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Development Aid and Economic Growth: A Positive Long-Run Relation

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Abstract

We analyze the growth impact of official development assistance to developing countries. Our approach is different from that of previous studies in two major ways. First, we disentangle the effects of two components of aid: a developmental, growth-enhancing component, and a geopolitical, possibly growth-depressing component. Second, our specifications allow for the effect of aid on economic growth to occur over long time-lags. Our results indicate that developmental aid promotes long-run growth. The effect is large and robustly significant, and withstands an array of robustness checks including alternative specifications, choices of the proxy for development aid, and treatments of outliers.

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Development Aid and Economic Growth: A Positive Long-Run Relation[1]

Sanjay G. Reddy and Camelia Minoiu

Aid and Growth: What Does the Record Show?

Does aid (understood as grants or loans provided by governments or multilateral public institutions to governments or other entities in developing countries) promote economic growth?[2]

Interest in this question has grown as large infusions of aid to developing countries have been recommended in recent years as a means of promoting development (see e.g., Sachs 2005a, 2005b and Sachs and others, 2004 who argue that aid can be crucial in enabling countries to escape low-growth inducing "poverty traps"). There have also been major efforts to mobilize resources for increases in aid on the part of developed country governments and international agencies (e.g. in the form of the effort to develop a new International Financing Facility). On the other side, critics of development aid argue that it has historically been ineffectual in promoting growth and contend that increases in aid are therefore undesirable. An intermediate position is that focused increases in aid can be desirable under specific conditions which ensure that aid is likely to succeed in promoting growth and development (such as when countries have in place "good policies").

Is there a fact of the matter in regard to whether or not aid has promoted economic growth? Does the historical record permit inferences of this kind? Specifically, do comparisons over time and space of country-years in which aid was high to country-years in which aid was low demonstrate – when controlling for other possible determinants of growth – that greater economic growth has resulted (either contemporaneously or with a lag) when aid has been higher?

A number of studies have been presented in recent years attempting to answer the last question, using econometric techniques to analyze both cross-sectional and panel data on economic growth and aid (commitments or disbursements) in order to infer the relation between them. These studies include Burnside and Dollar (2000), Clemens, Radelet and Bhavnani (2004), Dalgard, Hansen and Tarp (2004), Easterly (2003), Easterly, Levine and Roodman (2004), Milanovic (2005), and Rajan and Subramanian (2005). Unfortunately, "the debate about aid effectiveness is one where little is settled" (Rajan, 2005).

In this paper, we provide new evidence on the effect of aid on growth by means of a cross-country causal analysis. We distinguish between "developmental" and "geopolitical" aid (defined further below) as

1 We would like to offer our sincere thanks to Raghuram Rajan and Arvind Subramanian for their exemplary openness and generosity in providing us with their data and in assisting us with queries concerning it. We would like to thank Rathin Roy and Jomo K.S. for their crucial encouragement and the Department of Economic and Social Affairs of the United Nations for financial support for this research. The paper has benefited from helpful comments by Antoine Heuty, Jan Kregel and Francisco Rodriguez. We are grateful for assistance with data on the National Rainfall Index for developing countries from the Food and Agriculture Organization, Environment and Natural Resources Services (FAO-SDRN).

2 We recognize that it is controversial whether or not to identify loans specifically, and financial transfers generally, as aid, because of the ethical presuppositions and ordinary language connotations of the term. However, we use it as we do here for linguistic convenience.

distinct aid categories which are likely to have distinct effects on per capita GDP growth. The specifications that we apply allow aid flows to translate into economic growth after long time periods. We find that growth-enhancing, developmental aid has a positive, large and robustly significant effect on growth, while geopolitical aid has a negative, robustly significant effect on growth in some specifications, or is growth neutral. We conclude that aid of the right kind is good for growth and that it translates into growth outcomes after long periods of time. In contrast, total aid (comprising geopolitical and developmental aid together) has no such effect.

These results carry potentially significant implications for policy, as they entail that shifting the composition of aid in favour of developmental aid or increasing its quantity can lead to sizable long-term benefits. The results may also help to resolve the so-called "macro-micro paradox" wherein aid is found to have average effects that are 'roughly zero' in macroeconomic studies but to have positive effects in microeconomic studies such as project assessments (see e.g., Boone, 1994, and Clemens, Radelet and Bhavnani, 2004). From the perspective, we present in this study, a possible resolution is that whereas macroeconomic studies have been concerned with identifying the impact of aggregate aid, project assessments have focused specifically on projects with plausible developmental impact. As we shall see, macroeconomic studies of aid impact have also failed to be concerned with the impact of aid over long periods of time, as is necessary in order adequately to identify the effects of developmental aid in particular.

The paper is structured as follows: in the next section, we discuss the problem of endogeneity of aid in growth regressions. In the following section, we highlight limitations of the strategy for addressing endogeneity which has been dominant in the recent empirical literature. The next section discusses the problem of model misspecification arising from overly aggregative views of aid in empirical assessments of the effect of aid on growth, and in the following two sections, we present our empirical results. Robustness checks are then included before we draw some conclusions.

The Problem of Endogeneity

A central issue bedevilling all of the studies mentioned above is that of endogeneity. Aid may affect growth but it is also entirely possible that the amount of aid received by a country in a given year is influenced by its present or expected future growth rates. If so, the causal effect of aid on growth may well be misestimated unless an effort is made to correct for possible endogeneity bias which results from such bi-directional causation. The direction and magnitude of the endogeneity bias are not entirely obvious, however. It is plausible to imagine that a country may receive *greater* aid if it possesses lower growth (after controlling for initial income and other factors), as aid may be directed to such a country for humanitarian reasons, or because it is perceived that it "needs" supplemental resources due to its perceived inability to achieve the same growth rates as other countries through its available domestic savings or receipts of foreign direct investment. On the other hand, it is also plausible to imagine that the country may receive *less* aid if it possesses lower growth, as such a country may be viewed as being less credit worthy or as possessing expected performance that is less likely to place development agencies that provide aid to them in a positive future light.

It seems clearer that aid is likely to be endogenous to the level of *income* of a country than that it is likely to be endogenous to its level of economic *growth*. For example, greater aid may flow to countries that are perceived as more needy because they have lower incomes. Since the economic growth experienced by a country may be related to its level of income, economic aid may also be correlated with economic growth for

this *derivative* reason. However, including initial income as a control variable can deal with this derivative association between aid and growth.[3]

There are at least two plausible ways of dealing with the problem of the possible endogeneity of aid with respect to economic growth. The first, which has been extensively explored in the literature, is to use instrumental variable analysis to attempt to isolate an exogenous source of variation in aid which is not attributable to the level of economic growth experienced by a country, and to attempt to determine the impact on economic growth of variations in aid arising from this exogenous source. Various strategies have been adopted for this purpose.

A number of the choices of instrumental variables applied in this literature exploit the idea that aid may be given for geopolitical reasons, which are extraneous to the economic performance of a country (this is referred to as the "friends of the donors" class of variables by Easterly, 2003). This idea has received perhaps its most careful implementation in the widely publicized work of Rajan and Subramanian (2005) who estimate the level of aid likely to be received by a particular recipient country from a particular donor on the basis of geopolitical factors including whether or not the recipient country is a member of or a signatory to a strategic alliance, whether or not they have been a present or former colony of the donor, and whether or not the donor and the recipient share a common language. They then estimate the impact of aid receipts explained on the basis of these geopolitical factors on the level of growth experienced by the country. They find little relationship between aid explained in this way and the level of growth experienced.

Similarly, Easterly (2005) draws instruments from the class of donor interest variables in an attempt to isolate the causal effect of repeated structural adjustment lending by the International Financial Institutions on economic growth. The author uses various instruments for aid that are intended to capture geopolitical influences. These include: volume of US military assistance to aid recipient countries, the size of the recipient countries measured by their population, dummy variables for Egypt and for oil producing countries (with which to reflect the increase in US aid to these countries after the 1977 Camp David accord), a dummy variable for former French colonies, and the length of time spent under an IMF program during the 1970s. The empirical estimations reveal no robust effect of repeated or lengthy multilateral lending on growth.

The aforementioned papers build on the earlier work by Burnside and Dollar (2000) and Boone (1994, 1996) who use donor interest variables to address the endogeneity problem in relation to aid (Egypt and Franc Zone dummies, lagged volume of arms imports and population size). In a panel setting, Daalgard, Hansen and Tarp (2004) also include lagged aid as an instrument in a first stage regression predicting exogenous variation in aid. The rationale for using lagged aid as an instrument is that it is highly correlated with present aid and it acts as a proxy for country-specific determinants of the level of aid. These authors identify a positive effect of total aid on growth.

The second method of dealing with the problem of the possible endogeneity of aid with respect to economic growth is to examine this effect over long periods of time, of sufficient duration to rule out any plausible conditioning of aid received on expectations of future economic growth. We do not know of any

3 Once more, the sign of the effect is indeterminate. According to standard economic theory, poor countries are expected to grow more quickly as a result of possessing higher marginal returns to capital. However, this conclusion has been contested recently on both theoretical and empirical grounds (see e.g. Sachs and others, 2004). It is an empirical regularity that the least developed countries possess slower rates of growth of per capita income than do other countries (see e.g. Milanovic, 2005).

studies in the literature which have specifically adopted this approach to addressing the problem of endogeneity. We will discuss below our findings when applying this approach.

Limitations of the Predominant Strategy for Addressing Endogeneity: Does Aid of Different Types Have Different Effects?

The predominant strategy for addressing endogeneity in the literature has involved, as noted above, isolating the level of aid received by a particular recipient country that is explained on the basis of geopolitical factors. The implicit premise of this instrumentation strategy is that the effects of aid on growth are the same regardless of whether that aid is received for geopolitical reasons or for other reasons. However, this premise is questionable.

For example, one can raise the question of whether aid ("geopolitical aid") taking the form of general budgetary support for an authoritarian regime that enables it to coerce its population to sustain political support from specific constituencies or to invest in infrastructure (such as roads between military bases) that facilitate military objectives is likely to have the *same* effect on growth as aid ("developmental aid") taking the form of investments in irrigation, infrastructure (such as rural roads, bridges and ports) that helps to bring goods to market, or immunization campaigns, health clinics, schools and universities.[4] If aid of different kinds indeed has different effects, then this instrumentation strategy may lead to inferences concerning the impact of developmental aid which are quite incorrect, as discussed further below.[5]

For the purposes of this paper, developmental aid is understood as aid expended in a manner that can reasonably be anticipated to promote development (understood as improvements in human well-being, whether achieved through economic growth or other means). Geopolitical aid is defined as aid of all other kinds. Developmental aid is in practice presumed generally to be undergirded by a developmental motive and geopolitical aid is in practice presumed generally to be undergirded by other motives (perhaps prominently including military and political considerations). It is important to note that these definitions place requirements on the nature of expenditures and on the impact that might reasonably be expected of these expenditures but neither on the motives underlying these expenditures nor on the ultimate effects that these expenditures eventually have. Both aid received due to geopolitical ties that is spent in a manner that might reasonably be anticipated to promote development and aid intended to promote development and spent in a manner that could reasonably be anticipated to promote development but which fails ultimately to do so are classified as developmental aid according to the 'expenditure side' definition that we adopt.

In the identification strategy we pursue below, however, we will make the *empirical* assumption that aid received for the reason that geopolitical ties exist between a donor and a recipient is also more likely to be geopolitical aid according to our definition (i.e. aid spent in a manner that cannot reasonably be anticipated to promote development). Of course, the contrast between expenditures that can be expected to promote

4 It should be noted here that our premise in defining geopolitical aid is that aid received for geopolitical reasons is more often spent in a non-developmental way, *on average*, than is aid received for non-geopolitical reasons. This may not be true in individual cases.

5 A *New York Times* (February 6, 2006) editorial discusses the shares of "developmental" and "geopolitical" aid in the US foreign aid budget: "Economic aid for strategic allies and military aid make up more than half of the foreign aid budget. About 30 countries on the front line of the war on terror receive aid, mainly to buy their governments' support. Development assistance is only 30 per cent of the budget, and a lot of that goes into projects undertaken in the name of promoting economic reform, democracy and good government." The same editorial goes on to argue that "Congress should pass a law mandating that a decent percentage of the foreign aid budget go to basic antipoverty efforts".

development and those that cannot be expected to do is not easy to draw without an exercise of judgment including the specification of a threshold level of impact on developmental needs necessary in order to classify a particular kind of expenditure as developmental in nature. This necessity is not an embarrassment but rather is in the very nature of classification.

Clemens, Radelet and Bhavnani (2004) have independently noted the possibility that aid of different types may have different effects on growth, although they do not make the distinction between developmental aid and geopolitical aid and focus solely on the short-run impact of aid.[6] Unlike Clemens, Radelet and Bhavnani (2004), we focus specifically on "developmental aid" as contrasted with "geopolitical aid" and on the effects of such aid over *long* time periods. In this way, we are able to respond directly to a central objection to that study, and to provide new evidence that aid of the right kind can have a robust and sizable impact on long-run economic growth.[7]

The Specification Problem: Theoretical Results

In this section, we present analytical results identifying the bias in the Ordinary Least Squares (OLS) and Two-Stage-Least-Squares (2SLS) estimators of the effect of total aid on growth that can result from failing to take account of the possibility that different kinds of aid may have different effects on economic growth.

The analytical derivations for the multivariate case are presented in full in Appendix 1. We reproduce here the main findings. We posit that the *true* model is given by:

$$\gamma = DA\beta_1 + GA\beta_2 + C\delta_T + \varepsilon_T \quad (1)$$

where γ denotes per capita income growth, DA stands for developmental aid, GA represents geopolitical aid, and C is a matrix of suitably identified covariates. We suppose that the actually *estimated* model is given by:

$$\gamma = TA\beta + C\delta_R + \varepsilon_R \quad (2)$$

where TA represents total aid and is the sum of developmental aid and geopolitical aid.

6 Another study which assesses the influence of aid flows on growth rates in sub-Saharan Africa between 1970 and 1997 is Gomanee, Girma and Morrissey (2002). The authors use "adjusted" measures of (grant and total) aid from which they exclude food aid (which is assumed by the authors not to have a direct impact on growth) and technical cooperation (which is assumed by the authors to influence growth, but with a long time-lag). However, their specifications do not allow for a long-run effect of aid on growth, as "adjusted" aid is included in the specifications either contemporaneously or in one period (i.e., four years) lagged form.

7 Rajan (2005) notes in relation to Clemens, Radelet and Bhavnani (2004):
The study indeed shows that aid likely to have a short-term economic impact (for instance, aid used to build roads or support agriculture directly) is positively correlated with short-term growth. Here again, however, I'm not fully persuaded. The authors of this study argue that the reason to focus on short-impact aid is because the literature focuses on country growth rates over four-year periods. So I presume it follows that if one were to depart from the literature and look at long-run growth (say growth over decades, which is what we really care about), economic aid (as contrasted with, say, humanitarian aid) cumulated during the period should have a discernible effect on growth (and there would be no need to separate out short-impact aid from long-impact aid). My work with Subramanian suggests that economic aid doesn't have a robust positive correlation with long-run growth.
The contrasting conclusion arrived at in *this* paper is precisely that "economic aid" has a robust positive impact on long-run growth.

As noted earlier, when estimating the marginal impact of total aid on growth, one can employ two strategies for dealing with the endogeneity problem. First, total aid can be included in cross-sectional regressions in lagged form. The motivation for such a specification could be either that it is desired to assess the effect of *past* aid on present growth or that it is desired to assess the effect of present aid on present growth but to use lagged values of aid as explanatory variables for the reason that they are correlated with present aid but unlikely to be endogenous to present growth. In this case, it can be shown that the OLS estimator of the effect of total aid on growth is a weighted function of the true coefficients on developmental and geopolitical aid, respectively. In particular, it is given by:

$$\hat{\beta}^{OLS} \xrightarrow{P} \left[\beta_1 \frac{Cov(\widetilde{TA}, \widetilde{DA})}{Var(\widetilde{TA})} + \beta_2 \frac{Cov(\widetilde{TA}, \widetilde{GA})}{Var(\widetilde{TA})} \right] \quad (3)$$

The weights are functions of variances and covariances involving the values taken by the developmental, geopolitical and total aid variables conditional on the set of covariates (with this conditionality signified by the tildes over the variables). It is easy to see from (3) that if the two categories of aid have opposite effects on growth but the model estimates the effect of total aid on growth, then OLS estimates of that effect can be zero.

Second, an instrumentation strategy can be employed. In this case, a proxy for geopolitical aid is first predicted on the basis of a set of donor interest variables (as for example, in Rajan and Subramanian (2005)). This proxy is then used as an instrument for total aid and a 2SLS estimation procedure is employed to estimate the effect of total aid on growth. We show in the Appendix that the 2SLS estimator of the effect of total aid on growth is also given by a weighted function of the true coefficients on developmental and geopolitical aid:

$$\hat{\beta}^{2SLS} \xrightarrow{P} \left[\beta_1 \frac{Cov(\widetilde{DA}, \widetilde{GA})}{Cov(\widetilde{GA}, \widetilde{TA})} + \beta_2 \frac{Var(\widetilde{GA})}{Cov(\widetilde{GA}, \widetilde{TA})} \right] \quad (4)$$

Thus, in either case, estimating the incorrect equation (2) instead of the correct equation (1) results in misleading conclusions regarding the growth-effectiveness of aid. The results described here help to explain how the recurrent finding that total aid has average effects that are "roughly zero" can be reconciled with the findings presented below – that developmental aid has robust and sizable positive effects while geopolitical aid is often found to have negative effects on long-term economic growth.

Empirical Findings (cross-section)

The Effects of Total Aid

We follow the methodology of Rajan and Subramanian (2005) and estimate a standard cross-country growth model which seeks to identify the effect of aid on growth. However, we allow for distinct categories of aid to have distinct effects on growth. We use aid data from the OECD-DAC database and GDP data from the World Development Indicators online (2006) for 107 countries between 1960 and 2000. All other variables are taken from the Rajan and Subramanian (2005) dataset which was made available to us by courtesy of the authors. The variables and data sources are listed in Appendix 2.

The relevant variables are averaged and the regressions are run over four different time periods: 1960-2000, 1970-2000, 1980-2000, and 1990-2000. Lagged values of aid of distinct types are used as explanatory variables. Averages over the relevant time periods are constructed only if data for *all* years within

a time period are available. This restricts the number of observations to a minimum of 64 countries and a maximum of 77 countries in any given cross-sectional regression.[8] Summary statistics for selected variables are reported in Appendix 3.[9]

We begin by replicating the baseline model used by Rajan and Subramanian (2005), namely one in which we estimate the effect of total aid on growth. In Appendix 4, the first table includes the estimation results from running Rajan and Subramanian's regressions and including the same lags of total aid as did they. We obtain the same results as Rajan and Subramanian. These reveal a persistent lack of explanatory power for economic growth for various lags of total aid.

We proceed to include more lags of total aid as explanatory variables for each time period over which the growth rate of the GDP we seek to explain. We do so for all time periods, but we fail to find any significant results for periods other than the 1990s. Therefore, we only show the regressions explaining growth in the 1990s, in Tables 4-2A and 4-2B. The results are surprisingly robust and show that total aid lagged over different time periods has explanatory power for average growth in the 1990s. In particular, the coefficients on aid lagged over periods such as 1960-1970, 1960-1980 and 1960-1990 are as high as 8.5, suggesting that an increase of total aid during these periods by 1 per cent of GDP is associated with an average GDP per capita growth rate that is higher by approximately 0.085 percentage points in the 1990s.

The Effects of Aid of Different Kinds

As shown later, coefficient estimates on total aid may lead to erroneous conclusions as the true effect of the developmental, growth-enhancing components of total aid may be rather different from that of components of total aid (in particular, geopolitical aid) which may have no or a negative effect on growth. We now present empirical estimations in which we include suitable proxies for the developmental and geopolitical components of total aid. We estimate the following baseline model:

$$Growth = \beta_1 Developmental\_Aid + \beta_2 Geopolitical\_Aid + \delta_T Controls + \varepsilon_T$$

where the other covariates are precisely those included by Rajan and Subramanian (2005), namely: initial per capita income, initial level of life expectancy, institutional quality, geography, initial level of government consumption, an indicator of social unrest (revolutions), the growth rate of terms of trade and their standard deviation, initial level of policy (Sachs-Warner), and continent dummies (Sub-Saharan Africa and East Asia).

Developmental aid is included as a regressor in lagged form, which means that its coefficients can be interpreted as the effect of past developmental aid on current growth. Insofar as past developmental aid is correlated with present developmental aid, lagging the regressor can also be viewed as an alternative to instrumentation. Geopolitical aid is not included as a regressor in lagged form because it is by assumption largely exogenous to the economic performance of the country.[10] The estimate of its effect on growth will therefore be interpreted as the marginal effect of present geopolitical aid on present growth.

8 However, all the empirical estimations presented in the paper are robust to also including countries for which incomplete data is available by constructing averages across *available* years. These results are available from the authors upon request.

9 Summary statistics for all covariates included in the regressions are presented in Rajan and Subramanian (2005).

10 Moreover, the variable is not available in the database in an averaged form over different time periods.

We consider the following five distinct proxies for developmental aid: (1) multilateral aid (DA), (2) the sum total of bilateral aid from a group of Nordic countries comprised of: Denmark, Finland, Norway, Sweden, and Iceland (G1), and (3) the sum total of bilateral aid from a larger group of countries comprised of: Denmark, Finland, Norway, Sweden, Iceland, Austria, Canada, Luxembourg, the Netherlands, and Switzerland (G2). The fourth and fifth proxies are based on the 2005 donor rankings produced by the "Commitment to Development Index" developed by Roodman (2006) (henceforth, 'CDI'). The index was developed with the aim of broadly assessing the performance of rich nations along various dimensions of policy, including aid trade, investment, migration, security, environment, and technology. The 'aid quality' CDI ranks donor nations after adjusting their aid figures for the type of aid extended to recipient countries. In particular, the index penalizes donor countries which offer tied rather than untied aid, loans rather than grants, and too many small aid projects which burden the recipient government. According to the 2005 'aid quality' CDI rankings, the top five nations were: Denmark, Norway, Sweden, the Netherlands and Switzerland. These constitute our G3 group. The last proxy of developmental aid used includes bilateral aid from G3 and five additional donor nations: Ireland, UK, Belgium, Finland and France (G4), which also score highest on the 'aid quality' CDI.

The motivation for each of these possible proxies for developmental aid is respectively (1) the premise that multilateral aid (as distinguished from bilateral aid) is more likely to have a developmental rather than a geopolitical rationale and to be expended accordingly[11], (2) the premise that the Nordic countries (G1) and selected additional countries (G2) are reputed to have aid programs oriented toward developmental aims (especially economic infrastructure, poverty eradication and social services) and (3) the premise that the groups of countries identified (G3 and G4) as ranking highest in terms of 'aid quality' according to the CDI are likely to have a greater focus on developmental aims.

In Table 3-10, we report the contribution of bilateral aid from each group of donors to total aid and to total bilateral aid extended to developing countries over time. Net bilateral aid from the first group of countries represented 4 per cent of total bilateral aid in the 1970s, 6 per cent in the 1980s and 7.2 per cent in the 1990s. It represented approximately 5 per cent of total aid allocated to aid recipients in the 1990s. Net bilateral aid from the second group of countries represented approximately slightly more than one tenth of total aid in the last two decades, and 11.5 per cent of bilateral aid in the 1970s, 15.7 per cent in the 1980s and 16.3 per cent in the 1990s. The third group of donor countries accounted for higher shares of total aid and bilateral aid each decade than G1. Finally, flows from the G4 made up between 25.4 per cent (in the 1980s) and 30.5 (in the 1990s) per cent of total bilateral aid to recipient countries and about one fifth of total aid in the same decades. Two countries which belong to G4 but do not belong to G2 and account for a large share of aid are the UK and France: during the 1990s, the UK and France accounted for 12 per cent of *all* bilateral aid and 10 per cent of total aid extended to developing countries.

We consider the following two proxies for geopolitical aid: (1) aid predicted on the basis of past and present geopolitical ties (as reflected by colonial relationships, a shared language, and common membership in an entente, alliance, or agreement). This variable (henceforth, 'RS-predicted GA') is available in the Rajan and Subramanian (2005) database and has been constructed on the basis of an auxiliary, pre-first stage regression predicting bilateral aid with geopolitical dummy variables[12]; (2) Total aid minus the aforementioned

11 Part 1 of the definition of multilateral aid provided in the OECD-DAC database reflects this idea: "Multilateral transactions are those made to a recipient institution which conducts all or part of its activities in favor of development."

12 For details on the regression model used to construct the geopolitical aid variable, see Rajan and Subramanian (2005: 9).

proxies for developmental aid (namely, total aid minus multilateral aid, and total aid from which we subtract multilateral aid and DA-G1, DA-G2, DA-G3 and DA-G4, respectively). For reasons of space, and since the findings are broadly invariant to the choice of proxy, in this paper we present cross-sectional estimations involving the first proxy for geopolitical aid.[13] We also focus our attention on estimations which seek to explain the variation in GDP per capita growth rates over the periods 1980-2000 and 1990-2000 since the results for time periods beginning earlier (1960-2000 and 1970-2000) are not statistically significant for a wide range of specifications (choices of lags). We are not perturbed by this finding since the lags feasible in these specifications are small (the dataset begins in 1960) restricting the ability to test our hypothesis that aid acts on growth with long lags for these earlier time periods.

Before proceeding with the empirical findings, we discuss some data-related caveats. First, our specific choices of proxies for developmental aid and geopolitical aid have been constrained by several data limitations. For example, while the OECD-DAC database includes information on categories of aid such as development food aid, emergency aid and technical cooperation, the dataset for each aid category only goes back to 1975, 1995 and 1966, respectively. In contrast, multilateral and bilateral aid information is available for all years going back to 1960 and can serve as the basis for an analysis of the long-run impact of aid of the kind we are interested in.

A second matter to consider is the treatment of "debt forgiveness" in recording ODA. It is unclear whether "debt forgiveness" should be taken to be developmental or geopolitical in nature as it releases resources which may be used for diverse purposes. Further, the entire principal forgiven in a given year is counted as aid provided in that year in the OECD-DAC database. This way of recording "debt forgiveness" makes it almost useless for our purpose since the bulk of the "aid" recorded as having been provided in a given year is notional in that year and its benefits will be distributed over many subsequent years. Nevertheless, it should be noted that the "total aid" variable in the database includes substantial debt relief extended to countries under the HIPC Debt Initiative during the last decade.

In Appendix 5, we present results from a first set of estimations in which we employ multilateral aid as a proxy for developmental aid (Table 5A).[14] Implicitly, in interpreting these results we make the assumption that bilateral aid is all geopolitical in nature, so that there are no omitted variables which may give rise to a bias in the coefficient on multilateral aid (interpreted as developmental aid). We relax this assumption later.

We find that the coefficients on both multilateral aid and geopolitical aid are statistically significant and of large magnitude. As shown in Table 5A, an increase of 1 per cent of GDP in multilateral aid receipts in the 1960s is associated with an increase of half of a percentage point of the average growth rate of per cap-

13 However, the regressions that involve RS-predicted GA are consistent with those based on the second proxy for geopolitical aid (in which the additive identity between geopolitical aid, developmental aid and total aid holds) with the exception that the coefficient on the GA proxy is statistically significant in the first case and is not in the second case. In Section VI, we use the second proxy of geopolitical aid. Furthermore, one consequence of using RS-predicted GA as a proxy for geopolitical aid that has been constructed via an auxiliary first-step regression (Rajan and Subramanian, 2005: 9) is that the asymptotic t-statistics associated with *all* coefficient estimates in the reported regressions are biased upwards if geopolitical aid has an impact on growth (Wooldridge, 2002: 116). It is notable, however, that if geopolitical aid is growth-neutral (its coefficient is zero in the aid-growth equation) and if the variables used to predict it are exogenous to growth (which is indeed held to be the case by the proponents of instrumentation with donor interest variables), then the variance-covariance matrix of the OLS estimator is consistently estimated and statistical inference can be undertaken as usual (Pagan, 1984: 226; Wooldridge, 2002: 115-116).

14 All cross-sectional regression results presented in this paper are robust to weighing the observations according to the Huber (1981) procedure.

ita GDP in the 1990s. Similarly, an increase of 1 per cent of GDP in multilateral aid receipts in the 1970s is associated with GDP per capita growth in those countries two decades later that is higher by a quarter of a percentage point. These are sizable effects. We also find that geopolitical aid is negatively and statistically significantly associated with growth, although its marginal impact is much smaller. Increases in the share of geopolitical aid in GDP by 1 per cent over the period 1960-1980 are associated with average GDP per capita growth rates in the 1990s that are lower by 0.08 percentage points.

A possible reason for concern in interpreting these results is that some bilateral aid may be developmental in nature, but may have been omitted from our proxy for developmental aid in the regressions. This may lead to challenges in interpreting the coefficient estimates presented in Table 5A. To address this concern, we proceed to test variants of the baseline model which seek to identify the developmental (growth-enhancing) components of total aid differently. The results are presented in Tables 5B to 5E. In these specifications, we examine the possibility that the most growth-enhancing form of bilateral aid is that which comes from the donor countries belonging to Groups 1 to 4 (as defined above). In order to avoid an omitted variable bias, we allow for multilateral aid, which is also presumptively developmental in nature, to have a distinct effect on growth, and include it alongside bilateral aid in the specifications. As usual, geopolitical aid is proxied by a variable which reflects variation in aid receipts explained by past colonial ties, current strategic relationships, etc.

The results are striking. First, we identify a positive effect of bilateral aid from Group 1 donors on growth, with coefficients that are large in magnitude: average growth in 1980-2000 was higher by as much as 1.02 percentage points for countries that received 1 additional per cent of GDP as aid transfers from Group 1 donor countries in 1960-1975. Furthermore, a 1 per cent increase the ratio of developmental aid from Group 1 donor countries to GDP in the 1970s and 1980s, is found to be associated with average growth rates in the 1990s that have are higher by 0.7 and 0.5 percentage points, respectively. These impacts are very large - even massive. In addition, lagged multilateral aid continues to have a statistically significant positive effect on average growth, and its beneficial effects on income growth operate over long lags. However, its effectiveness as measured by its marginal impact on the average GDP growth rate is substantially lower (by a factor of two or three) than that of bilateral aid from Group 1 countries.

One reason for preferring the specifications shown in Table 5C over those from the Table 5B is the possibility that there exists omitted variable bias. Such bias may arise if some of the aid provided by unincluded bilateral donors (e.g., belonging to G2 but not to G1) is correlated with the aid provided by members of G1 but not with geopolitical aid. If the effect of this omitted bilateral aid is positive, then the effects of this aid would lead to an over-estimation of the effect of developmental aid (DA-G1) on growth. The results shown in Table 5C for the larger group of donor countries are consistent with those in Table 5B, and the coefficients are statistically significant and of comparable magnitude. As in the previous regressions, contemporaneous geopolitical aid has a statistically significant, negative effect on growth. In these regressions, an increase in geopolitical aid of 1 per cent of GDP in the 1990s is associated with average growth rates that are lower by between 0.06 and 0.09 percentage points in the same period.

Tables 5D and 5E report the regressions results where developmental aid is measured as total bilateral aid from Groups 3 and 4 of countries (that ranked highest according to the 'aid quality' CDI). Although memberships of G1 and G3 differ by two countries (the Netherlands and Switzerland belong to G3 while Iceland and Finland belong to G1) the magnitude of the coefficients on net bilateral aid (and indeed, all regressors of interest) are very similar (Tables 5B versus Table 5D for the 1990s). This is not the case when

comparing the growth-effectiveness of aid from G2 and G4, respectively (Tables 5C versus 5E for the 1990s). In particular, it appears that the inclusion of the United Kingdom and France among the "development-oriented" Group 4 of countries results in a lower coefficient on developmental aid suggesting that aid from these countries is in fact less developmental in nature. While aid from Group 2 countries in the 1970s and 1980s contributes to increasing growth in the 1990s in developing countries by between 0.3 and 0.5 percentage points, the same coefficients for Group 4 countries are 0.2 and 0.3, respectively. Geopolitical aid, however, continues to be negatively associated with growth in all the reported specifications: an increase by 1 percentage of GDP in geopolitical aid is contemporaneously associated with average growth in the 1990s lower by between 0.03 and 0.1 percentage points.

To illustrate the strength of the association between different categories of aid and average growth, we present a set of partial scatterplots in Graphs 1-4 (Appendix 6). We restrict our attention to selected regressions. However we note that the partial scatterplots for all the regressions (which show statistically significant relationships between different lags of aid and average growth) are very similar due to the large correlation between aid receipts for different time periods for a given country. The partial scatterplots reveal strong correlations between the different categories of lagged aid and current growth -- a result summarized in the regressions. We recognize that the cross-sectional regressions presented in this paper are not infallible; for example, a real concern is that some
time-invariant country characteristics might have been omitted and might lead to inconsistency of the OLS estimator if correlated with the level or nature of aid receipts. We address this concern in the next section by estimating the impact of aid on growth in a panel setting.

Empirical Findings (panel)

In this section, we seek to address the concern that omitted time-invariant country characteristics in the cross-sectional regressions, may be causing the coefficients on various types of aid to be inconsistent. In particular, we estimate the baseline growth model using panel data containing eight five-year averages between 1960 and 2000 and the "system GMM" estimator proposed by Blundell and Bond (1998). We offer below a justification for this estimation strategy.

First, estimation of a differenced equation is necessary to ensure elimination of the fixed effects. Second, instrumentation of endogenous variables is required so as to avoid dynamic panel bias. Third, the nature of the short panel (small sample) and the likely high level of persistence in the outcome variable (output) need to be taken into account by employing an appropriate estimation strategy. An estimator available for purposes of estimating a dynamic panel model of the kind employed in this paper is 2SLS on the First-Differenced equation as proposed by Anderson and Hsiao (1981), in which the instruments for the first-differenced variables are given by at least *twice* lagged levels of those variables. The instruments are valid under the assumption that initial values of endogenous regressors are predetermined and that the original error of the model is not serially correlated.[15] The 2SLS estimator, however, is not efficient in the presence of heteroskedasticity since it does not exploit the fact that the differenced error term is a first order moving average.

The asymptotically efficient alternative estimator is the Arellano and Bond (1991) GMM "difference" estimator (for the equation in levels). In the context of estimation of empirical growth models, however, this estimator has been shown to perform poorly for several reasons: many specifications of output

15 A variable is predetermined if its past and current values are uncorrelated with the current error of the model.

dynamics are used on panel datasets whose time dimension is not rich enough to provide for highly relevant instruments. The problem can be made worse by a highly persistent outcome variable (such as output). If the instruments used in the "difference" GMM estimator are weak, a large downward bias may plague the estimates in the context of small samples (i.e., small number of time series observations) and statistical inference becomes problematic (as shown in Blundell and Bond, 1998).

A superior alternative to the "difference" GMM estimator has been shown to be the Blundell-Bond GMM estimator (Blundell and Bond, 1998). This is the "system" GMM estimator. Its advantage lies in enriching the set of instruments for the difference equation (i.e., lagged levels) with instruments for the levels equation (i.e., lagged first differences), hence attenuating the weak instruments problem. The restrictions needed for the "system" GMM estimator to perform well involve initial conditions. It is desirable that the initial conditions perform well as instruments even if the outcome variable (output) is highly persistent. This can be investigating using standard tests of over-identifying-restrictions (which we report with all subsequent panel regressions). Simulation studies by Blundell and Bond (1998) and Blundell, Bond and Windmeijer (2000) show that the "system" GMM estimator outperforms in terms of bias and precision the "difference" GMM estimator.

We therefore proceed to include in the paper estimation output based solely on the "system" GMM estimator. In all reported regressions, we implement a small sample correction suggested by Windmeijer (2005) since our sample size shrinks as higher lags of aid are introduced as regressors. To assess the validity of the instrument set, the p-value for the Hansen test of over-identifying restrictions is reported after each specification. Following Rajan and Subramanian (2005), we treat as endogenous, and instrument for, the following regressors: beginning-of-period income level, inflation, Sachs-Warner policy indicator, and government consumption. We treat as contemporaneously uncorrelated with growth the following regressors: institutional quality and revolutions. We treat as strictly exogenous and use as an additional instrument the geography variable. An East Asia and sub-Saharan Africa regional dummy, as well as time dummies are included in all specifications.

Our proxies for developmental aid are lagged at least *two* time periods and are taken to be uncorrelated with future shocks to the growth model, though there may exist contemporaneous feedback from the outcome variable onto contemporaneous developmental aid. Consistent with our conjecture about the mechanisms through which geopolitical aid is extended to countries and operates through growth, we allow geopolitical aid to have either a contemporaneous or lagged effect on growth. In the former case, if geopolitical aid contains developmental elements or otherwise affects subsequent growth rates, we instrument for it with as many lagged values and lagged first differences as are available for "system" GMM estimation. In the latter case, geopolitical aid can be treated as strictly exogenous to growth (on the assumption that it is typically given to countries for reasons independent of their economic performance)[16], or alternatively it can be treated as endogenous (and is instrumented for) if it is misidentified by our proxy for it. For reasons of space, we only include here specifications in which geopolitical aid has been included in lagged form, but all other specifications give similar results.[17]

16 It should be noted here that donors may extend geopolitical aid to countries and still be sensitive to those countries' growth performance. That case, however, is dealt with via instrumentation of geopolitical aid in the "system" GMM procedure.

17 These additional results are available from the authors upon request.

In Appendix 7, we present regression results involving the four proxies for developmental aid constructed by summing up net bilateral aid across the four different groups of development-oriented donors (G1 to G4). To avoid misspecification, we always include the share of multilateral aid in GDP as a second proxy for developmental aid. Our proxy for geopolitical aid is total aid minus the sum of multilateral aid and aid from the group of "development-oriented" bilateral donors. Although we have experimented with various lags and these were occasionally significant, we only present results in which each aid category has been lagged *five* time periods (i.e., twenty-five years) as we would like to allow for as long a lag as possible given data limitations (for other lags, the coefficients on developmental aid were not robustly significant across donor groups). Specifications involving lags higher than five were infeasible because of the short time dimension of our panel (eight time periods).

Our findings (Tables 7A and 7B) show that the developmental component of aid has a positive, statistically significant impact on growth decades later: in particular, a 1 per cent increase in developmental aid in GDP is associated with average growth that is higher by almost 0.5 percentage points 10 years later, and higher by between 0.98 and 1.75 percentage points 25 years later. In contrast, multilateral aid and geopolitical aid have no statistically discernable impact on growth. In all regressions, the p-values of the Hansen over-identifying restriction test indicate that the GMM instruments are valid.

Further refinements and robustness checks

In this section, we seek to further refine our analysis and discuss additional results (some of which we selectively report in the paper). We focus on the following issues: first, we construct an alternative, distinct and plausibly exogenous proxy for developmental aid. Second, we specify richer aid-growth specifications in order to test a series of hypotheses: namely, the hypothesis that low and lower middle income countries are more effective at translating developmental aid into economic growth, as well as the conjectures that aid is more effective in 'better' policy environments and that there are diminishing returns to aid.

Alternative proxies for developmental aid

We propose an alternative proxy for developmental aid by identifying a plausibly exogenous source of variation in the amount of ODA received by developing countries. We posit that the amount of developmental aid extended to recipient countries is related to the quality of the agricultural season in those countries. An indicator of the quality of the agricultural season, which is highly correlated with crop yields, is the National Rainfall Index (henceforth, 'NRI') developed by FAO-SDRN.[18] The index is defined for areas where water is limiting for agricultural production. It represents the national average of the total annual precipitation weighted by its long-term average and it is available for all developing countries in our sample between 1960 and 2000.

We use the variation in NRI to predict the share of total aid in GDP received by developing countries by fitting the share of total aid in GDP using one-period lagged NRI and a fixed effects estimation procedure.[19] We then construct our developmental aid proxy by averaging the fitted values of the share of

18 The NRI data from FAO-SDRN is distinct from rainfall estimates used by Miguel (2004) and obtained from the FAOCLIM database (which ceased to be updated in the mid-1990s). In contrast, NRI data covers a broader span of countries and years.

19 Notably, both the fixed effects and the random effects estimation procedures yield the same coefficient estimates on NRI. Since there are no country-specific time-invariant country features which are systematically correlated with the included NRI.

total aid in GDP within each decade, and subsequently use this regressor in our cross-country OLS regressions. Once again, we allow developmental aid to translate into growth outcomes over a long time-horizon. It is implicitly assumed in the second stage specifications that NRI does not have an independent effect on growth other than via its effect on aid transfers.[20] The regression used to construct the DA proxy as well as the growth regressions for the 1990s are reported Appendix 8.[21]

We find that our previously identified statistically significant and positive effect of developmental aid on growth is robust to using this alternative proxy.[22] In particular, increasing the share of developmental aid by 1 per cent of GDP in any prior decade leads to GDP growth rates that are higher by roughly a quarter of a percentage point in the 1990s. However, in these specifications, our geopolitical aid proxy is no longer significant, which may be indicative that the negative, statistically significant relationship that we have previously uncovered is weak. This finding leaves open an alternative hypothesis concerning the geopolitical aid is on average growth-neutral.

Aid effectiveness and income threshold effects

In this section, we test whether the data is consistent with income threshold effects that may influence countries' ability to transform productive capital into economic growth. According to the poverty trap model outlined in Sachs and others (2004), capital thresholds may be responsible for the inability of less developed countries to embark on a path of sustained economic growth when these are combined with low savings rates and high population growth. The authors argue that a poverty trap inducing combination of low productivity capital, low savings rates and high population growth are the result of underlying structural causes (among which, high transport costs and small market size, low productivity agriculture, high disease burden, adverse geopolitics, and slow diffusion of technology from abroad).

The hypothesis we seek to test is whether aid has greater effectiveness in low or lower-middle income countries. To do so, we include a series of interaction terms between income-group dummies and developmental aid in our baseline specifications. We do not find evidence in favour of this hypothesis and thus do not report our results further. Since a very large share of the countries in our 107 country sample are low and lower-middle income countries, we face a problem of high correlation between the development aid proxy and its interaction with the low- and/or lower-middle income country dummies. Notwithstanding this variance-inflating problem, we find that the interaction term is mostly insignificant regardless of the proxy we use for developmental aid; however, the coefficient on developmental aid continues to be statistically significant, large and positive.

Aid, diminishing returns, and of the policy environment

We also tested the widely cited conjecture that aid is more growth-effective in "better" policy environments (Burnside and Dollar, 2000) as well as the hypothesis of diminishing marginal efficacy of developmental

20 We make this assumption based on approaches in the growth literature related to the inclusion of geographical variables which are considered to be determinants of growth (see, for example, Sala-i-Martin (1997) who only includes latitude, area, and continent dummies as geographical determinants of growth).

21 For reasons of space, we only report in the paper the growth regressions for the period 1990-2000 although we obtain significant (and qualitatively similar) results for the periods 1960-2000 as well as 1980-2000. The full set of results is available from the authors upon request.

22 The standard error estimates are not corrected for the use of generated regressors (predicted DA and RS-fitted GA), which requires that the threshold of significance must be set at a higher level than is customary in all regressions shown in Appendix 8.

aid (see, for example, Collier and Dollar, 2002 and many subsequent aid-growth studies). Specifically, we added quadratic terms of aid in our baseline specifications. The following alternative proxies were included as a proxy for the "quality" of the policy environment: the Sachs-Warner (1995) policy variable, the updated Sachs-Warner policy variable (Wacziarg and Welch, 2003), the World Bank CPIA ratings (used by Collier and Dollar, 2002), and a policy index representing the weighted average of budget surplus, inflation and trade openness (constructed by Burnside and Collier, 2000).[23] In regressions not reported here, we find no evidence that that aid raises growth only in a "good" policy environment (as interpreted by these measures) regardless of the proxy we use for developmental aid.

Conclusions

In this paper, we have attempted to provide new evidence concerning the growth effectiveness of official development assistance to developing countries. In particular, we have built upon the most comprehensive and careful estimates so far presented in the literature and re-estimated the causal relationship between aid and growth in a cross-section of aid recipients, allowing for different categories of aid to have distinct, possibly opposed effects on growth. We have attempted to disentangle the effects of two components of aid: a developmental, growth-enhancing component, and a geopolitical, possibly growth-depressing component. Each of the two categories of aid has been measured via appropriately constructed proxies and using relevant instrumental variables. Our specifications allow for the effect of aid on economic growth to be identifiable after long time-lags (possibly involving several decades).

We find that developmental aid has a strong, robustly significant and positive effect on growth. The coefficient estimates show a sizable marginal impact of developmental aid on growth: in cross-country regressions, an increase in average bilateral aid from Nordic countries by 1 per cent of GDP during 1960-1985 is associated with average growth rates in the 1990s that are higher by an (enormous) 1.5 percentage points. The effect is slightly smaller, yet equally remarkable, when bilateral aid from a larger number of donor countries is used as a proxy for developmental aid. In addition, multilateral aid has a strong, positive impact on growth. We also find that contemporaneous geopolitical aid is negatively correlated with growth. Countries which received 1 additional percentage of GDP in geopolitical aid have experienced average growth rates in the 1990s that are lower by between 0.06 and 0.09 percentage points. Panel regressions confirm the cross-sectional results: an increase in average bilateral aid from countries ranking highest according to the Commitment to Development Index by 1 per cent of GDP is associated with average growth rates 25 years later that are higher by 1.75 percentage points. A similar increase in bilateral aid from Nordic countries is associated with growth rates that are higher by 0.5 percentage points ten years later.

Our main findings concerning the growth-impact of developmental aid are robust to the choice among alternative proxies for this type of aid (including total aid as predicted by a rainfall index) and exclusion of outliers. Furthermore, we find *no* robust evidence in favour of the hypotheses that aid is more effective in lower income countries, that aid is more effective in "better" policy environments, and that there are diminishing returns to aid.

We conclude that, contrary to previous findings in the literature, certain types of aid (developmental aid) have a strong, positive impact on growth. Estimating models in which all sources of aid are aggregated into one quantity and presumed to have the same impact on economic growth may give rise to biased esti-

23 The latter was obtained from the online database associated with Easterly, Levine and Roodman (2004).

mates and lead to erroneous assessments of the growth-promoting potential effects of aid. This causal process appears to operate over several decades. This is not surprising. Developmental aid may support investments in physical infrastructure, organizational development and human capabilities which bear fruits only over long periods (consider, for instance, the long-term impact of investment in child health, nutrition and schooling). We find no evidence that aid is more effective in "good" policy environments, that aid is more effective in countries belonging to a particular income group, or that there are diminishing returns to aid.

The results of this study give rise to important policy implications. A change in the composition of aid toward developmental aid, and an increase in its quantity can be expected to create sizable returns in the long-run. The recent scepticism about aid based on cross-country studies of the impact of total aid on economic growth does not appear to be justified. There is an urgent need for a re-evaluation of the lessons learned from studies of the impact of aid on growth, and for further research aimed at identifying the growth effects of distinct categories of aid over relevant time periods.

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Appendix 1A. Derivation of the bias in the OLS estimator of the effect of Total Aid on Growth when the model is mis-specified

The hypothesized *True* model is: $\gamma = DA\beta_1 + GA\beta_2 + C\delta_T + \varepsilon_T$ (1) where:

- $\gamma =$ per capita income growth
- DA = developmental aid, with associated coefficient β_1
- GA = geopolitical aid, with associated coefficient β_2, and
- $C =$ matrix of suitable controls with
  $\delta_T =$ vector of coefficients on controls.

The *Estimated* model is: $\gamma = TA\beta + C\delta_R + \varepsilon_R$ (2) where

- TA = total aid = DA + GA and $E(TA \mid \varepsilon_R) = 0$ (e.g., lagged values of TA are used).

The OLS estimator of β is given by $[TA'M_C TA]^{-1}TA'M_C\gamma$ where M_C is the residual-maker matrix and therefore $M_C TA$ and $M_C\gamma$ are the residuals from the partialled-out regressions of TA and γ on the set of controls. Given (1), the OLS estimator can be re-written as:

$$\hat{\beta}^{OLS} = [TA'M_C TA]^{-1}TA'M_C[\beta_1 DA + \beta_2 GA + C\delta_T + \varepsilon_T]$$
$$= \beta_1[TA'M_C TA]^{-1}TA'M_C DA + \beta_2[TA'M_C TA]^{-1}TA'M_C GA +$$
$$+\delta_T[TA'M_C TA]^{-1}TA'M_C C + [TA'M_C TA]^{-1}TA'M_C\varepsilon_T$$

The last two terms are zero since $M_C C = 0$ and $M_C\varepsilon_T = 0$ (given exogeneity of C).

Using the fact that the residual-maker matrix is symmetric and idempotent, we can write:

$TA'M_C TA = TA'M_C{}'M_C TA = (M_C TA)'M_C TA$; the same relationship holds for DA and GA:
$TA'M_C DA = TA'M_C{}'M_C DA = (M_C TA)'M_C DA$ and
$TA'M_C GA = TA'M_C{}'M_C GA = (M_C TA)'M_C GA$. Denote $M_C TA = \widetilde{TA}$, $M_C DA = \widetilde{DA}$ and $M_C GA = \widetilde{GA}$ to obtain $\hat{\beta}^{OLS} = \beta_1(\widetilde{TA}'\widetilde{TA})^{-1}\widetilde{TA}'\widetilde{DA} + \beta_2(\widetilde{TA}'\widetilde{TA})^{-1}\widetilde{TA}'\widetilde{GA}$.

This can be re-written as: $\hat{\beta}^{OLS} = \beta_1\dfrac{\widehat{Cov}(\widetilde{TA},\widetilde{DA})}{\widehat{Var}(\widetilde{TA})} + \beta_2\dfrac{\widehat{Cov}(\widetilde{TA},\widetilde{GA})}{\widehat{Var}(\widetilde{TA})}$ (1). Furthermore, by the Law of Large Numbers, $\hat{\beta}^{OLS} \xrightarrow{P} \beta_1\dfrac{Cov(\widetilde{TA},\widetilde{DA})}{Var(\widetilde{TA})} + \beta_2\dfrac{Cov(\widetilde{TA},\widetilde{GA})}{Var(\widetilde{TA})}$, which means that the OLS estimator converges to a weighted average of the true coefficients

identifying the effect of Developmental and Geopolitical aid, respectively, and the weights are (positive) functions of the variances and covariances involving the two components of aid.

A test of the validity of the True Model is $\beta_1 = \beta_2$.

Appendix 1B. Derivation of the bias in the 2SLS estimator of the effect of Total Aid on Growth when the model is mis-specified

As before, the hypothesized *True* model is: $\gamma = DA\beta_1 + GA\beta_2 + C\delta_T + \varepsilon_T$ (1) where:

- $\gamma =$ per capita income growth
- DA = developmental aid, with associated coefficient β_1
- GA = geopolitical aid, with associated coefficient β_2, and
- $C =$ matrix of suitable controls with
  $\delta_T =$ vector of coefficients on controls.

The *Estimated* model is: $\gamma = TA\beta + C\delta_R + \varepsilon_R$ (2) where

- TA = total aid = DA + GA and $E(TA \mid \varepsilon_R) \neq 0$ due to reversed causality. For this reason, an instrumentation strategy is employed whereby TA is instrumented for with GA. GA fulfils only two of the three requirements for a proper instrument: relevance and exogeneity. However, GA has a direct effect on growth; hence it belongs to the true model.

β is estimated through Two Stage Least Squares. The two stages are outlined below:

1. In the first stage, we obtain exogenous variation in the instrumented variable: $TA = GA\pi + C\delta_1 + \varsigma$, yielding $\hat{\pi}^{OLS} = [GA' M_c GA]^{-1} GA' M_c TA$ and $\widehat{TA}$
2. in the second stage, we run the original regression replacing TA with the $\widehat{TA}$: $\gamma = \widehat{TA}\beta + C\delta_R + \varepsilon_R$. The 2LS estimator is $\hat{\beta}_{2SLS} = \left[\widehat{TA}' M_c \widehat{TA}\right]^{-1} \widehat{TA}' M_c \gamma$

By symmetry and idempotency of the residual-maker matrix, the first multiplicative term in the formula of $\hat{\beta}_{2SLS}$ is given by $\widehat{TA}' M_c \widehat{TA} = \widehat{TA}' M_c{}' M_c \widehat{TA} = (M_c \widehat{TA})' M_c \widehat{TA}$. Given the first stage, we have:
$M_c \widehat{TA} = M_c \left[GA\hat{\pi} + C\delta_1 \right] = \hat{\pi} M_c GA + M_c C\delta_1 = \hat{\pi} M_c GA$ since $M_c C = 0$. Therefore,
$\widehat{TA}' M_c \widehat{TA} = \left[\hat{\pi} M_c GA \right]' \hat{\pi} M_c GA = \hat{\pi}^2 GA' M_c GA$. The second multiplicative term is given by $\widehat{TA}' M_c \gamma = \left[M_c \widehat{TA} \right]' M_c \gamma = \left[\hat{\pi} M_c GA \right]' M_c \gamma = \hat{\pi} GA' M_c \gamma$

The 2SLS estimator becomes:

$$\hat{\beta}_{2SLS} = \left[\hat{\pi}^2 GA'M_c GA\right]^{-1} \hat{\pi} GA'M_c \gamma = \hat{\pi}^{-1}\left[GA'M_c GA\right]^{-1} GA'M_c \gamma$$

Now, replace $\hat{\pi}$ with its formula from the First Stage regression. First, note that:

$$\hat{\pi}^{-1} = \left[[GA'M_c GA]^{-1} GA'M_c TA\right]^{-1} = \left[GA'M_c TA\right]^{-1} GA'M_c GA$$

Then, $\hat{\beta}_{2SLS} = \left[GA'M_c TA\right]^{-1} GA'M_c GA\left[GA'M_c GA\right]^{-1} GA'M_c \gamma = \left[GA'M_c TA\right]^{-1} GA'M_c \gamma$

Using (1), we have that:

$$\hat{\beta}_{2SLS} = \left[GA'M_c TA\right]^{-1} GA'M_c \left[\beta_1 DA + \beta_2 GA + C\delta_T + \varepsilon_T\right] = \beta_1\left[GA'M_c TA\right]^{-1} GA'M_c DA +$$

$$+ \beta_2\left[GA'M_c TA\right]^{-1} GA'M_c GA + \left[GA'M_c TA\right]^{-1} GA'M_c \varepsilon_T$$

The last term is equal to zero since GA is exogenous. Thus,

$$\hat{\beta}_{2SLS} = \beta_1\left[GA'M_c TA\right]^{-1} GA'M_c DA + \beta_2\left[GA'M_c TA\right]^{-1} GA'M_c GA \quad (3)$$

Factor out $\left[GA'M_c TA\right]^{-1}$ to obtain: $\hat{\beta}_{2SLS} = \widehat{Cov}(\widetilde{GA},\widetilde{TA})^{-1}\left[\beta_1 \widehat{Cov}(\widetilde{DA},\widetilde{GA}) + \beta_2 \widehat{Var}(\widetilde{GA})\right]$

Finally, we obtain that the 2SLS estimator converges to a weighted average of the coefficients of developmental aid and geopolitical aid, with weights given by function of the variances and covariances involving the two variables (conditional on the set of covariates):

$$\hat{\beta}_{2SLS} \xrightarrow{P} \left[\beta_1 \frac{Cov(\widetilde{DA},\widetilde{GA})}{Cov(\widetilde{GA},\widetilde{TA})} + \beta_2 \frac{Var(\widetilde{GA})}{Cov(\widetilde{GA},\widetilde{TA})}\right]$$

Appendix 2. Variables and sources

Variable	Source
Multilateral aid, Bilateral aid, Bilateral aid broken down by donor [in 2003 million US$] (net, grants and loans)	OECD-DAC database
GA/GDP	Rajan and Subramanian (2005) or proxies constructed by the authors
Nominal GDP used to construct proxies of DA/GDP and GA/GDP [in 2000 million US$]	World Development Indicators (2006)
Initial per capita income	Rajan and Subramanian (2005)
Initial level of life expectancy	Rajan and Subramanian (2005)
Institutional quality	Rajan and Subramanian (2005)
Geography	Rajan and Subramanian (2005)
Initial level of government consumption	Rajan and Subramanian (2005)
Revolutions	Rajan and Subramanian (2005)
Growth rate of terms of trade	Rajan and Subramanian (2005)
Standard deviation of terms of trade	Rajan and Subramanian (2005)
Initial “level of policy” (updated Sachs-Warner variable)	Rajan and Subramanian (2005)
World Bank CPIA ratings	Rajan and Subramanian (2005)
Burnside and Dollar (2000) policy variable	Easterly, Levine and Roodman (2004)
Sachs-Warner policy variable	Sachs-Warner (1995)
National Rainfall Index	FAO, Environment and Natural Resources Service

Appendix 3. Selected summary statistics for Total Aid/GDP, Multilateral Aid/GDP, Bilateral Aid/GDP, proxies for Developmental Aid and Geopolitical Aid, and other variables used in the regressions

Table 3-1. Total Aid/GDP (TA/GDP)

Variable	Obs	Mean	Std. Dev.	Min	Max
TA/GDP 1960-1970	67	0.0729	0.0935	0.0000	0.4364
TA/GDP 1970-1980	67	0.0893	0.1087	0.0000	0.5701
TA/GDP 1980-1990	87	0.1147	0.1598	0.0000	0.8916

Table 3-2. Multilateral Aid/GDP (MA/GDP)

Variable	Obs	Mean	Std. Dev.	Min	Max
MA/GDP 1960-1970	67	0.0096	0.0141	-0.0001	0.0677
MA/GDP 1970-1980	76	0.0293	0.0395	0.0000	0.1715
MA/GDP 1980-1990	87	0.0390	0.0647	-0.0001	0.3813

Table 3-3. Bilateral Aid/GDP (BA/GDP)

Variable	Obs	Mean	Std. Dev.	Min	Max
MA/GDP 1960-1970	67	0.0096	0.0141	-0.0001	0.0677
MA/GDP 1970-1980	76	0.0293	0.0395	0.0000	0.1715
MA/GDP 1980-1990	87	0.0390	0.0647	-0.0001	0.3813

Table 3-4. Aid from Bilateral Donors (Group 1)/GDP (DA-G1/GDP)
Group 1:

Variable	Obs	Mean	Std. Dev.	Min	Max
DA-G1/GDP 1960-1970	67	0.0004	0.0012	0.0000	0.0064
DA-G1/GDP 1970-1980	76	0.0041	0.0152	0.0000	0.1206
DA-G1/GDP 1980-1990	87	0.0058	0.0174	0.0000	0.1260

Table 3-5. Aid from Bilateral Donors (Group 2)/GDP (DA-G2/GDP)

Variable	Obs	Mean	Std. Dev.	Min	Max
DA-G2/GDP 1960-1970	67	0.0016	0.0025	0.0000	0.0098
DA-G2/GDP 1970-1980	76	0.0095	0.0223	0.0000	0.1719
DA-G2/GDP 1980-1990	87	0.0139	0.0330	0.0000	0.2591

Table 3-6. Aid from Bilateral Donors (Group 3)/GDP (DA-G3/GDP)

Variable	Obs	Mean	Std. Dev.	Min	Max
DA-G3/GDP 1960-1970	67	0.0009	0.0017	-0.0001	0.0070
DA-G3/GDP 1970-1980	76	0.0066	0.0209	0.0000	0.1716
DA-G3/GDP 1980-1990	87	0.0111	0.0310	-0.0001	0.2551

Table 3-7. Aid from Bilateral Donors (Group 4)/GDP (DA-G4/GDP)

Variable	Obs	Mean	Std. Dev.	Min	Max
DA-G4/GDP 1960-1970	67	0.0410	0.0820	-0.0002	0.3856
DA-G4/GDP 1970-1980	76	0.0302	0.0431	0.0000	0.1924
DA-G4/GDP 1980-1990	87	0.0328	0.0529	0.0000	0.3117

Table 3-8. Geopolitical Aid/GDP

Variable	Obs	Mean	Std. Dev.	Min	Max
RS-predicted GA/GDP 1960-2000	107	0.1214	0.2688	0.0005	1.9194
RS-predicted GA/GDP 1970-2000	107	0.1065	0.2287	0.0004	1.5771
RS-predicted GA/GDP 1980-2000	107	0.1031	0.2188	0.0004	1.4053
RS-predicted GA/GDP 1990-2000	107	0.1016	0.2040	0.0003	1.3818

Table 3-9. Other variables used in cross-sectional regressions (1960-2000 average)

Variable	Obs	Mean	Std. Dev.	Min	Max
Average Annual Growth Rate of Per Capita GDP	86	1.3825	1.7510	-3.3734	6.7943
Initial Per Capita GDP	82	7.3858	0.6859	5.9442	8.9671
Initial Level of Life Expectancy	97	48.8192	10.9880	31.6100	71.6800
Institutional Quality	88	0.5271	0.1234	0.2250	0.8590
Geography	89	-0.4722	0.8306	-1.0400	1.7839
Initial Government Consumption	107	17.0369	12.3362	1.3766	65.0415
Revolutions	107	0.2243	0.2354	0.0000	1.4444
Average: Terms of trade	107	112.0005	21.7761	66.6658	176.2134
St dev: Terms of trade	107	23.8871	18.1735	0.0058	94.3235
Initial Sachs-Warner policy	107	0.0187	0.1361	0.0000	1.0000

Table 3-10. Contribution of each group of donors to net total aid and bilateral aid, by decade

Donor group	Decade	Share of Bilateral Aid[a]	Share of Total Aid
DA-G1	1960s	0.7	0.6
	1970s	4.0	3.0
	1980s	6.0	4.4
	1990s	7.2	5.0
DA-G2	1960s	4.0	3.7
	1970s	11.5	8.8
	1980s	15.7	11.4
	1990s	16.3	11.3
DA-G3	1960s	1.8	1.7
	1970s	7.6	5.8
	1980s	11.2	8.2
	1990s	11.7	8.1
DA-G4	1960s	25.9	24.0
	1970s	25.4	19.4
	1980s	27.7	20.3
	1990s	30.5	21.1

[a] All 107 countries that enter the regression analysis are used in these calculations.

Appendix 4. The effect of Total Aid on Growth. Replication of the results in RS (2005)

Table 4-1. Regressions including the same lags as RS.

Dependent variable: Average Annual Growth Rate of Per Capita GDP

Period over which GDP growth is explained	1960-2000	1960-1980	1970-2000	1980-2000	1990-2000
Period over which TA/GDP is lagged	1960-1970	1960-1970	1960-1980	1970-1980	1980-1990
TA/GDP lagged	-0.16	-2.97	0.99	2.98	*5.21***
	[2.76]	[2.95]	[2.00]	[2.79]	*[2.09]*
Observations	61	58	64	64	77
R-squared	0.73	0.51	0.72	0.68	0.56

Robust standard errors in brackets
* significant at 10%; ** significant at 5%; *** significant at 1%
Intercept and all controls as in RS (2005) are included, but coefficients not shown.
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Table 4-2A. Regressions for growth in the 1990s, including different lags than RS.

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which TA/GDP is lagged	1960-1965	1960-1970	1960-1975	1960-1980	1960-1985
TA/GDP lagged	3.9451	*6.0646***	*7.9111***	*8.4490***	*8.0199***
	[3.7457]	[2.8802]	[3.2969]	[3.3076]	[3.3997]
Observations	64	64	64	64	64
R-squared	0.62	0.63	0.64	0.65	0.64

Table 4-2B.

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which TA/GDP is lagged	1960-1990	1970-1980	1970-1990	1980-1990	1990-2000
TA/GDP lagged	*8.2196***	*6.7051***	*6.7692***	*5.2080***	*8.6552****
	[3.5666]	*[2.8989]*	*[2.7108]*	*[2.0851]*	*[3.2080]*
Observations	64	64	70	77	84
R-squared	0.64	0.64	0.61	0.56	0.54

In both tables:
Robust standard errors statistics in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
Intercept and all controls as in RS (2005) are included, but coefficients not shown.

Appendix 5. The effect of Developmental and Geopolitical Aid on Growth in the 1990s

Table 5A. Developmental Aid = Multilateral Aid
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP is lagged	1965-1970	1960-1970	1960-1975	1960-1980
Lagged MA/GDP	*49.0541***	*58.9424***	*57.2925***	*47.1262***
	[17.2589]	*[22.2058]*	*[17.4080]*	*[13.3617]*
RS predicted GA/GDP	-5.8826	-4.8461	*-7.3931***	*-8.6034***
	[4.1722]	[4.2949]	*[3.6465]*	*[3.6930]*
Observations	65	64	64	64
R-squared	0.66	0.65	0.66	0.66

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP is lagged	1960-1985	1960-1990	1970-1980	1970-1990	1980-1990
Lagged MA/GDP	*44.5292***	*39.9140***	*27.0409***	*30.3269***	*27.4650***
	[12.9242]	*[11.8151]*	*[12.3445]*	*[12.1674]*	*[9.4152]*
RS predicted GA/GDP	*-9.9379***	*-9.5007***	-1.8803	*-4.6880**	*-6.8091***
	[3.6301]	*[3.7378]*	[2.3777]	[2.3884]	*[2.5090]*
Observations	64	64	70	70	77
R-squared	0.66	0.66	0.63	0.64	0.58

In both tables:
Robust standard errors statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%
All controls as in RS (2005) are included, but coefficients not shown.
Intercept is included, but estimate not shown.

Table 5B. Developmental Aid = Aid from Bilateral Aid donors (Group G1) and Multilateral Aid
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1980-2000

Period over which MA/GDP and DA-G1/GDP are lagged	1960-1965	1960-1970	1960-1975	1960-1980	1970-1980	1980-1990
Lagged DA-G1 /GDP	-468.9356	107.0161	*102.8898***	*76.0352***	*27.5129***	11.1610
	[1,252.1411]	[120.4497]	*[46.8476]*	*[30.7858]*	*[11.1940]*	[8.7103]
Lagged MA/GDP	19.4459	17.6002	15.8784	15.1552	8.4909	-3.5625
	[28.1992]	[21.4851]	[19.0469]	[15.3419]	[9.0052]	[6.7655]
RS predicted GA/GDP	1.1460	-0.1962	-0.9300	-1.9097	-1.2462	2.0157
Observations	64	64	64	64	70	77
R-squared	0.68	0.68	0.69	0.69	0.70	0.67

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G1/GDP are lagged	1960-1970	1960-1975	1960-1980	1960-1985
Lagged DA-G1/GDP	*483.4241****	*259.8359****	*175.3491****	*159.8369****
	[166.4596]	*[56.2828]*	*[41.0479]*	*[39.5655]*
Lagged MA/GDP	*60.6419****	*56.6145****	*46.4336****	*43.8606****
	[20.7534]	*[16.2198]*	*[10.9762]*	*[10.4647]*
RS predicted GA/GDP	*-4.8363*	*-6.3518**	*-8.2192***	*-9.5503****
	[4.0390]	*[3.3520]*	*[3.3150]*	*[3.2944]*
Observations	64	64	64	64
R-squared	0.67	0.70	0.70	0.70

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G1/GDP are lagged	1960-1990 Regression ** for Graph 2	1970-1980	1970-1990 Regression * for Graph 1	1980-1990
Lagged DA-G1/GDP	*153.5850****	*67.3481****	*66.6559****	*51.2740****
	[42.4039]	*[15.9009]*	*[19.6409]*	*[14.7204]*
Lagged MA/GDP	*41.6750****	*32.4045****	*31.8847****	*23.3927****
	[9.8209]	*[10.6050]*	*[10.2148]*	*[8.3534]*
RS predicted GA/GDP	*-9.8350****	*-7.1934****	*-9.9309****	*-9.2094****
	[3.3616]	*[2.1513]*	*[2.7349]*	*[2.0442]*
Observations	64	70	70	77
R-squared	0.70	0.68	0.68	0.62

In all tables: Robust standard errors statistics in parentheses. *significant at 10%; ** significant at 5%; *** significant at 1%. All controls as in RS (2005) are included, but coefficients not shown. Intercept is included, but estimate not shown.

Table 5C. Developmental Aid = Aid from Bilateral Aid donors (Group G2) and Multilateral Aid
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1980-2000

Period over which MA/GDP and DA-G2/GDP are lagged	1960-1965	1960-1970	1960-1975	1960-1980	1970-1980	1980-1990
Lagged DA-G2 /GDP	75.2632	*73.3206***	*64.4445***	*36.6862****	*22.2288***	10.7207
	[86.3186]	*[34.3595]*	*[25.0318]*	*[12.7049]*	*[8.7989]*	[7.4477]
Lagged MA/GDP	18.3097	12.6607	11.4163	6.1480	6.4870	-5.9784
	[22.3178]	[19.1394]	[14.7901]	[10.8164]	[8.4297]	[7.8316]
RS predicted GA/GDP	-0.1459	-0.6427	-1.8809	-1.6288	-1.2341	1.9707
	[3.4515]	[4.0857]	[4.3000]	[4.8144]	[1.4651]	[1.5317]
Observations	64	64	64	64	70	77
R-squared	0.68	0.68	0.69	0.70	0.70	0.67

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G2/GDP are lagged	1960-1970 *Regression *** for Graph 3*	1960-1975	1960-1980	1960-1985
Lagged DA-G2/GDP	*302.9843**	*184.5499****	*142.7371****	*132.2320****
	[168.7915]	*[45.1491]*	*[31.6513]*	*[31.0158]*
Lagged MA/GDP	*64.2021****	*48.2258****	*37.2588****	*32.4877****
	[20.9855]	*[15.1613]*	*[9.0320]*	*[8.3589]*
RS predicted GA/GDP	-4.1913	-4.6837	*-6.9700***	*-7.6081***
	[4.0191]	[3.4861]	*[3.3745]*	*[3.4728]*
Observations	64	64	64	64
R-squared	0.69	0.72	0.73	0.73

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G2/GDP are lagged	1960-1990	1970-1980	1970-1990 *Regression **** for Graph 4*	1980-1990
Lagged DA-G2/GDP	*128.2503****	*51.6666****	*46.4950****	*32.3331****
	[32.6178]	*[11.9024]*	*[13.5186]*	*[8.5654]*
Lagged MA/GDP	*30.0364****	*27.9139****	*26.9011****	*19.4440***
	[7.9370]	*[9.9807]*	*[9.4529]*	*[8.2715]*
RS predicted GA/GDP	*-7.4680***	*-6.7158****	*-9.5508****	*-9.0682****
	[3.4890]	*[2.1699]*	*[2.7968]*	*[2.1161]*
Observations	64	70	70	77
R-squared	0.73	0.69	0.69	0.63

In all tables: Robust standard errors statistics in parentheses
*significant at 10%; ** significant at 5%; *** significant at 1%
All controls as in RS (2005) are included, but coefficients not shown.
Intercept is included, but estimate not shown.

Table 5D. Developmental Aid = Aid from Bilateral Aid donors (Group G3) and Multilateral Aid
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G3/GDP are lagged	1960-1970	1960-1975	1960-1980	1960-1985
Lagged DA-G3/GDP	*436.7097***	*252.9732****	*175.8611****	*158.9654****
	[167.3219]	*[59.2841]*	*[41.2603]*	*[41.6505]*
Lagged MA/GDP	*63.8642****	*53.8072****	*41.7909****	*37.1728****
	[19.8032]	*[16.1435]*	*[10.1866]*	*[9.3893]*
RS predicted GA/GDP	-4.5502	*-6.0332**	*-7.8482***	*-8.6495***
	[3.8522]	*[3.3313]*	*[3.2705]*	*[3.3098]*
Observations	64	64	64	64
R-squared	0.69	0.71	0.72	0.72

Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G3/GDP are lagged	1960-1990	1970-1980	1970-1990	1980-1990
Lagged DA-G3/GDP	*157.7138****	*51.8566****	*44.9139****	*32.6445****
	[43.8141]	*[13.9669]*	*[14.3833]*	*[9.5678]*
Lagged MA/GDP	*34.6060****	*31.0485****	*29.3779****	*21.0787***
	[8.7127]	*[10.6226]*	*[10.0879]*	*[8.4024]*
RS predicted GA/GDP	*-8.8729****	*-7.4897****	*-10.1117****	*-9.7199****
	[3.2847]	*[2.5082]*	*[3.0000]*	*[2.1959]*
Observations	64	70	70	77
R-squared	0.72	0.68	0.68	0.62

In all tables: Robust standard errors statistics in parentheses. *significant at 10%; ** significant at 5%; *** significant at 1%. All controls as in RS (2005) are included, but coefficients not shown. Intercept is included, but estimate not shown.

Table 5E. Developmental Aid = Aid from Bilateral Aid donors (Group G4) and Multilateral Aid
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G4/GDP are lagged	1960-1970	1960-1975	1960-1980	1960-1985
Lagged DA-G4/GDP	*8.0934***	*9.4691***	*11.9034***	*13.8141***
	[2.4717]	*[3.4133]*	*[4.0801]*	*[5.3668]*
Lagged MA/GDP	*56.4610***	*49.4445***	*39.1540***	*32.9734***
	[20.7385]	*[18.0620]*	*[12.7657]*	*[12.9755]*
RS predicted GA/GDP	*-7.3960**	*-9.1146***	*-10.1374***	*-10.5772****
	[4.2203]	*[3.8241]*	*[3.8059]*	*[3.6605]*
Observations	64	64	64	64
R-squared	0.67	0.68	0.68	0.68

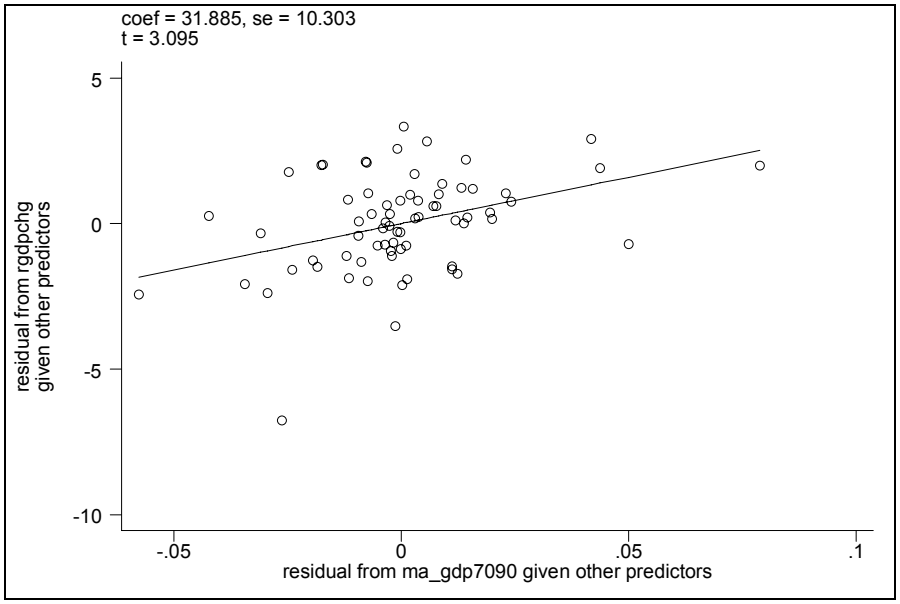
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which MA/GDP and DA-G4/GDP are lagged	1960-1990	1970-1980	1970-1990	1980-1990
Lagged DA-G4/GDP	*17.1864***	*24.6365***	*37.0269****	*29.4028****
	[6.4831]	*[9.6243]*	*[12.2681]*	*[8.9823]*
Lagged MA/GDP	*26.4530***	14.5696	7.8664	7.9007
	[12.6686]	[13.5065]	[14.1216]	[12.3310]
RS predicted GA/GDP	*-10.0707****	*-3.1543**	*-5.7053****	*-6.5966****
	[3.7461]	*[1.6900]*	*[1.6876]*	*[2.2401]*
Observations	64	70	70	77
R-squared	0.68	0.65	0.66	0.61

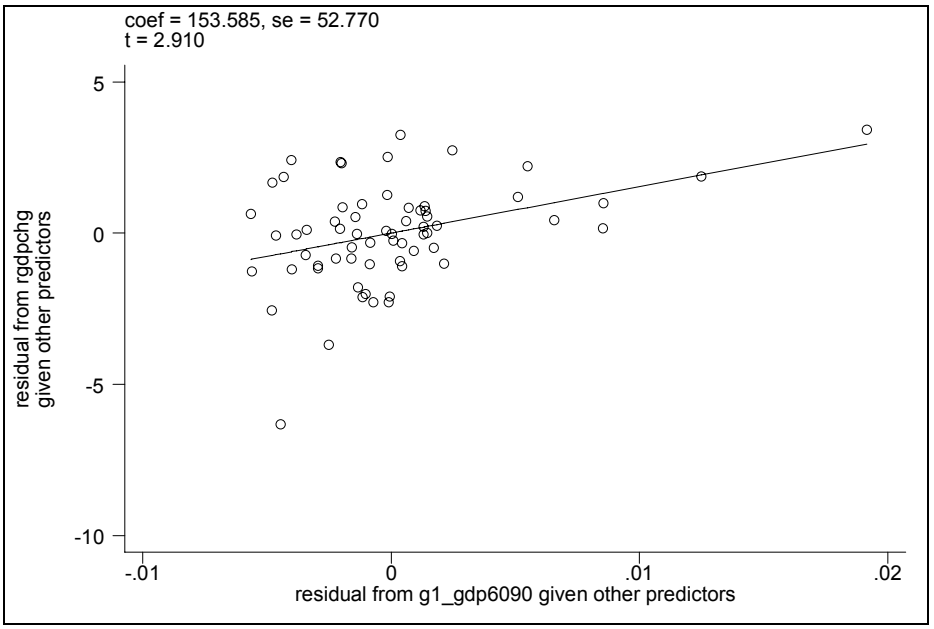
In all tables: Robust standard errors statistics in parentheses. *significant at 10%; ** significant at 5%; *** significant at 1%. All controls as in RS (2005) are included, but coefficients not shown. Intercept is included, but estimate not shown.

Appendix 6. Partial scatterplots of Growth and Aid.

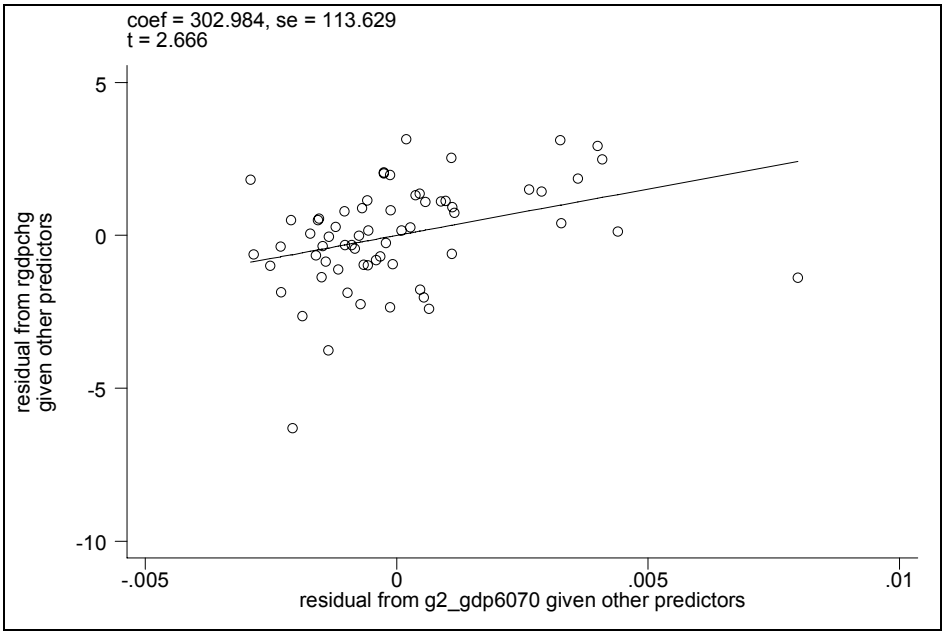
Graph 1. Partial scatterplot of Growth and Multilateral Aid (Regression * in Table 5B)



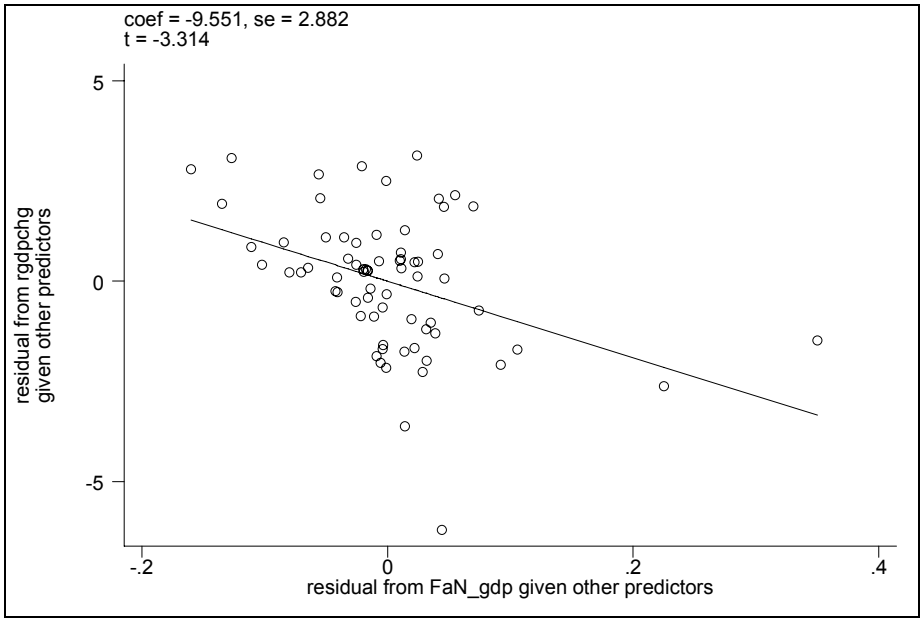
Graph 2. Partial scatterplot of Growth and Developmental Aid from Group G1 donor countries (Regression ** in Table 5B)



Graph 3. Partial scatterplot of Growth and Developmental Aid from Group G2 donor countries (Regression *** in Table 5C)



Graph 4. Partial scatterplot of Growth and Geopolitical Aid (Regression **** in Table 5C)



Appendix 7. Panel regressions ("system" GMM)

Table 7. Developmental Aid = Aid from Bilateral Aid donors (Group G1, G2, G3 and G4) and Multilateral Aid. Each category of aid is lagged *five periods*.
Dependent variable: Average Annual Growth Rate of Per Capita GDP

Developmental aid = Aid from bilateral donors in →	Group G1	Group G2	Group G3	Group G4
Lagged DA /GDP	*175.11***	*98.65***	*176.87***	5.24
	[59.03]	*[27.35]*	*[54.73]*	[4.81]
Lagged MA/GDP	4.36	-6.27	-1.89	-0.48
	[17.61]	[19.03]	[22.12]	[15.33]
Lagged GA/GDP[a]	1.94	2.24	2.06	1.85
	[4.53]	[5.19]	[4.37]	[6.62]
Wald chi2 (14)	244.39	249.10	230.63	258.93
p-value Wald test	0.000	0.000	0.000	0.000
p-value Hansen test of over identifying restrictions	0.924	0.870	0.920	0.853
Observations	196	196	196	196
# of countries	71	71	71	71

In the table above: Robust standard errors statistics in parentheses.
*significant at 10%; ** significant at 5%; *** significant at 1%.
All controls as in RS (2005) are included, but coefficients not shown.
Intercept is included, but estimate not shown.

[a] Geopolitical aid (GA) is defined as the difference between Total aid (TA) and the sum between multilateral aid and bilateral aid from each group of donor countries (G1, G2, G3 and G4).

Appendix 8. Alternative proxies for Developmental Aid.

Table 8A. Predicting TA/GDP with the average National Rainfall Index
Dependent variable: TA/GDP

	Fixed effects	Random effects
FAO-NRI lagged one period	*-0.000022*	*-0.000019*
	*(2.73)***	*(2.74)***
Constant	0.123907	0.117987
	(11.92)**	(8.33)**
Observations	3438	3438
# of countries	107	107
R-squared	0.0171	0.0171

T-statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 8B. Aid-Growth regressions. Developmental Aid = TA/GDP predicted by the NRI
Dependent variable: Average Annual Growth Rate of Per Capita GDP 1990-2000

Period over which predicted DA/GDP is lagged	1960-1970	1960-1975	1960-1980	1960-1985
Lagged predicted DA/GDP	*24.3099** [12.1672]*	*23.4091* [11.7753]*	*22.7454* [11.7891]*	*23.5119* [11.8538]*
RS predicted GA/GDP	1.3991 [1.7983]	1.3695 [1.7963]	1.3565 [1.7985]	1.3483 [1.7951]
Observations	84	84	84	84
R-squared	0.50	0.50	0.50	0.50

Dependent variable: Average Annual Growth Rate of Per Capita GDP, 1990-2000

Period over which predicted DA/GDP is lagged	1960-1990	1970-1980	1970-1990	1980-1990
Lagged predicted DA/GDP	*23.4592** [11.7596]*	*21.3581* [11.4885]*	*23.0043* [11.5921]*	*24.5094** [11.6949]*
RS predicted GA/GDP	1.3350 [1.7923]	1.3257 [1.7984]	1.3105 [1.7900]	1.2927 [1.7807]
Observations	84	84	84	84
R-squared	0.50	0.50	0.50	0.50

In all tables: Robust standard errors statistics in parentheses.
*significant at 10%; ** significant at 5%; *** significant at 1%.
All controls as in RS (2005) are included, but coefficients not shown.
Intercept is included, but estimate not shown.