column (6); column (6) repeats this estimator but uses residuals derived from the country-specific long-run equations, thereby more fully accounting for heterogeneity in these relations.

The results are broadly comparable. For the majority of coefficients, excluding the error correction terms, the estimates are well within sampling variation (95 per cent level). The error correction terms are highly significant in all specifications, with a t-statistic of over ten in many cases. This confirms the merit of the conceptual framework developed herein. Nevertheless, point estimates of the speed of error correction are sensitive to the empirical approach employed. For example, where allowances are made for greater heterogeneity between countries (e.g., column VI), the 'average' speed of error correction appears to be larger than in the pooled estimates of columns (1) and (2). Although the majority of estimates for the shock variables retain the same sign and approximate magnitude, they are often insignificant, implying there is no unambiguous relationship between changes in aid and these contemporaneous macroeconomic events (including the GDP growth rate). In some columns, aid appears to be positively related to the share of non-aid government spending in GDP (elasticity of around 0.7), but this is not consistently significant across estimators. The cross-section average change in aid is highly significant and close to one in all estimates. This points to material peer aid effects, as found elsewhere (e.g., Mosley 1985; Round and Odedokun 2004), further supporting the relevance of directly addressing cross-unit covariance in the estimation strategy. Lastly, the two instrumental panel estimators (columns

[10] Implemented in Stata v11.1 via the `xtpcse` command, with options `corr(psar1) np1`.

2 and 3) do little to alter the overall insight, but rather carry very large standard errors.

Most importantly, the results point to substantial heterogeneity between countries in aid supply decisions. Indeed, the test for coefficient stability across units is rejected (based on the Swamy estimator in column IV; $\chi^2_{209} = 348.03$). Table A.II, which summarises the country-specific estimates of the short-run model, shows large differences across the estimated coefficients in terms of both their magnitude and sign. Critically amongst these, the speed of error correction differs by a factor of around three (e.g., USA = 0.25; Denmark = 0.83) and is insignificantly different from zero in three cases (Portugal, Italy and Switzerland). The estimated partial dynamic effect of a banking crisis on aid disbursements also exemplifies the extent of slope heterogeneity. It is insignificant in most cases (at the 5% level), but significantly negative in only two cases – Norway and Finland – for cutting aid in response to domestic banking problems in the 1990s.

To get a further sense of the extent of this heterogeneity, Table 4 estimates the same dynamic model for different data subsets – namely, the pre- and post-Cold War period (columns 1 and 2); specific decades (columns 3 and 4); and larger and smaller donors (columns 5 and 6). Due to the smaller number of observations available for each subset, the MG estimators cannot be used. Thus, the Prais-Winsten panel estimator is employed (as per column I, Table 3), but in light of the heterogeneity in dynamic relations, the error correction term derived from the country-specific long-run estimates (column 6, Table 3) is employed. Despite use of this pooled estimator, the results give further credence to the extent of heterogeneity in aid supply dynamics. This applies between groups of countries and between different time periods, and is evident in the variation across columns in the coefficient estimates and regression summary statistics. In keeping with Boschini and Olofsgand (2007), the end of the Cold War is reflected in substantive changes in the determinants of foreign aid. Before 1991 the model performs relatively poorly, with few coefficients significantly different from zero. After 1991, however, aid appears to be more systematically affected by macroeconomic events and there is a significant positive relationship between changes in aid and changes in the global share of democracies. One interpretation of this shift is that during the Cold War, foreign aid was used by some donors as a geo-political tool to support pro-Western regimes. Following the fall of the Berlin Wall this motive no longer held; rather, donors became more selective in their choice of recipients, often using aid as a tool to promote democratic rule. Even so, the idea of two historical regimes in aid may be overly simplistic. Columns (3) and (4) of the table also suggest material differences between the 1990s and 2000s, with the most recent years showing a moderate trend increase in aid but weaker error correction and a lower overall model fit (R-squared).

Comparing across groups of larger and smaller donors, further differences are apparent. For example, smaller donors appear to be more sensitive to average changes in global governance than are larger donors. The average larger donor shows a somewhat slower pace of error correction and greater sensitivity to changes in domestic GDP. Also, only the disbursements of smaller donors tend to be cut during domestic banking crises, controlling for contemporaneous changes in macroeconomic indicators. However, this appears to be driven principally by events in the 1990s (see column 3), but is not apparent in any other time period. Drilling deeper, this result is likely to reflect the specific effects of the Nordic banking crisis, discussed in Roodman (2008), as both Norway and Finland report significant negative coefficients on the bank crisis dummy variable from the underlying country-specific estimates (Table A.II).

5.3 Interpretation

What are we to make of these findings? As found in other settings (e.g., Haque *et al.* 1999; Lee *et al.* 1997), the results confirm that a neglect of dynamics and heterogeneity can lead to inconsistent and misleading conclusions about cross-country behaviour. This is made plain in Table A.III, which reports alternative estimates of the determinants of the level of aid on the form of equation (2). Columns (1) to (3) are static regressions, allowing for differing degrees of heterogeneity. Note that estimates in column (2) broadly replicate findings from previous studies (e.g., Dang *et al.* 2009), being a static fixed effects regression. Columns (4) to (6) include a dynamic term, again allowing for differing degrees of heterogeneity. Inferences about aid supply behaviour are highly dependent on the estimator chosen. Many variables that appear significant in the static regressions with slope homogeneity imposed (columns 1 and 2), lose significance when one allows for slope heterogeneity (column 3) and/or dynamics (columns 4 to 6). In the latter estimates, consistent estimates of the speed of dynamic adjustment also requires that heterogeneity is addressed. The findings of this paper demonstrate that dynamics and heterogeneity are both material, meaning that only the MG results (column 6) are likely to be consistent.[11] Also, despite the moderate sample size (in dimension N), the MG results appear not unduly affected by outliers, as is evident from a comparison of the mean and median coefficient estimates from Tables A.I and A.II

An additional finding, not directly apparent from levels regressions, is the merit of differentiating between long- versus short-term influences on aid supplies. This distinction reflects the non-stationarity of aid and is naturally incorporated in the conceptual framework proposed in Section 3. In all but a few cases, the error correction representation finds strong empirical support. Nevertheless, the specific parameters of this model vary substantially, pointing to fundamental heterogeneity in aid supply behaviours in terms of both long- and short-run parameters. Indeed, compared with previous studies, the present results are substantially more ambiguous precisely due to the dominance of heterogeneity in both N and T dimensions. This is a tangible example of where the use of 'average' results to inform about expected behaviour at the country-level would be misleading. However, this is not to say that 'average' parameter estimates are redundant. The first point is that they must be estimated consistently, which means that standard panel estimators are unlikely to be reliable. Secondly, 'average' results must be interpreted carefully – i.e., as convenient ways to describe (true) parameter distributions that span a wide range.

With these points in mind, it is useful to reflect on how our preferred results alter our understanding of aid supply behaviour, particularly the response to domestic shocks. Taking the main coefficients from column (6) of Table 3 as the preferred estimates of the average past response to domestic economic conditions, an interesting pattern emerges. Figure 5 plots the expected dynamic path of aid supply occurring after a simulated set of shocks to macroeconomic aggregates at time t=0 and t=1, followed by a 5 year recovery. The timing and magnitude of the shocks are chosen to loosely replicate some of the larger shocks to real variables observed in response to the crisis (e.g., an initial shock in 2008, worsening in 2009). Critically, the figure shows a large divergence between the path for actual aid and that of the target, which refers to the long-run relation. The former is both smoother and more moderate than the latter, capturing the fact that the estimated long-run target immediately 'absorbs' the full magnitude of shocks. Short-term influences on aid, including the error correction parameter, modify the extent of immediate cuts to aid. In the present case, they temporarily push real disbursements upward as the share of spending in GDP rises (e.g., due to automatic stabilizers and the contraction of GDP). Thus, it takes two periods after the shock for actual aid to be materially lower than its base value and the direction of error correction remains consistently downward, taking around 4 periods for actual aid to bottom out

[11] The results in column (6) of Table A.III are comparable to those of columns (5) and (6) of Table 3. The latter results, however, distinguish between long- and short-run parameters, are based on the two-step procedure and include CCE terms.

after the initial shock. In sum, this indicates that although initial aid supply responses to negative shocks may be moderate, 'full' adjustment can be large and occurs over a much longer period.

6 Conclusion

This paper has taken advantage of increasingly rich time series data about bilateral supplies of foreign aid. Building on the existing literature, a principal contribution was to take into account heterogeneity between donors, differences between long and short term response factors and the non-stationary nature of the data. In doing so, it has been established that an error correction model for aid supplies is well supported in the data for most countries. This means that bilateral aid supplies have broadly followed long-run trends, rooted in fixed and slow-moving factors, but have also shown substantial short-run variation. At the same time, heterogeneity both between countries and over time is substantial. Thus, where feasible, country-specific estimates of aid supply behaviour are to be relied upon in place of pooled panel estimators.

Two more specific lessons also stand out. First, there is evidence that aid supply behaviours continue to evolve over time (on average). During the Cold War, bilateral supplies of aid were comparatively insensitive to domestic macroeconomic events or global governance conditions. Since 1991, short-run changes in aid appear to be more responsive both to improvements in global democracy and to changes in domestic macroeconomic conditions. The first decade of this century also marks differences with the 1990s (on average), including a trend increase in aid and the absence of any systematic direct supply response to domestic banking crises. This leads to the second lesson. Previous studies have been too confident in their ability to predict aid supplies, in many cases forecasting a drastic and rapid reduction in aid in response to the present financial crises. To date, neither the average nor aggregate aid volumes have fallen as expected. To a certain extent this is broadly consistent with the present results, which would predict a lagged but more persistent response (fall in aid) operating through macroeconomic aggregates and the error correction mechanism. However, given the fundamental heterogeneity in the historical data, one must be sceptical of our ability to use the past to predict the future.

On a more positive note, the cautious nature of these findings does not inevitably lead to pessimistic conclusions. Distinct differences between donors is evident in both long-run trends and short-run dynamics. Thus, the kind of analysis undertaken here can be used to make comparisons between donors and advocate against poor performance or unpredictable behaviour (as shown by Italy). Also, the capacity of donors to change their aid supply behaviour over time can be seen in a positive light. The moderate and declining success in explaining short-term aid dynamics, particularly in recent years, may signal that aid is becoming less responsive to domestic factors than in the past. If so, this could have positive implications for aid predictability at the aggregate level. Consequently, the research agenda remains open as new and better data becomes available. In particular, as the number of observations for individual countries increases, country-specific models that combine donor and recipient behaviours will need to be elaborated.

References

Arellano, Manuel and Bond, Stephen (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *Review of Economic Studies*, **58**(2), 277–97.

Arndt, Channing, Jones, Sam, and Tarp, Finn (2010). Aid, growth, and development have we come full circle? *Journal of Globalization and Development*, **1**(2), article 5.

Banerjee, Anindya (1999). Panel data unit roots and cointegration: An overview. *Oxford Bulletin of Economics and Statistics*, **61**(0), 607–29.

Beck, T.H.L., Clarke, G., Groff, A., Keefer, P., and Walsh, P. (2001). New tools in comparative political economy: The database of political institutions. *World Bank Economic Review*, **15**(1), 165–176. Database update December 2009.

Bertoli, Simone, Cornia, Giovanni Andrea, and Manaresi, Francesco (2008). Aid effort and its determinants: A comparison of the Italian performance with other OECD donors. Working Papers Series wp2008-11, Universita' degli Studi di Firenze Dipartimento di Scienze Economiche.

Boschini, Anne and Olofsgand, Anders (2007). Foreign aid: An instrument for fighting communism? *The Journal of Development Studies*, **43**(4), 622–648.

Chong, Alberto and Gradstein, Mark (2008). What determines foreign aid? the donors' perspective. *Journal of Development Economics*, **87**(1), 1–13.

Clemens, Michael A. and Moss, Todd J. (2007). The ghost of 0.7 per cent: origins and relevance of the international aid target. *International Journal of Development Issues*, **6**, 3–25.

Coakley, Jerry, Fuertes, Ana-Maria, and Smith, Ron (2006). Unobserved heterogeneity in panel time series models. *Computational Statistics & Data Analysis*, **50**(9), 2361 – 2380.

Dang, Hai-Anh, Knack, Steve, and Rogers, Halsey (2009). International aid and financial crises in donor countries. Policy Research Working Paper Series 5162, The World Bank.

Engle, Robert F and Granger, Clive W J (1987). Co-integration and error correction: Representation, estimation, and testing. *Econometrica*, **55**(2), 251–76.

Ericsson, Neil R. and MacKinnon, James G. (2002). Distributions of error correction tests for cointegration. *Econometrics Journal*, **5**(2), 285–318.

Fleck, Robert K. and Kilby, Christopher (2010). Changing aid regimes? U.S. foreign aid from the cold war to the war on terror. *Journal of Development Economics*, **91**(2), 185–197.

Frot, Emmanuel (2009). The consequences of financial crises on aid. Technical report, Stockholm: Stockholm School of Economics.

Garrett, Laurie A. (2009). *The Future of Foreign Assistance Amid Global Economic and Financial Crisis: Advancing Global Health in the U.S. Development Agenda.* Council on Foreign Relations Press.

Gonzalo, Jesus and Pitarakis, Jean-Yves (1998). Specification via model selection in vector error correction models. *Economics Letters*, **60**(3), 321–328.

Hallet, Martin (2009). Economic cycles and development aid: What is the evidence from the past? ECFIN Economic Brief 5, European Commission's Directorate-General for Economic and Financial Affairs.

Haque, Nadeem Ul, Sharma, Sunil, and Pesaran, M. Hashem (1999). Neglected heterogeneity and dynamics in cross-country savings regressions. IMF Working Papers 99/128, International Monetary Fund.

Kao, Chihwa (1999). Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics*, **90**(1), 1–44.

Laeven, Luc and Valencia, Fabian (2010). Resolution of banking crises: The good, the bad, and the ugly. IMF Working Papers 10/146, International Monetary Fund.

Lee, Kevin, Pesaran, M Hashem, and Smith, Ron (1997). Growth and convergence in multi-country empirical stochastic solow model. *Journal of Applied Econometrics*, **12**(4), 357–92.

MacKinnon, James G (1996). Numerical distribution functions for unit root and cointegration tests. *Journal of Applied Econometrics*, **11**(6), 601–18.

Maddala, G S and Wu, Shaowen (1999). A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics*, **61**(0), 631–52.

Mark, Nelson C. and Sul, Donggyu (2003). Cointegration vector estimation by panel dols and long-run money demand. *Oxford Bulletin of Economics and Statistics*, **65**(5), 655–680.

Mold, Andrew, Prizzon, Annalisa, Frot, Emmanuel, and Santiso, Javier (2010). Aid flows in times of crises. Paper presented to the conference on development cooperation in times of crisis and on achieving the MDGs, IFEMA convention centre (Madrid).

Mosley, Paul (1985). The political economy of foreign aid: A model of the market for a public good. *Economic Development and Cultural Change*, **33**(2), 373–93.

Pallage, Stephane and Robe, Michel A (2001). Foreign aid and the business cycle. *Review of International Economics*, **9**(4), 641–72.

Persyn, Damiaan and Westerlund, Joakim (2008). Error-correction-based cointegration tests for panel data. *Stata Journal*, **8**(2), 232–241.

Pesaran, M. Hashem (2006). Estimation and inference in large heterogeneous panels with a multifactor error structure. *Econometrica*, **74**(4), 967–1012.

Pesaran, M. Hashem and Smith, Ron (1995). Estimating long-run relationships from dynamic heterogeneous panels. *Journal of Econometrics*, **68**(1), 79–113.

Roodman, David (2008). History says financial crisis will suppress aid. Global Development: Views from the Center.

Round, Jeffery I. and Odedokun, Matthew (2004). Aid effort and its determinants. *International Review of Economics & Finance*, **13**(3), 293–309.

Smith, Ron P. (2001). Estimation and inference with non-stationary panel time-series data. Paper prepared for the RC33 Conference, Cologne October 2000, Department of Economics, Birkbeck College, London.

Stock, James H and Watson, Mark W (1993). A simple estimator of cointegrating vectors in higher order integrated systems. *Econometrica*, **61**(4), 783–820.

Swamy, P A V B (1970). Efficient inference in a random coefficient regression model. *Econometrica*, **38**(2), 311–23.

Westerlund, Joakim (2007). Testing for error correction in panel data. *Oxford Bulletin of Economics and Statistics*, **69**(6), 709–748.

A Appendix: Additional tables

Table A.I: Country-specific long-run estimates, summary

Country	Obs.	R^2	GDP log	Time	$Time^2$	Aid mean	GDP mean
AUS	50	0.81	1.58	-0.09***	0.00*	0.24	1.38
AUT	49	0.66	-0.98	0.14	-0.00**	0.27	1.84
BEL	50	0.49	5.81***	-0.14***	0.00***	0.61***	-3.53***
CAN	50	0.92	-0.94	-0.01	-0.00***	1.08***	4.03***
CHE	44	0.98	1.24*	0.12***	-0.00***	0.45***	-1.45*
DNK	44	0.97	-0.74	0.08**	-0.00***	-0.18	3.17***
ESP	30	0.76	13.56	0.17	-0.00	-0.86	-19.27*
FIN	48	0.94	4.35***	0.20***	-0.00***	1.72***	-8.16***
FRA	50	0.71	3.54***	-0.00	0.00	0.55***	-5.35***
GBR	50	0.83	-2.10*	-0.12***	0.00***	0.26	2.86***
IRL	36	0.96	4.46***	0.28***	-0.00***	-0.04	-11.54***
ITA	50	0.57	-0.29	0.51	-0.00	4.82***	-17.09***
JPN	50	0.89	0.72	0.10**	-0.00**	0.02	-1.31
LUX	26	0.99	1.65	0.45***	-0.01***	-0.09	0.96
NLD	50	0.93	0.52	0.05**	-0.00***	0.27	1.03
NOR	50	0.99	3.60***	-0.01	-0.00***	0.82**	1.81**
NZL	49	0.78	2.00**	-0.02	0.00	0.37*	-0.01
PRT	30	0.85	9.94***	0.22	-0.01*	5.20***	-7.59
SWE	50	0.96	6.38***	0.01	-0.00***	0.40	1.06
USA	50	0.62	0.87	-0.10***	0.00***	0.60*	-0.47
Mean			2.76	0.09	-0.00	0.83	-2.88
Median			1.61	0.06	-0.00	0.38	-0.24
St.dev			3.90	0.18	0.00	1.52	6.67

significance: * 0.1, ** 0.05, *** 0.01

Notes: columns report the underlying country-specific (single equation) parameter estimates from which the mean-group estimator given in Table 2 column (6) is derived; R^2 refers to the R-squared of each regression; summary statistics refer to the vector of estimated parameters for each variable.

Table A.II: Country-specific short-run estimates, summary

Country	R^2	L.EC	ΔGDP	ΔSpend	ΔUnemp.	Av. ΔAid	ΔDemoc.	Bank crisis
AUS	0.42	-0.54***	3.39**	1.15	2.35	0.37	0.36	0.03
AUT	0.49	-0.21**	-9.35**	0.43	-29.06	2.67***	6.64*	-0.27
BEL	0.53	-0.25**	-2.94***	0.46	-6.09*	0.16	-1.49**	0.07
CAN	0.49	-0.25*	0.88	-3.60*	-1.76	1.72***	-0.96	-0.07
CHE	0.58	-0.34	-1.12	-1.21	5.82	0.21	-1.68	0.01
DNK	0.50	-0.82***	-1.33	-0.05	1.76	-0.32	-0.31	0.07
ESP	0.49	-0.51**	0.05	1.83	-5.60	0.65	3.36	0.41
FIN	0.53	-0.41***	4.38	2.74**	5.21**	1.54***	-0.83	-0.14*
FRA	0.54	-0.93***	7.79**	0.16	8.20	0.61	2.97	0.25**
GBR	0.58	-0.76***	-1.78	-1.48**	0.57	0.44	-1.10	-0.10
IRL	0.59	-0.51***	-1.47	0.56	-2.82	-0.20	-0.13	-0.16
ITA	0.36	0.18	4.68	4.99	28.28**	2.32	-7.15**	0.09
JPN	0.55	-0.62***	1.92	-0.38	41.26***	1.39***	0.67	0.08
LUX	0.88	-1.35***	4.17**	0.30	4.96	0.11	-2.15	0.03
NLD	0.39	-0.47***	-2.44	-0.20	-4.95	-0.06	-1.90*	0.11
NOR	0.57	-0.39***	2.33	-0.13	-2.37	0.37	0.48	-0.18***
NZL	0.67	-0.55**	-0.95	1.15	-0.92	0.70	1.44	-0.05
PRT	0.68	-0.05	-8.32*	2.11	-17.84**	1.55	1.27	0.12
SWE	0.62	-0.56***	4.42**	1.87***	5.29*	1.88**	3.78*	0.05
USA	0.39	-0.26***	3.91*	2.27	-1.18	0.57	0.43	-0.03
Mean		-0.48	0.41	0.65	1.56	0.83	0.18	0.02
Median		-0.49	0.46	0.44	-0.17	0.59	0.12	0.03
St.dev		0.33	4.31	1.79	14.36	0.86	2.81	0.15

significance: * 0.1, ** 0.05, *** 0.01

Notes: columns report the underlying country-specific (single equation) parameter estimates from which the mean-group estimator given in Table 3 column (6) is derived; selected variables shown; R^2 refers to the R-squared of each regression; summary statistics refer to the vector of estimated parameters for each variable.

Table A.III: Static and dynamic levels regressions, 1960-2009

	(1) RE b/se	(2) FE b/se	(3) MG b/se	(4) FE b/se	(5) GMM b/se	(6) MG b/se
L.Aid				0.72***	0.43***	0.18***
				(0.07)	(0.16)	(0.06)
GDP (log)	1.14***	2.00	1.89	0.49	1.87***	1.64*
	(0.14)	(1.41)	(1.48)	(0.34)	(0.61)	(0.87)
Spend / GDP	6.12***	6.74**	3.85*	1.57*	4.89*	3.65*
	(2.14)	(2.39)	(2.04)	(0.87)	(2.53)	(2.09)
Save / GDP	3.71*	3.47	-1.98	0.39	2.21	-1.72
	(2.16)	(2.46)	(1.99)	(0.65)	(1.89)	(1.88)
Unemployment rate	-0.04*	-0.03	-0.01	-0.02*	-0.00	-0.00
	(0.03)	(0.04)	(0.06)	(0.01)	(0.02)	(0.04)
Democracies (%)	-0.22	-0.05	-1.62**	-0.18	-0.29	-1.15
	(0.75)	(0.88)	(0.71)	(0.23)	(0.37)	(0.84)
Bank crisis (dummy)	0.15*	0.12	0.09	0.03	0.03	0.04
	(0.08)	(0.08)	(0.08)	(0.04)	(0.05)	(0.05)
Time	-0.02	-0.07	0.05	-0.02	-0.09**	0.03
	(0.04)	(0.09)	(0.08)	(0.02)	(0.04)	(0.09)
$Time^2$	0.00	0.00	-0.00	0.00	0.00**	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-10.16***	-20.62	-18.86	-4.59	-20.48***	-17.38
	(1.87)	(16.55)	(17.94)	(3.98)	(7.29)	(10.95)
N	773	773	773	763	742	763
R2		0.46	0.88	0.77		0.89
Chi2	168.5		39.7		404.4	117.4

significance: * 0.1, ** 0.05, *** 0.01

Notes: dependent variable is the log. of net bilateral aid; columns (1) to (3) are static panel regressions estimated respectively by random effects, fixed effects, and the mean-group estimator (Pesaran and Smith 1995); columns (4) to (6) add a lag of the dependent variable and are estimated respectively by fixed effects, Arellano-Bond GMM, and the mean-group estimator; all standard errors are based on robust estimates of the variance-covariance matrix.

Source: author's estimates, see Appendix B for variable definitions

B Appendix: Dataset description

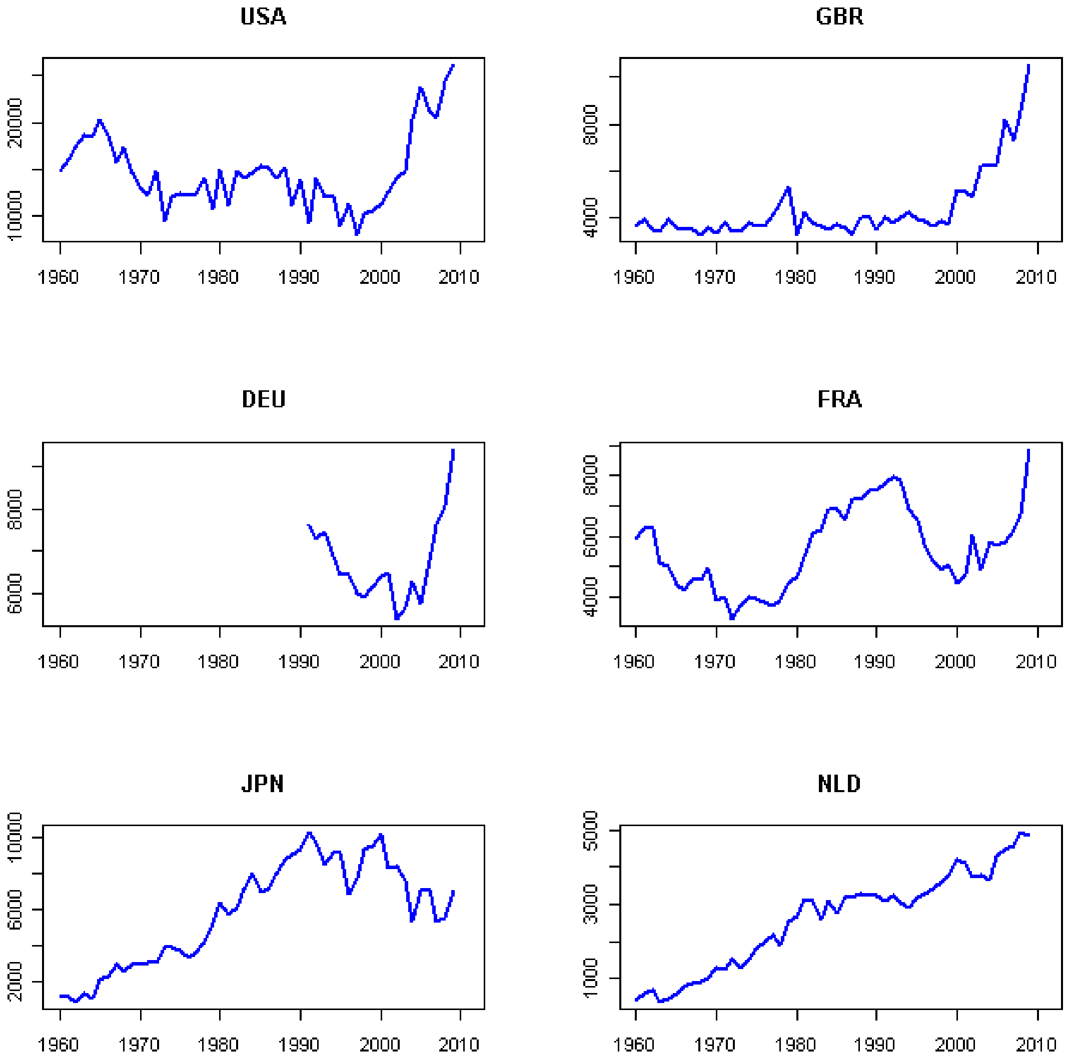
The majority of data is taken from OECD statistical series for the 1960-2009 period – see summary table below. For consistency between countries and over time, all money-valued variables are stated in constant 2005 USD with a PPP adjustment. The principal unit of observation is the members of the DAC, which covers all major donors in advanced countries. Newer members such as South Korea, Turkey and ex-Soviet bloc Eastern European countries are excluded due to the comparatively low value and predominantly local focus of their aid disbursements, as well as the small number of available observations. Of the remaining N=23 countries, a further 3 countries are excluded (Germany, Iceland and Greece) due to a small number of valid observations (T<20). Aid supplied by individual countries is defined as total net bilateral aid disbursements minus debt relief, which excludes disbursements to multilateral organizations but includes support to NGOs and international private organizations. All definitions follow those of the Development Assistance Committee (DAC) of the OECD.

Table B.I: Variable description and sources

Variable	Source	Comment
Net bilateral aid	OECD.Stat DAC dataset, by donor	Net disbursements of bilateral aid excluding debt relief. Converted from current USD to constant international dollars (at 2005 prices) by application of GDP deflator index and PPP conversion factor.
Real GDP	OECD Economic Outlook 86, December 2009	Converted from local currency units to international dollars (at 2005 prices) by application of GDP deflater index and PPP conversion factor.
GDP deflater	ibid.	(Used to convert to constant values).
Govt. saving in GDP	ibid.	Net government saving divided by GDP (local currency units).
Govt. spend in GDP	ibid.	General government total disbursements minus net bilateral aid (above), divided by GDP (local currency units).
Unemployment	ibid.	Unemployed as share of labour force.
Population	OECD.Stat National Accounts, Table 3	Working age population
Exchange rates	OECD.Stat National Accounts, Table 4	(Used to convert to US dollars)
PPP conversion	ibid.	(Used to convert to international dollars)
Upper income GDP	Author, using Penn World Tables, v6.3	Average GDP growth of all countries with per capita real incomes above US$ 12000
Low income GDP	ibid.	Average GDP growth of all countries with per capita real incomes below US$ 1000
Bank crisis (dummy)	Laeven and Valencia (2010)	Systemic banking crisis; variable takes a value of one for all years up to and including reported start and end dates; 2009 is assumed to be a crisis year for all financial crises starting 2008; for countries with no recorded financial crisis, one year is randomly given a value. This is to avoid the variable being dropped in the mean group estimates.
Democracies (%)	Beck *et al.* (2001)	Calculated by the author from the `checks_lax` variable as the share of all countries (with data available) who have legislatures that are competitively elected. Data is not available before 1975, therefore values for changes between 1960-1974 are imputed as a random normal variable with mean equal to the average change between 1975-1984 and standard deviation equal to the standard error of that estimate.

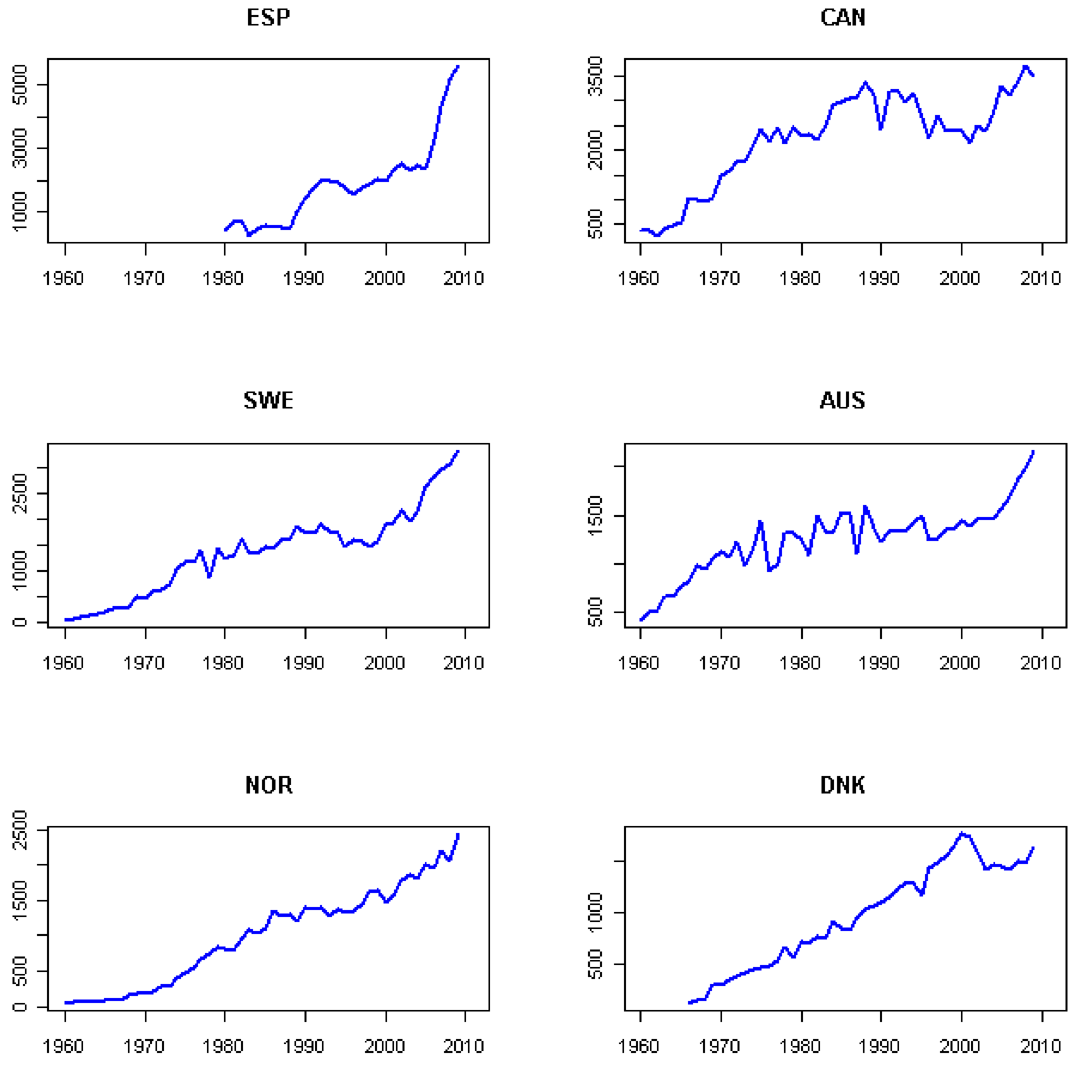
Note: all data accessed July 2010; OECD.Stat found at http://stats.oecd.org/Index.aspx; Penn World Tables found at http://pwt.econ.upenn.edu/php_site/pwt_index.php.

Figure 1: Bilateral aid flows (USD millions), 1960-2009



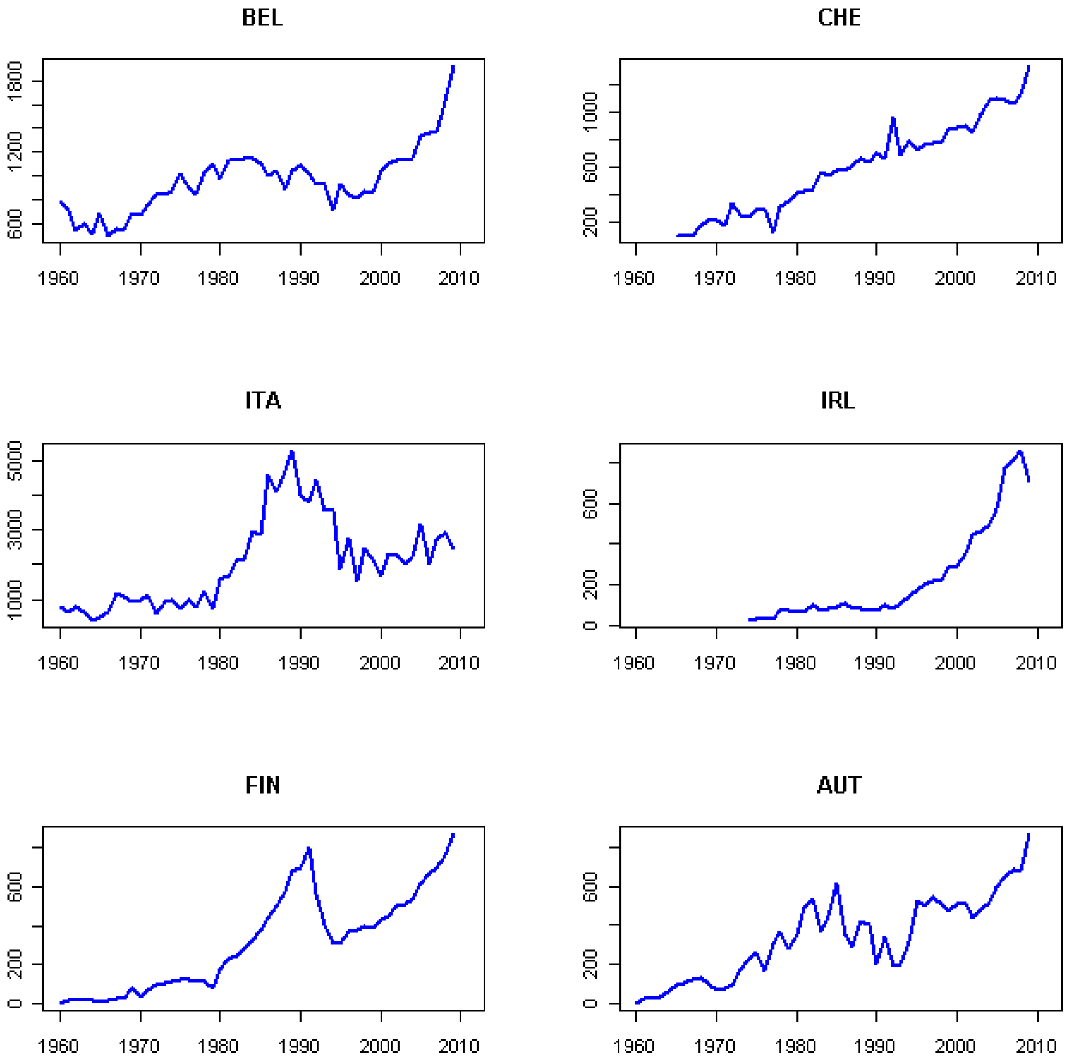
Source: authors' calculations, see Appendix B for variable definitions and sources.

Figure 2: Bilateral aid flows (USD millions), 1960-2009



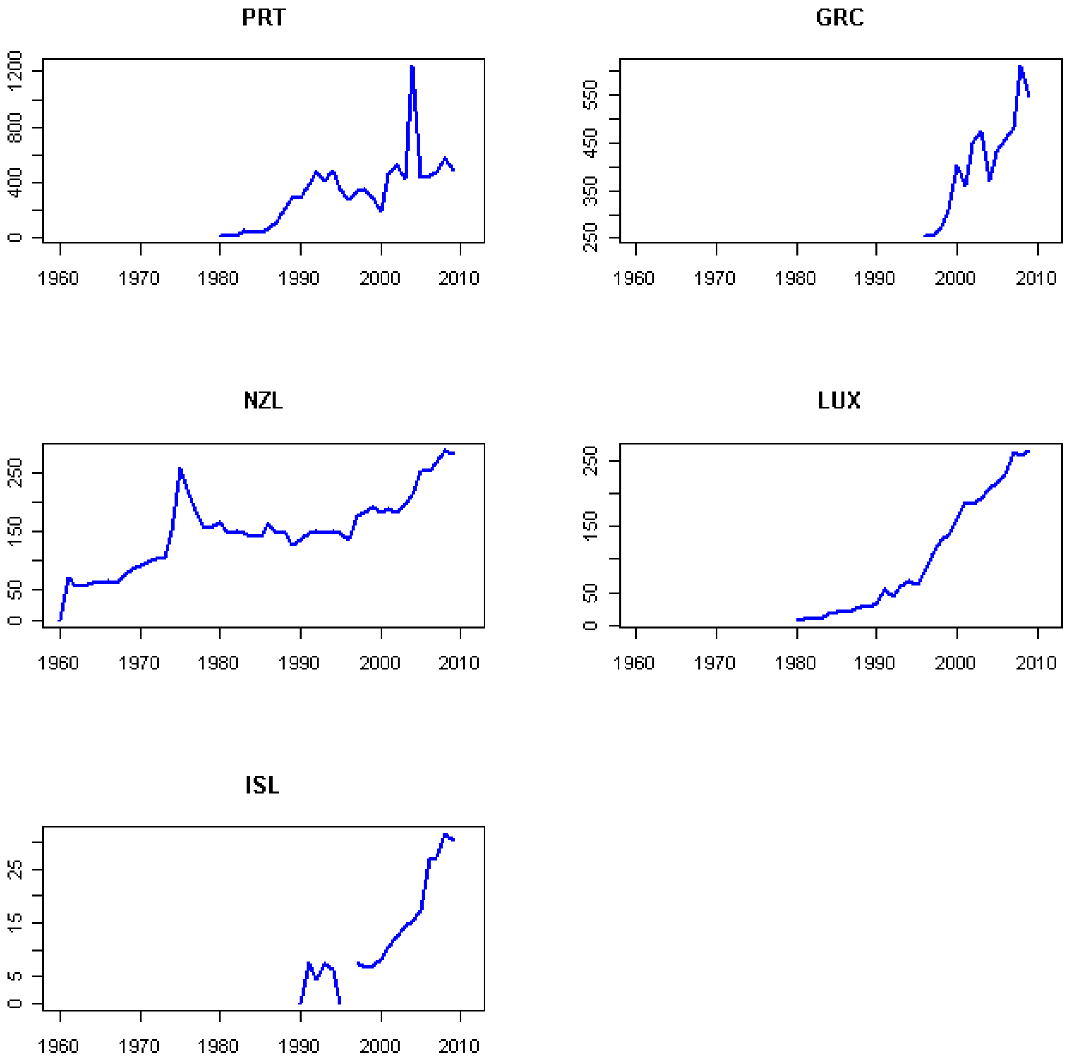
Source: authors' calculations, see Appendix B for variable definitions and sources.

Figure 3: Bilateral aid flows (USD millions), 1960-2009



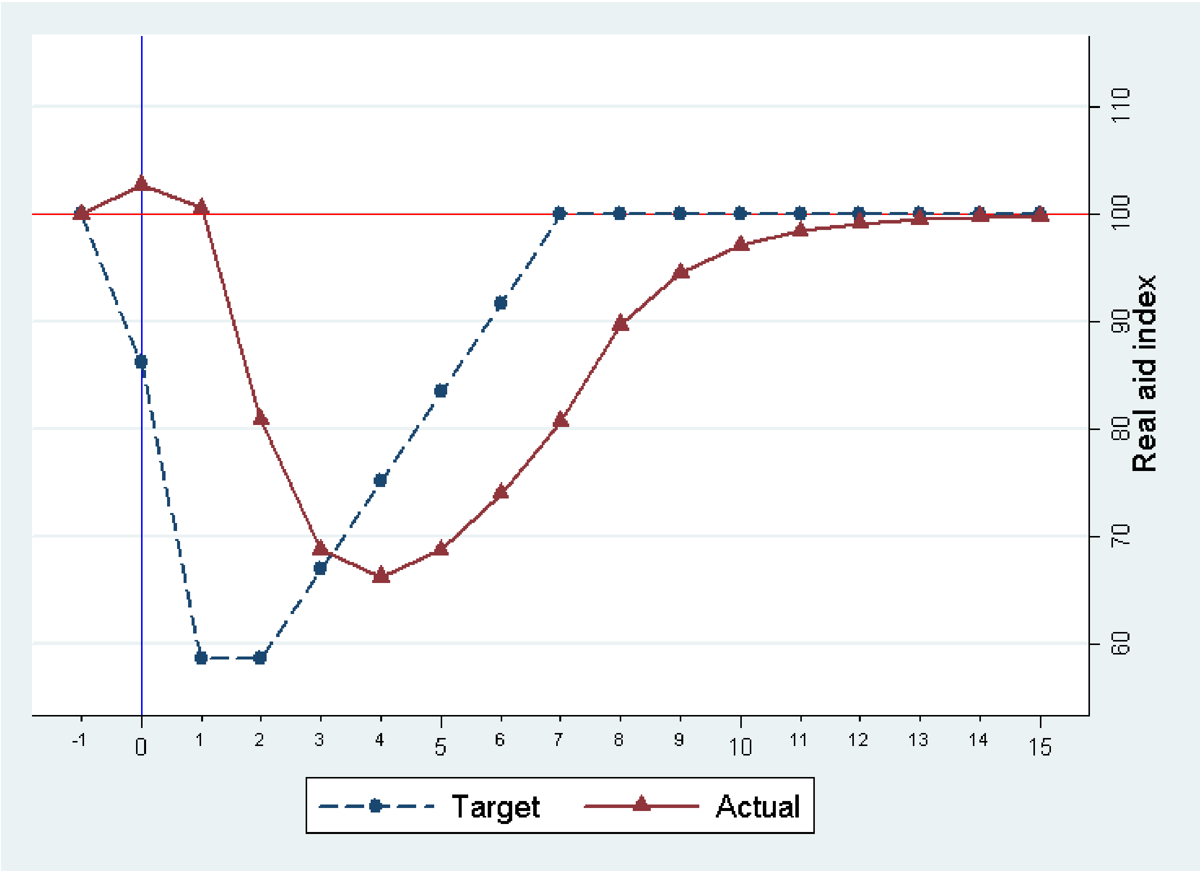
Source: authors' calculations, see Appendix B for variable definitions and sources.

Figure 4: Bilateral aid flows (USD millions), 1960-2009



Source: author's calculations, see Appendix B for variable definitions and sources.

Figure 5: Simulation of aid supply response to macroeconomic shocks



Notes: simulation is based on coefficients from column (6) of Table 3. Assumed real shocks at time [x axis] t=0 are ΔGDP = -5%, ΔGovt. saving = -3.5%, ΔGovt. spending = +3%; at t=1 the same shocks are repeated, at double their previous magnitude; at t=2 there are no external changes to the system; recovery occurs in a linear fashion from t=3 to t=7, after which there are no further external changes; both random error and trend changes in aid are assumed to be zero throughout.

Source: author's calculations.

Table 1: Unit root and cointegration tests, by country

	Obs	Aid	GDP	CEQs	t_R	t_E	Rejects
AUS	50	0.560	0.056	1	-4.21	-3.40	2
AUT	49	0.267	0.611	1	-3.37	-3.16	1
BEL	50	0.970	0.433	1	-3.65	-3.69	1
CAN	50	0.014	0.355	1	-5.52	-3.95	3
CHE	44	0.822	0.000	.	-5.29	-3.98	2
DNK	44	0.450	0.902	1	-4.79	-3.66	2
ESP	30	0.066	0.627	0	-3.56	-3.52	0
FIN	48	0.822	0.530	.	-6.16	-2.95	1
FRA	50	0.499	0.385	1	-4.88	-3.28	2
GBR	50	1.000	0.245	1	-6.23	-5.34	3
IRL	36	0.129	0.337	1	-3.29	-4.40	2
ITA	50	0.729	0.969	1	-5.18	0.89	2
JPN	50	0.885	0.622	1	-4.35	-4.25	3
LUX	26	0.898	0.690	1	-5.81	-4.97	3
NLD	50	0.014	0.151	1	-4.88	-4.62	3
NOR	50	0.191	0.939	1	-5.71	-2.16	2
NZL	49	0.362	0.145	1	-3.59	-4.60	2
PRT	30	0.540	0.850	0	-5.00	-1.50	1
SWE	50	0.005	0.136	1	-3.94	-3.33	2
USA	50	0.960	0.262	1	-3.75	-2.10	1
χ^2 / mean	45	52.700	52.000	1	-4.70	-3.40	1.9
(prob.)		0.085	0.097				

Notes: Aid is the log. of net bilateral aid excluding debt relief at 2005 prices; GDP also in logs and 2005 constant prices; for Aid and GDP, each country-variable cell reports the probability associated with the null hypothesis that the column variable contains a unit root, calculated via an Augmented Dickey Fuller test (with 3 lags and a trend term); column CEQs reports the number of cointegrating equations between Aid and GDP (on the form of equation 4) from a Johansen vector error-correction procedure, chosen by an information criterion; column t_R reports the t-statistic from an Augmented Dickey Fuller test on the residuals from country-specific estimates of the long-run cointegrating relation; t_E reports the t-statistic on the (lagged) error correction term in country-specific dynamic regressions; the final column reports the number of instances the null hypothesis of no cointegration is rejected for the tests in the preceding three columns; final two rows report the test statistic means or, for Aid and GDP, the χ^2 test statistic and associated probability from a Fisher meta-test of the combined column probabilities (see Maddala and Wu 1999).
Source: author's estimates, see Appendix B for variable definitions

Table 2: Model for long run bilateral aid supplies, 1960-2009

	(1) FEs b/se	(2) PDOLS b/se	(3) CCE b/se	(4) PDOLS-CCE b/se	(5) Swamy b/se	(6) MG b/se
GDP (log)	1.84**	2.17**	2.06**	2.36**	2.30**	2.76***
	(0.84)	(0.85)	(0.95)	(0.91)	(0.93)	(0.87)
Time	-0.01	-0.02	0.02	0.02	0.08*	0.09**
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Time^2	-0.00	0.00	-0.00	-0.00	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
FD.GDP (log)		1.24		0.77		
		(1.54)		(1.28)		
D.GDP (log)		-1.89**		-1.04		
		(0.68)		(0.66)		
LD.GDP (log)		-0.18		0.58		
		(1.41)		(1.38)		
Aid mean			0.76**	0.80**	0.76**	0.83**
			(0.30)	(0.36)	(0.35)	(0.34)
GDP mean			-1.85	-2.33	-1.86	-2.88*
			(1.73)	(1.63)	(1.56)	(1.49)
Constant	-16.71	-20.48*	1.38	2.61	-1.28	3.29
	(9.92)	(10.03)	(14.19)	(14.56)	(12.72)	(12.21)
N	906	877	906	877	906	906
R2	0.69	0.69	0.69	0.69		0.83
Kao-DF_γ	-0.11	-0.65	-9.12	-10.87	-8.61	-8.65
prob.	0.46	0.26	0.00	0.00	0.00	0.00
Kao-DF_t	-6.70	-7.24	-7.09	-7.73	-5.50	-5.53
prob.	0.00	0.00	0.00	0.00	0.00	0.00

significance: * 0.1, ** 0.05, *** 0.01

Notes: dependent variable is the log of net bilateral aid; columns (1) to (4) apply pooled panel estimators, which are respectively a simple fixed effects (FEs) estimator, FEs augmented by panel dynamic OLS (PDOLS) terms, FEs augmented by common correlated effects (CCE) terms, and FEs with both PDOLS and CCE terms; column (5) is the Swamy (1970) random coefficients estimator; column (6) is the unweighted mean-group estimator of Pesaran and Smith (1995); all models use robust estimates of the variance-covariance matrix.

Source: author's estimates, see Appendix B for variable definitions

Table 3: Error correction model for bilateral aid flows, 1960-2009

	(1) PCSE b/se	(2) IV b/se	(3) GMM b/se	(4) Swamy b/se	(5) MG b/se	(6) MG b/se
Error correction (lag)	-0.12***	-0.13***	-0.75***	-0.25***	-0.30***	-0.48***
	(0.01)	(0.02)	(0.22)	(0.06)	(0.05)	(0.07)
Δ Real GDP	1.14***	2.25	2.07	0.41	0.01	0.41
	(0.37)	(3.14)	(6.84)	(1.12)	(0.96)	(0.96)
Δ Gov. spend in GDP	0.70***	0.56	1.28	0.56	0.64	0.65
	(0.17)	(0.47)	(4.24)	(0.51)	(0.42)	(0.40)
Δ Govt. saving in GDP	-0.51	-0.96	7.52	-0.87	-0.22	-0.39
	(0.40)	(1.26)	(12.36)	(0.94)	(0.68)	(0.69)
Δ Unemployment	-0.77	0.06	11.17	0.87	2.24	1.56
	(0.70)	(3.13)	(19.54)	(3.40)	(3.07)	(3.21)
Δ Upper income GDP	-0.37	-1.37	-5.68	0.26	0.55	0.17
	(0.42)	(1.40)	(7.28)	(1.18)	(1.02)	(0.94)
Δ Low income GDP	0.09	-0.04	0.49	-0.04	-0.05	-0.12
	(0.13)	(0.25)	(1.66)	(0.27)	(0.21)	(0.19)
Mean Δ aid	1.00***	0.97***	0.69*	0.83***	0.95***	0.83***
	(0.10)	(0.19)	(0.37)	(0.25)	(0.20)	(0.19)
Δ Democracies (%)	-0.02	0.12	0.58	-0.18	-0.12	0.18
	(0.29)	(0.54)	(2.85)	(0.71)	(0.60)	(0.63)
Bank crisis (dummy)	0.02	0.01	0.04	0.01	0.02	0.02
	(0.02)	(0.04)	(0.09)	(0.05)	(0.04)	(0.03)
Time	0.00	0.00	-0.00	0.00	0.00	-0.00
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Constant	-0.07	-0.05	0.10	-0.07	-0.08	-0.04
	(0.05)	(0.13)	(0.58)	(0.09)	(0.08)	(0.07)
N	735	725	682	735	735	735
R2	0.25				0.49	0.54
Chi2	1199.5	189.7	7608.2	70.9	234.0	251.1

significance: * 0.1, ** 0.05, *** 0.01

Notes: dependent variable is the first difference of the log. of net bilateral aid; columns (1) to (3) are pooled models estimated respectively by a Prais-Winsten regression including 5 year period and country dummies, a 2SLS panel fixed effects instrumental variables estimator (including period dummies), and the Arellano-Bond GMM procedure; all pooled models define the lagged error correction term (L.EC) from residuals estimated from Table 2 column (4); column (4) uses the Swamy (1970) random coefficients estimator and defines L.EC from residuals estimated from Table 2 column (5); columns (5) and (6) use the Pesaran and Smith (1995) mean-group estimator; column (5) defines L.EC from the residuals estimated from the averaged coefficients in Table 2 column (6) ; column (6) defines L.EC from the country-specific residuals associated with Table 2 column (6); column (1) reports panel-corrected standard errors (which adjust for panel-specific autocorrelation and heteroskedasticity as well as cross-unit correlation); all other models report robust (sandwich) estimates of the variance-covariance matrix.

Source: author's estimates, see Appendix B for variable definitions

Table 4: Error correction model of bilateral aid flows, various data subsets

	(1) 1960-91 b/se	(2) 1992-09 b/se	(3) 1990s b/se	(4) 2000s b/se	(5) Donors-I b/se	(6) Donors-II b/se
Error correction (lag)	-0.25***	-0.29***	-0.35***	-0.25***	-0.19***	-0.35***
	(0.03)	(0.04)	(0.06)	(0.06)	(0.05)	(0.04)
Δ Real GDP	0.00	1.55***	2.19**	1.34**	1.10*	-0.48
	(0.55)	(0.55)	(0.88)	(0.56)	(0.58)	(0.55)
Δ Gov. spend in GDP	0.85***	0.73***	0.61	1.00***	0.96***	0.54**
	(0.29)	(0.27)	(0.39)	(0.33)	(0.29)	(0.26)
Δ Govt. saving in GDP	0.30	-1.07**	-2.24***	-0.11	-0.70	-0.48
	(0.92)	(0.54)	(0.87)	(0.63)	(0.86)	(0.54)
Δ Unemployment	-1.79	-0.44	-0.19	-1.06	-0.15	-4.21***
	(1.13)	(0.88)	(1.36)	(1.27)	(1.39)	(1.02)
Δ Upper income GDP	0.54**	-0.76	0.03	-1.88**	-0.34	0.01
	(0.27)	(0.71)	(1.10)	(0.95)	(0.62)	(0.70)
Δ Low income GDP	0.15	-0.17	-0.32*	0.05	0.17	0.08
	(0.14)	(0.17)	(0.17)	(0.27)	(0.19)	(0.21)
Mean Δ aid	1.06***	0.79***	0.69***	0.80***	0.84***	1.14***
	(0.12)	(0.17)	(0.12)	(0.23)	(0.16)	(0.16)
Δ Democracies (%)	-0.19	0.70**	0.52	-0.65	-0.47	0.77*
	(0.36)	(0.33)	(0.37)	(1.09)	(0.45)	(0.43)
Bank crisis (dummy)	0.04	0.02	-0.05**	0.02	0.05	-0.05*
	(0.12)	(0.02)	(0.03)	(0.03)	(0.03)	(0.02)
Time	0.00	0.00**	0.00	0.01*	0.01*	0.00
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Constant	-0.00	-0.24***	-0.12	-0.30**	-0.13*	0.02
	(0.05)	(0.08)	(0.13)	(0.15)	(0.07)	(0.12)
N	382	353	194	196	413	322
R2	0.18	0.28	0.43	0.24	0.19	0.32
Chi2	1000.6	213.7	243.3	97.4	216.0	239.6

significance: * 0.1, ** 0.05, *** 0.01

Notes: underlying model is as per Table 3; columns (1) to (4) restrict the sample to the time periods indicated and include dummies for large, medium and small groups of donors (not reported); column (5) restricts the sample to donors whose average net real ODA is above US$1 billion; column (6) is restricted to all other donors; both columns (5) and (6) include individual donor and 5 year time period dummies; all models estimated by a Prais-Winsten regression using panel-corrected standard errors, which adjust for panel-specific autocorrelation and heteroskedasticity as well as cross-unit correlation.

Source: author's estimates, see Appendix B for variable definitions