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Abstract

This paper examines the relationship between foreign aid and growth in real GDP per capita as it emerges from simple augmentations of popular cross-country growth specifications. It is shown that aid in all likelihood increases the growth rate, and this result is not conditional on 'good' policy. There are, however, decreasing returns to aid, and the estimated effectiveness of aid is highly sensitive to the choice of estimator and the set of control variables. When investment and human capital are controlled for, no positive effect of aid is found. Yet, aid continues to impact on growth via investment. We conclude by stressing the need for more theoretical work before this kind of cross-country regressions are used for policy purposes.

JEL classification: O1; O2; O4; C23

Key words: Aid impact; Economic growth; Investment; Generalized method of moments; Panel data

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1 Introduction

The past 30 years have witnessed the publication of a large number of studies on aid effectiveness. The methods employed to study the subject range from detailed case studies at the project level to regression analyses of the growth impact of aid in samples of almost a hundred countries. The micro and macro analyses have generally been perceived to yield different results; many successful projects leaving no lasting imprint on economy wide growth rates. We concentrate in this paper on the aid-growth relation at the macro level as it emerges from cross-country regressions based on large panel data sets.

We compare recent growth studies in which the relationship between aid and growth is modeled as non-linear. On the one side, Burnside and Dollar (2000) have found evidence of threshold effects by the introduction of an aid-policy interaction term in the growth regressions. In their model, aid contributes positively to growth, but only in good policy environments. On the other side, Hadjimichael et al. (1995), Durbarry et al. (1998), and Lensink and White (1999) have found positive, but decreasing marginal returns to aid flows, by the introduction of aid squared. As none of the studies provide models that encompass both possibilities we start by formulating a unified empirical model where quadratic aid and policy terms appear alongside the aid-policy interaction. A reduction to the Burnside-Dollar specification is not supported by the data. This is important in view of the widespread attention paid to the Burnside-Dollar results.

Concern about simultaneity bias in aid-growth regressions, caused by potential endogeneity of aid, is another common feature in recent studies. To our surprise, they all find negligible bias. Due to the importance of this finding for the conclusions drawn about the impact of aid, we re-visit the endogeneity issue and suggest an explanation for why others conclude that aid is exogenous. There are strong signs of biased results once the model is enlarged to take account of country specific effects. We argue that such effects are important and proceed to estimate a fairly standard growth model using ordinary least squares as well as a generalized method of moments estimator that yield consistent estimates, also in the presence of both endogenous regressors and country specific effects. Compared to the other studies mentioned, we find very different (and positive) estimates of the impact of aid.

Turning to the question why aid increases growth, we include investment and human capital in the growth regression. The result is that, conditional on these variables, aid has no effect on growth. We interpret this finding as supportive of the view that aid affects growth via capital accumulation. An equation for gross domestic investment as a share of GDP is also estimated. By introducing aid squared we allow for level effects by which the fraction of aid that is actually invested can change with the aid dependency ratio. It emerges that in the majority of countries, there is a one-to-one relation between increased aid flows and increased investment.

The remainder of the paper is organized as follows: In section 2 we compare the latest cross-country aid-growth regressions. In section 3 we give results for the model when endogeneity of aid and country specific effects are taken into account. The model is respecified to include the main determinants of capital accumulation in section 4, in which we also examine the impact of aid on investment. Section 5 concludes.

2 Cross-country aid effectiveness studies

Hansen and Tarp (2000) provide a survey of empirical analyses from the last 30 years that make use of cross-country regressions in assessing the effectiveness of foreign aid. From 131 such regressions, a reasonably consistent pattern emerges: (i) aid increases aggregate saving, although not by as much as the aid flow, (ii) aid increases investment, and (iii) aid has a positive effect on the growth rate whenever growth is driven by capital accumulation.

In the 1990s a new generation of aid effectiveness studies appeared focusing on the relations between aid, policies, and growth. Boone (1994, 1996) signaled the shift, showing that aid has no impact on investment or growth in standard neo-classical growth models. The result was substantiated by panel data regressions based on a sample of more than 90 countries covering twenty years.[1]

Boone's theoretical results have later been qualified. Obstfeld (1999) shows that within the class of growth models, considered by Boone, an increase in aid raises both consumption and investment as well as the growth rate provided the economy is initially below the steady state.[2]

Boone's empirical results have also been questioned. The studies by Hadjimichael et al. (1995), Durbarry et al. (1998), Lensink and White (1999), and Burnside and Dollar (2000) are all based on fairly standard cross-country growth relations, modified to analyse the effectiveness of aid by adding foreign aid as a fraction of GDP. These studies have a lot in common, including overlap in samples and estimation methods; and in contrast to Boone (1994), they all find a positive impact of aid on growth. The crux of this difference is that while Boone treats the aid-growth relation as linear it is modelled as non-linear in the four other studies. Nevertheless, the empirical formulation of the non-linear relation is not the same. Burnside and Dollar use an interaction term between aid and an index of economic policy. The three other studies include aid squared as regressor.

The theoretical arguments put forward to motivate the non-linear specifications of the aid-growth relation varies. Hadjimichael et al. refer to absorptive capacity constraints. Durbarry et al. discuss Dutch disease problems and capacity constraints, and Lensink and White consider inappropriate technology and institutional destruction caused by the aid inflow. These causal mechanisms can all be interpreted as ways in which economic policy impacts on aid effectiveness. Capacity constraints and institutional destruction are closely related to macroeconomic governance, and Dutch disease reflects poor management of the exchange rate and domestic fiscal and monetary policy.

Burnside and Dollar focus explicitly on the impact of policy on aid effectiveness. They note that in a neoclassical growth model the impact of aid on growth will be greater when there are fewer policy distortions affecting the incentives of economic agents. Hence, they hypothesize that synergy effects among aid and policy are critically important. These effects may work either through increased productivity of capital or because a larger fraction of the aid flow is actually invested.

The theoretical arguments provide no conclusive basis on which to distinguish between aid-policy interactions and diminishing returns to aid. The preferred formulation of the non-

[1] The lack of empirical association between aid and growth was also remarked by Mosley, Hudson, and Horrell (1987, 1992).

[2] A move towards endogenous growth models can be found in Lensink and White (1999). They analyse the effectiveness of aid in a model with productive public expenditure, as in Barro (1990).

linearity is in other words an empirical issue. We therefore proceed to evaluate the statistical significance of the synergy effect between aid and policy, on the one hand, and decreasing marginal returns to aid, on the other, within the same regression model. Results are shown in Table 1 in which the average rate of growth in per capita GDP in 56 countries and five periods, covering the years 1974-1993, is regressed on several policy and institutional control variables and aid. Throughout aid is measured as official development assistance, ODA, relative to the World Bank Data on GDP.

As the study by Burnside and Dollar is at odds with the three other studies and since it is the most widely known among the four, we find it appropriate to formulate the initial regression model in accordance with the specification used in Burnside and Dollar (2000) adding aid squared and policy squared to the regressors, though. The central indicators of macroeconomic policy are the budget surplus relative to GDP, inflation, and trade openness, measured by the indicator variable defined by Sachs and Warner (1995). The three policy variables are used to construct a policy index, given by

$$Policy = 1.28 + 6.85\,Budget\ surplus - 1.4\,Inflation + 2.16\,Openness.$$

In addition to the central economic policy variables a number of other political and institutional indicators which have appeared in empirical growth studies over the last decade, are included. Specifically, the state of the financial system is proxied by M2 relative to GDP while ethnolingustic fractionalization, assassinations, and a measure of institutional quality are included to capture political instability and government bureaucracy.

The final control variable, apart from regional and period dummies, is the logarithm of the initial level of per capita GDP. This regressor captures the conditional convergence effects, which have been found in almost all empirical growth studies in the 1990s.[3]

Turning to the aid regressors, our general model includes aid, aid squared, aid times policy, and policy squared. Together with the three variables in the policy index these four regressors form the aid-policy response surface in a second-order polynomial regression. As the model is linear in the parameters it is simple to estimate using standard regression techniques. Thereby the importance of the individual terms in the response surface can be evaluated statistically.

A topic related to polynomial regressions, and non-linear regressions in general, is the interpretation of parameter estimates. In the models estimated by Hadjimichael et al. (1995), Durbarry et al. (1998), and Lensink and White (1999) the aid variables are included as uncentered regressors. As a result the estimated coefficient to the aid variable is a measure of the partial effect of aid on growth evaluated at no (zero) aid. We have chosen to center the aid variable around the sample mean, so the estimated aid-coefficient is the marginal effect of aid on growth evaluated at the mean, 0.061. Throughout, we also report the marginal effect at the median, 0.028. We do this because the distribution of aid over countries and time is extremely skewed. Hence, in terms of country coverage the effectiveness of aid is of more interest at the median than at the mean.

A final technical issue concerns the estimation method. Again, following Burnside and Dollar, we show results of instrumental variable estimations in which all regressors involving aid are treated as endogenous. We use, however, a different set of instruments. The main change is that we include all the aid regressors lagged one period. This extension leads to improvements

[3]Detailed data definitions and sources are given in Appendix A.

Table 1: Growth regressions with polynomial effects of aid and policy

Dependent variable	Annual growth rate in GDP per capita					
Sample	56 countries, 5 periods (1974-77 to 1990-93)					
Regression	1.1	1.2	1.3	1.4	1.5	1.6
Aid	0.238	0.241	0.044	0.262	0.274	0.134
	(2.28)	(2.34)	(1.08)	(2.56)	(2.64)	(2.49)
Aid^2	−0.754	−0.763		−0.570	−0.699	
	(2.31)	(2.38)		(2.02)	(2.52)	
Aid x Policy	−0.006		−0.004	0.052		0.097
	(0.22)		(0.15)	(1.26)		(2.22)
Policy^2	0.0002			0.002		
	(0.26)			(2.22)		
Budget surplus	0.096	0.091	0.077	0.114	0.103	0.081
	(2.36)	(2.49)	(1.89)	(2.63)	(2.56)	(1.95)
Inflation	−0.013	−0.011	−0.013	−0.016	−0.007	−0.015
	(2.22)	(2.30)	(2.86)	(2.44)	(1.46)	(2.35)
Openness	0.016	0.017	0.019	0.015	0.018	0.025
	(2.67)	(3.36)	(3.66)	(2.62)	(3.56)	(5.10)
Financial depth	0.010	0.010	0.018	0.012	0.010	0.018
	(0.54)	(0.55)	(1.12)	(0.62)	(0.50)	(0.98)
Ethnic fract.	0.002	0.001	−0.002	0.002	0.003	−0.001
	(0.18)	(0.12)	(0.21)	(0.25)	(0.33)	(0.12)
Assassinations	−0.454	−0.460	−0.418	−0.458	−0.485	−0.427
	(1.98)	(2.02)	(1.86)	(1.99)	(2.16)	(1.89)
Ethnic x Assas.	0.911	0.919	0.775	0.899	0.959	0.783
	(2.15)	(2.17)	(1.89)	(2.11)	(2.30)	(1.87)
Inst. quality	0.811	0.810	0.676	0.836	0.824	0.762
	(4.57)	(4.57)	(4.26)	(4.82)	(4.60)	(4.66)
Initial GDP per capita	0.001	0.001	−0.002	0.001	0.002	−0.001
	(0.13)	(0.14)	(0.33)	(0.10)	(0.26)	(0.19)
Effect of aid at median	0.289	0.291	0.045	0.287	0.320	0.110
	(2.31)	(2.37)	(1.14)	(2.37)	(2.64)	(2.24)
Degrees of freedom	211	213	213	206	208	208
DWH test[a]	0.22	0.11	0.3	0.15	0.05	0.14
Sargan test[b]	0.47	0.65	0.1	0.87	0.75	0.38
$\hat{\sigma}_{\varepsilon} \times 100$	3.0	2.99	2.97	2.97	2.99	2.95

[a]The p-value of the Durbin-Wu-Hausman test for equality of the OLS and the IV estimates. [b]The p-value of Sargan's test for overidentifying restrictions. Heteroskedasticity consistent t-values in parenthesis. Time dummies and dummies for Sub-Saharan Africa and East Asia are included in all regressions. Regressions 1.4, 1.5, and 1.6 exclude five observations as discussed in the main text. The five observations are: Nicaragua (1986-89, 1990-93), Gambia (1986-89, 1990-93) and Guyana (1990-93). Instruments: Dummy for Egypt, Arms imports$(t-1)$, Policy $(t-1)$, Policy^2 $(t, t-1)$, Policy × ln(population), Policy × Initial GDP per capita, Policy × (Initial GDP per capita)^2, Policy × aid $(t-1)$, Policy × aid^2 $(t-1)$, aid $(t-1)$, aid^2 $(t-1)$. The reduced form partial R^2 measures for the endogenous regressors, Aid, Aid^2 and Aid×policy, are 0.30 (0.30), 0.38 (0.33), and 0.38 (0.39) in regression 1.1 (1.4) , respectively.

in efficiency measured by the reduced form R^2 for the endogenous regressors without leading to a rejection of the over-identifying restrictions.[4]

Turning to the results, regression (1.1) in Table 1 is the general model that encompasses the two contesting, more specific formulations, as special cases which can be obtained by parametric restrictions. Quite a few of the control variables are highly insignificant having t-values well below one but the results for the non-aid related variables are in accordance with the findings in Burnside and Dollar (2000). The estimation results for the aid variables in regression (1.1) indicate that the statistically preferred model includes aid squared, but no interaction term.[5] The model excluding interaction and policy squared is reported as regression (1.2). Evaluated from (1.1) and (1.2) aid appears to be quite efficient. An increase of one percentage point in the aid/GDP ratio leads to an increase of roughly 0.25 percentage point in the growth rate when the effect is evaluated at the average level of aid/GDP. The positive marginal effect decreases quite fast, and the turning point for which the marginal effect of an increase in aid becomes negative is within the sample range. Nonetheless, the specific aim of this section is not to evaluate the effectiveness of aid, per se. Instead focus is on evaluating the regression specifications proposed in other studies within a unified empirical framework.

If aid and policy are correlated, insignificance of the interaction term may be caused by collinearity problems, whereby the squared terms capture the potential significance of aid-policy interaction. One simple way to check this is to estimate the model without the squared aid and squared policy terms. This leads to the Burnside and Dollar specification in regression (1.3). Neither aid nor the interaction between aid and policy are significant in this reduction of the general model.[6] This indicates that collinearity is not the cause of lacking significance of the interaction term.

Another simple test of the functional form is to compare the full sample results in (1.1)-(1.3) with results based on the sample preferred by Burnside and Dollar. This test is interesting because Burnside and Dollar did not obtain a significant estimate of the aid policy interaction in the full sample because five outliers affected their results.

Regressions (1.4)-(1.6) report estimation results based on a sample in which the five observations are excluded. Comparing (1.1) and (1.4) it appears that two coefficients are highly influenced by the five observations. Policy squared increases ten fold and becomes significant even at a 5 percent level, and the interaction term turns positive, although still insignificant in this model specification.

Comparing (1.2) and (1.5), there appears to be virtually no effect on the estimated parameters. There are no changes in signs or significance. Yet, in (1.5) there seems to be a marginal rejection of the hypothesis of equality of least squares and instrumental variable results as seen from the Durbin-Wu-Hausman test.

Finally, comparing (1.3) and (1.6), three parameters are highly influenced by the change in sample. The coefficients to aid and the interaction increase considerably and they are both significant at a 5 percent level in (1.6). Likewise, the coefficient to openness increases substantially relative to the regression uncertainty.[7]

[4] As a consequence of this choice of instruments we only include five periods in the panel regressions as opposed to six periods in Burnside and Dollar.

[5] A Wald type test of joint significance of policy squared and the interaction results in a p-value of 0.92.

[6] A Wald type test of the joint significance of aid squared and policy squared results in a p-value of .04.

[7] All of the above comparisons are supported by more rigorous analysis of influence measures such as the scaled

Regression (1.6) shows that we are capable of arriving at the Burnside and Dollar results, but only through a statistically invalid reduction of our model and sample data. Our ability to find results that are similar to those of Burnside and Dollar is interesting as we use different data for two of the variables in the regressions. First, we rely on World Bank data to compute levels of real GDP per capita. Burnside and Dollar use data from the Penn World Table. Second, while we use a standard measure of aid, Burnside and Dollar use a new measure of effective development assistance, EDA, (Chang et al., 1998) and deflate this by the unit-value of imports price index from the IFS. The resulting real aid figure is then measured relative to the Penn World Table data on GDP.

While the first change in data does make a difference, as shown in Barro and Sala-i-Martin (1995, chapter 12), this is only minor. The latter change is potentially important. We have therefore re-estimated the six models in Table 1 using the exact Burnside and Dollar data set. The change in data only leads to minor differences in the parameters and, more importantly, the conclusions remain the same.[8]

By way of conclusion, in Hansen and Tarp (2000) we caution against evaluations of aid effectiveness that are based on (lack of) statistical significance of aid variables in regressions that do not reflect established theoretical or empirical results. Seen in this perspective, and from the point of view of the empirical growth literature from the past decade, the main issue in relation to the regressions in Burnside and Dollar (2000) and Table 1 is that the log of the initial level of income is never significant, even at 15 or 20 percent levels of significance. This means that, for some reason, there is no statistically significant conditional convergence among the 56 countries in the sample. This does not imply, of course, that there is no convergence, just that it is not clear in the estimated model. There may also be good reasons for not finding conditional convergence among the countries in the sample. However, in our view the reasons should be explored and explained before policy conclusions are drawn.

We hypothesize that the regression results in this section may be biased as a result of the joint effect of endogeneity of the aid flows, unobserved country specific factors, and conditional convergence. In the remainder of the paper we therefore try to formulate regression models that take these effects into account.

3 Endogeneity of aid and country specific effects

Boone (1994, 1996), Hadjimichael et al. (1995), and Burnside and Dollar (2000) explicitly consider simultaneity bias due to endogeneity of aid. Boone and Burnside and Dollar briefly discuss the reasons for the possible endogeneity of aid in the growth regressions. The main reason is that it is difficult to perceive of aid as a lump-sum transfer, independent of the level of income. Empirically, a negative relation between aid and income per capita is well established.[9]

If aid depends on the level of income it cannot be exogenous with respect to growth as traditionally assumed. At most, we may hope that aid is predetermined.[10] In the typical cross-country

changes in the individual coefficients and covariance ratios (DFBETAS and COVRATIO, cf. Belsley et al., 1980) and (approximate) likelihood distance measures (Cook and Weisberg, 1982).

[8]See Dalgaard and Hansen (2000) for an elaborate analysis of the Burnside and Dollar data.

[9]See among many others the panel data aid allocation studies by Trumbull and Wall (1994) and Alesina and Dollar (2000).

[10]Predetermined means that the allocation of aid may be influenced by random events in past growth rates but not

growth regression, variables are averaged over a time period of, say, five years. In this case we must assume that aid allocation decisions are made with a planning horizon of five to six years in order to maintain an assumption of pre-determinedness. This is not easy, so the endogeneity issue needs to be taken serious and, in our view, it is one of the most interesting issues brought up by Boone and Burnside and Dollar.

Burnside and Dollar (2000) test for endogeneity of aid using Durbin-Wu-Hausman (DWH) tests. The test statistics reveal that ordinary least squares estimates do not deviate significantly from instrumental variable estimates in the growth regressions when the aid regressors are treated as endogenous variables. In the same vein, the DWH tests given in Table 1 do not reject the null hypothesis of equality of the OLS and the IV-estimates.[11] Nevertheless, we do not conclude on this basis that aid is exogenous. Instead, we argue that both estimators are inconsistent, implying that the test statistics are not tests of endogeneity of aid in the growth regressions.

The parameters in Table 1 are estimated under the assumption that none of the exogenous variables are correlated with the error term in the model. Specifically, there can be no country specific effects apart from country specific variations in the regressors. The existence of such unmodelled/unobserved effects renders the IV-estimators inconsistent because the country specific effects are correlated with the initial level of income.

Moreover, any significant correlation between the policy variables and unobserved country specific effects would also lead to inconsistency of the IV-estimators since the policy indicators are used as instruments. Whether macroeconomic indicators are strictly exogenous or not has been discussed intensively in the growth literature. The studies by Easterly and Levine (1997) and Temple (1998) point to persistent correlations between macroeconomic policy indicators and country specific, cultural, and socioeconomic characteristics in developing countries. In addition, part of the literature analyzing the relationship between inequality and growth points out that some policy variables depend on the distribution of income.[12] If the effect of income distribution on growth is part of the error term, some policy variables will be endogenous.

Taken together, all this indicates that most of the explanatory variables in the recent aid-growth regressions are, probably, endogenous. We therefore proceed and apply an estimator that is consistent in the presence of endogenous regressors and country specific effects.

The econometric approaches to deal with these issues in the context of panel data models have developed in several stages in the literature over the past decade.[13] For reasons of clarity in the following discussion, we therefore briefly outline below the regression model, the estimation problems, and the generalized method of moments (GMM) estimator, we have chosen to use. It offers a reasonably robust solution to the problems of possible mis-specification.

The growth regression for N countries and T time periods, where countries are indexed by i and time by t, can be formulated as

$$\Delta y_{i,t} = \gamma y_{i,t-1} + \sum_{j=1}^{k} \beta_j x_{j,i,t} + \alpha_t + u_{i,t}. \tag{1}$$

Here $\Delta y_{i,t}$ is the average growth rate, $y_{i,t-1}$ is the log of the initial level of per capita GDP, $x_{j,i,t}$

by contemporaneous events.

[11]Except for (1.5) as noted above. Moreover, in Hansen (2000) the DWH tests indicate rejection of the null hypothesis using the Burnside-Dollar data and regression models as in Table 1.

[12]See e.g., Alesina and Rodrik (1994) and Persson and Tabellini (1994).

[13]See, for example, Mátyás and Sevestre (1996) or the survey by Ahn and Schmidt (1999).

are the k additional regressors, and α_t is a constant term that may change over time. The errors $u_{i,t}$ are decomposed into time invariant country specific effects, μ_i, and random noise, $\varepsilon_{i,t}$ so

$$u_{i,t} = \mu_i + \varepsilon_{i,t}. \quad (2)$$

This model formulation shows that the presence of country specific effects in the growth model ($\text{var}(\mu_i) > 0$) leads to correlation between a regressor ($y_{i,t-1}$) and the error term. This is the reason we argue that the IV-estimator used in Table 1 is inconsistent.

Static panel data models in which the regressors are correlated with the country specific effects are usually estimated using the so-called fixed effects (FE) estimator. The FE estimator requires, however, strict exogeneity of the explanatory variables with respect to the random error term, $\varepsilon_{i,t}$ because country specific time averages, $\bar{x}_{j,i,t} = \frac{1}{T}\sum x_{j,i,t}$ are used to transform the regressors and the dependent variable whereby the time averages of the random shocks, $\bar{\varepsilon}_{i,t}$, are introduced in the model. If some of the policy variables at time t are correlated with the random shocks at some earlier time $s \leq t$, then the fixed effects estimator and instrumental variable estimators, based on the fixed effects transformation, are inconsistent. This is the case even if there is no conditional convergence.

In contrast, the instrumental variable estimator, introduced by Anderson and Hsiao (1981) for dynamic panels, yields consistent estimates of the parameters in (1). The solution lies in removing the country specific effects by differencing the data, whereby (1) becomes

$$\Delta y_{i,t} - \Delta y_{i,t-1} = \gamma(y_{i,t-1} - y_{i,t-2}) + \sum_{j=1}^{k'} \beta_j (x_{j,i,t} - x_{j,i,t-1}) + (\alpha_t - \alpha_{t-1}) + \varepsilon_{i,t} - \varepsilon_{i,t-1}. \quad (3)$$

In this model the regressors are clearly correlated with the error term under the above assumptions; $y_{i,t-1}$ *is* correlated with $\varepsilon_{i,t-1}$ and $x_{j,i,t}$ *may be* correlated with $\varepsilon_{i,t-1}$. This problem is solved by using lagged observations of the regressors as instruments. Specifically, under the assumption that $x_{j,i,t}$ is predetermined, $x_{j,i,t-1}$ is a valid instrument and $x_{j,i,t-2}$ is valid if $x_{j,i,t}$ is endogenous, as we assume for aid.

By noting that $x_{j,i,t-2}$ is also a valid instrument if $x_{j,i,t-1}$ is valid, it is clear that when the panel of countries is considered as a collection of cross-country regressions, the number of valid instruments in each cross-section is increasing in the time dimension. This property is utilized in various types of GMM estimators, and we have chosen to rely on the GMM estimator proposed by Arellano and Bond (1991). This estimator is linear and estimation software is freely available.[14] Moreover, there is support in the cross-country literature for this choice. In 1996, Caselli, Esquivel and Lefort advocated for the use of the GMM panel data estimator in an analysis of conditional convergence in the augmented Solow growth model, and more recently, Forbes (2000) has challenged established results about inequality and growth using the same estimator.

In growth regressions there are three issues to consider when unobserved country specific effects are removed by differencing. They relate to loss of information, serially correlated measurement errors, and the timing of relationships, say, from aid to growth. Brief comments on these issues are therefore in place.

Whether or not there is excessive loss of information when country means are removed depends on the subject matter and the data. The loss in data variation is certainly critical when for example the level of per capita GDP is compared across sub-Saharan Africa and OECD. However,

[14] All GMM results are obtained using the DPD package for OX, see Doornik, Arellano, and Bond (1999).

Table 2: Summary statistics for the central variables in the analysis

	56 countries					
	Series in levels 268 observations			Series in differences 263 observations		
Variable	Mean	Std.dev.	Corr.[a]	Mean	Std.dev	Corr.[a]
Growth rate in per capita GDP	0.0086	0.0359		-0.0045	0.0423	
Aid	0.0581	0.0822	-0.14	0.0112	0.0404	0.06
Inflation	0.2538	0.3989	-0.22	0.0458	0.3083	-0.15
Openness	0.2575	0.4116	0.34	0.0865	0.2628	0.20
Gdi	0.2215	0.0765	0.48	0.0013	0.0510	0.40
Fdi	0.0084	0.0130	0.31	0.0004	0.0158	0.26
log(initial per capita GDP)	6.6396	0.8829	0.10	0.0405	0.1420	-0.21
	45 countries					
	Series in levels 214 observations			Series in differences 210 observations		
Variable	Mean	Std.dev.	Corr.[a]	Mean	Std.dev	Corr.[a]
Growth rate in per capita GDP	0.0095	0.0324		-0.0044	0.0368	
Aid	0.0436	0.0579	-0.16	0.0084	0.0282	0.12
Inflation	0.2610	0.3693	-0.21	0.0467	0.2715	-0.19
Openness	0.2839	0.4241	0.38	0.0905	0.2770	0.23
Gdi	0.2141	0.0707	0.49	0.0016	0.0487	0.31
Fdi	0.0075	0.0100	0.28	0.0008	0.0112	0.29
log(initial per capita GDP)	6.6261	0.8362	0.12	0.0463	0.1314	-0.28

[a]Corr. is the correlation between the dependent variable, the growth rate, and the explanatory variable. In the columns with differences both variables are differenced.

this is not so when the growth rates of the 56 countries in the present sample are compared.[15] In the upper part of Table 2 we report the mean, the standard deviation, and the correlation with the response variable (either growth or the changes in growth) for the central variables in the study. The first three columns are results for the levels of the variables, the last three are for the first-differences.

Taking a look at the standard deviations reported, Table 2 reveals that it is only when we consider the initial level of per capita GDP there is a major loss of variation. For the growth rate, there is little variation across countries as compared to across time, and for the central explanatory variables there is plenty of variation in the differences, i.e., over time. The variation in the differences may in principle be caused by purely random events, or measurement error.[16] However, if this were the case, we should find a dramatic drop in the correlation between the explanatory variables and growth. As seen from Table 2 the correlations between the explanatory variables and growth *is* smaller for the differences compared to the levels, but still substantial.

The bottom part of Table 2 presents the same summary statistics as the upper part, but for a sub-sample of 45 countries, which in the following is used for comparisons.[17] As can be seen,

[15]There are other issues when the purpose of the analysis is to estimate the speed of convergence, but this is not the objective of the present analysis.

[16]Consider for example a random variable x_t with variance σ^2. If x_t is uncorrelated over time, the variance in $x_t - x_{t-1}$ vill be $2\sigma^2$.

[17]The selection of the smaller sample is based purely on data availability. The 45 countries are covered in the

the differences between the two samples are minor for most of the variables.

An interesting result in Table 2 is the correlation between aid and growth. While the correlation is negative for the levels it is insignificant for the differences. Looking at the sub-sample of 45 countries the correlation even turns significantly positive for the differences.[18] As we expect a non-linear relation between aid and growth, we cannot infer too much from the pairwise correlations in Table 2. This is, however, an example of divergent information in the cross-section dimension compared to the time-series dimension.

Turning to the second issue, serially correlated measurement errors can lead to inconsistency of the GMM estimator as it may lead to correlation between the instruments and the errors. In this case, level estimators such as the IV-estimator in section 2 may be less biased than the GMM estimator. Thus, it is important to test the validity of the instruments and for serial correlation in the residuals. All GMM results in the following are accompanied by a Sargan test for over-identifying restrictions and a test for serial correlation of the residuals. The latter test is based on the residuals for the difference equation (3) and it is therefore a test of second-order correlation, see Arellano and Bond (1991). Throughout, neither of the test statistics leads us to reject the assumption of consistency of the GMM estimator.

With respect to the third issue; timing in the regressions using differences, this has been addressed by time-series econometricians. For macroeconomic data the autoregressive distributed lags model, in which lags of the dependent variable as well as the explanatory variables are included in the regression, have proven to be quite useful. We have therefore experimented with lags of the growth rate and the explanatory variables in the regressions. This led to the introduction of lags of aid, aid squared, and the growth rate. When these variables are introduced, the Budget surplus and Financial depth variables become highly insignificant. Consequently, they were left out.

In the regressions we make use of a standard time-series transformation of the aid regressors. In a stylized regression model the transformation is:

$$\begin{aligned} y_t &= \alpha + \beta_1 x_t + \beta_2 x_{t-1} + \varepsilon_t \\ &= \alpha + (\beta_1 + \beta_2) x_t - \beta_2 \Delta x_t + \varepsilon_t. \end{aligned}$$

The advantage of the transformation is that the partial effect of a permanent change in x can be read off directly as the coefficient to the level. Applying this transformation implies that we include aid and aid squared in levels and differences in equation (1).

Returning to the aid-growth results, we compare results from OLS- and GMM estimations, respectively. This shows that the choice of estimator matters a great deal, so we must be cautious when the model is used for policy recommendations. We present in Table 3 the outcome of the reformulated growth regression. Regressions 3.1 and 3.3 in Table 3 are OLS regressions while 3.2 and 3.4 are GMM estimations. In regressions 3.2 and 3.4 we assume that changes in the

Nehru, Swanson, and Dubey (1995) database on human capital, which is further discussed in section 4. The regional distribution and the distribution of low- and middle-income countries is fairly constant in the two samples, although some of the extreme observations differ. There are differences with respect to the poorest, the richest, slowest-, and fastest-growing countries. There is also a change in the most aid dependent country.

[18] The only other variable for which there is a change in sign is the level of per capita income. Here the change is from an insignificant correlation to a significantly negative correlation. However this simply indicates that the income process is not stationary, whereas the growth process is.

Table 3: Growth regressions with country specific effects

Dependent variable	Annual growth rate in GDP per capita			
Sample	56 countries		45 countries	
Estimation method	OLS	GMM	OLS	GMM
Regression	3.1	3.2	3.3	3.4
Aid	0.117	0.905	0.090	0.559
	(2.00)	(4.22)	(1.49)	(1.77)†
Aid^2	−0.301	−2.012	0.04	−4.304
	(1.97)	(3.83)	(0.07)	(2.56)
ΔAid	−.198	−0.697	−.184	−0.563
	(1.69)	(4.91)	(1.33)	(2.96)
ΔAid^2	0.380	0.981	0.112	4.537
	(1.32)	(3.64)	(0.14)	(2.24)
Inflation	−0.012	−0.002	−0.010	−0.000
	(4.00)	(0.30)	(3.10)	(0.00)
Openness	0.022	0.028	0.018	0.016
	(4.50)	(4.37)	(3.59)	(2.49)
Assassinations	−0.331	−0.534†	−0.239	−0.44†
	(1.44)	(2.31)	(0.99)	(1.93)
Ethnic x Assassinations	0.590	1.004	0.398	0.804†
	(1.46)	(2.75)	(0.96)	(2.25)
Lagged growth rate	0.082	−0.369	0.106	−0.466
	(1.16)	(7.09)	(1.45)	(4.49)
ln(initial GDP per capita)	−0.003	−0.036	−0.005	−0.062†
	(0.61)	(1.05)	(1.90)	(1.74)
Effect of aid at median	0.137	1.038	0.088	0.843
	(2.03)	(4.21)	(1.05)	(2.13)
Degrees of freedom	251	199	197	156
$\hat{\sigma}_\varepsilon \times 100$	2.90	2.53	2.52	2.3
Sargan test[a]		0.39		0.46
Serial correlation[b]		0.12		0.33

Heteroskedasticity-consistent t-values in parenthesis. Time dummies are included in all regressions. Institutional quality and dummies for Sub-Saharan Africa and East Asia are included in the OLS regressions. †The parameter is not significant at the 10% level in a one-step GMM estimation. [a]The p-value of Sargan's test for overidentifying restrictions. [b]The p-value of a test for second-order serial correlation in the residuals of the differenced equation.

policy variables are predetermined while there may be contemporaneous correlation between aid and the random shocks.[19]

From Table 3 it is clear that 'aid effectiveness' is highly sensitive to the choice of estimator, while parameter estimates are reasonably constant across samples. The most striking result is the difference in the marginal effect of aid when the two estimators are compared. Using the OLS results for the large sample (3.1), an increase in the aid/GDP ratio of one percentage point – roughly from 6% to 7% – leads to an increase in the annual growth rate of 0.1 percentage point. Judging from the GMM results (3.2) the estimated effect is eight times higher, leading to an increase of almost one percentage point in the growth rate.

The effect of aid may seem excessively high in the GMM regressions as judged from the marginal effects alone. However, the strong transitory effect from changing aid-GDP ratios implies a much smaller reaction to aid inflows in the short run. The estimated immediate response in the growth rate to an increased aid flow is only about 0.2 percentage points. This is in accordance with the OLS results in Table 1 and 3, but the GMM results confirm that this is only the short run impact.

The main result we derive from Table 3 is the sensitivity of aid effectiveness conclusions to differences in estimation techniques and, hence, underlying assumptions. If country specific effects and endogeneity of the explanatory variables were of minor importance there should only be minor differences in the estimated parameters when comparing OLS and GMM results. This is not so.

4 Aid, capital accumulation, and growth

Even though the theoretical model underlying modern empirical aid-growth work has moved beyond the Harrod-Domar model, aid is still meant to impact on growth via capital accumulation. To analyze whether aid works through the investment link it is necessary to show that (i) investment impacts on growth, and (ii) aid impacts on investment. Accordingly, we reformulate the growth regression and include investment and human capital explicitly as shown in Table 4. If aid has an effect on growth, conditional on a fixed investment ratio and a constant level of human capital, then aid works through channels that impact on total factor productivity.[20] To capture this, aid is retained as regressor.

One potential problem is to make sure that all sources of capital accumulation are included in the regressions. We therefore include gross domestic investment, foreign direct investment, and a measure of human capital. Even though these variables may not be exhaustive they do cover the main sources. In the regressions, we use the logarithm of gross domestic investment relative to GDP (gdi), while foreign direct investment (fdi) and aid, both as shares of GDP, were transformed as $\ln(1+x)$. The squares of the last two variables are also included.

The measure of human capital, mean years of education at the primary and secondary level, is from the Nehru et al. (1995) database. The data is available for 45 countries in our sample.

[19] Appendix B provides the details on the specification of the GMM regressions.

[20] It has for example been argued that aid leads to investment in inappropriate technologies. If so there will be a negative effect of aid in a regression that includes investment. This effect may also be a result of institutional destruction.

However, the database only covers 1960-87. It was therefore necessary to generate country specific forecasts for the year 1990. This was done using exponential smoothing.

The results in Table 4 are straightforward. Once we control for gross domestic investment, the only significant policy indicator is inflation. Again, the two estimation methods yield widely different results. In the OLS-regression (4.1) aid has a marginally positive effect, while there is no effect when judged from the GMM regression (4.2).

Adding foreign direct investment, as in regressions (4.3) and (4.4), does not change the effect of gross domestic investment, but it has a sizeable effect on the response to aid in the GMM regression. Foreign direct investment, by itself, has a considerable impact on growth. This is partly because fdi is very sensitive to the policy regime and the institutional quality in the host country, and partly because fdi is an important vehicle for technology transfers, see de Mello (1997) and Borensztein et al. (1998). Hence, in growth regressions foreign direct investment has a triple role; as a flash indicator of good institutions and good policy, by contributing to capital accumulation, and by increasing total factor productivity. In the GMM regressions we find high marginal effects of fdi but also strong non-linearities indicating rapidly decreasing returns. However, in more than 99% of the sample the fdi ratio is low enough to ensure a positive effect.

Adding human capital, as done in regressions (4.5) and (4.6), does not lead to significant changes in the OLS regression results where the human capital variable is highly insignificant. The result is quite different when we use GMM. In (4.6) human capital is significant and the inclusion leads to an increase in the responsiveness to changes in gross domestic investment while the response to foreign direct investment is unchanged.

In the present context the most interesting result is that once we condition on domestic investment in regression (4.2), aid has no impact on growth. In regression (4.6) where we also condition on human capital, the marginal effect of aid evaluated at the mean is even negative, while it is zero at the median. In the intermediate case in (4.4), in which we condition on only gdi and fdi, aid appears to have a positive effect on growth.[21] We interpret these results as indicating that aid may have had a negative marginal effect on total factor productivity for highly aid dependent countries. However, this effect has been dominated by the positive impact working through investment as shown below.

Table 5 presents investment regressions in which the policy variables from Table 3 are used as regressors alongside foreign direct investment, human capital, GDP per capita, and aid. The regressions may be seen as quasi-reduced form equations and, as such, they are similar to the relations presented in Barro (1998), Borensztein et al. (1998), and Feyzioglu et al. (1998). These studies also show the rather broad spectrum of possible (quasi-)reduced forms.

As for the growth specification, we present results for two different estimators. For investment the presence of country specific effects is evident as noted in Feyzioglu et al. (1998). We have therefore replaced the OLS regressions with fixed effects (FE) regressions, and in the GMM regressions we take account of potential correlations between the random shocks and aid, fdi, and the growth rate in GDP per capita, respectively. We use again both linear and squared terms of aid and fdi as regressors to capture level dependent crowding-in or -out.

If the explanatory variables are strictly exogenous there should be no significant difference between the FE and the GMM results. Yet, the two estimators do show different results. Gross

[21] Throughout, the effect of aid is insignificant in one-step GMM regressions.

Table 4: Growth regressions with investment and human capital

Dependent variable	Annual growth rate in GDP per capita					
Sample	56 countries				45 countries	
Estimation method	OLS	GMM	OLS	GMM	OLS	GMM
Regression	4.1	4.2	4.3	4.4	4.5	4.6
ln(1+aid)	0.108	0.077	0.078	0.251†	0.083	−0.142†
	(1.74)	(0.40)	(1.33)	(2.31)	(1.32)	(2.11)
ln(1+aid)^2	−0.542	−0.414	−0.422	−0.931†	−0.114	−1.366†
	(2.53)	(0.64)	(2.12)	(2.68)	(0.18)	(1.56)
Δln(1+aid)	−0.228	−0.683†	−0.184	−0.164	−0.194	−0.607†
	(1.87)	(3.77)	(1.56)	(1.51)	(1.37)	(2.62)
Δln(1+aid)^2	0.539	1.041†	0.415	0.200	−0.076	3.337†
	(1.5)	(3.65)	(1.19)	(0.88)	(0.08)	(2.44)
Inflation	−0.009	−0.001	−0.008	−0.015†	−0.005	−0.024†
	(2.16)	(0.21)	(1.88)	(4.53)	(1.50)	(2.60)
Lagged growth rate	−0.002	−0.351	−0.002	−0.295	0.004	−0.356
	(0.02)	(6.76)	(0.03)	(10.6)	(0.06)	(8.77)
ln(initial GDP per capita)	−0.007	−0.176	−0.009	−0.114	−0.009	−0.092
	(2.04)	(6.13)	(2.59)	(4.54)	(2.81)	(5.42)
ln(gdi)	0.032	0.059	0.030	0.052	0.024	0.08
	(4.34)	(3.71)	(4.19)	(5.82)	(3.33)	(9.87)
ln(1+fdi)			0.479	1.147	0.538	1.502
			(2.65)	(4.65)	(2.53)	(4.43)
ln(1+fdi)^2			0.375	−9.743†	−7.759	−13.296†
			(0.16)	(3.34)	(1.64)	(2.84)
Human capital					−0.0002	0.016†
					(0.17)	(3.06)
Effect of aid at median	0.144	0.105	0.106	0.313†	0.091	−0.053
	(1.93)	(0.45)	(1.51)	(2.43)	(1.01)	(0.57)
Degrees of freedom	253	201	250	198	195	154
$\hat{\sigma}_{\varepsilon} \times 100$	2.83	2.57	2.78	2.34	2.48	2.02
Sargan test[a]		0.38		0.33		0.45
Serial correlation[b]		0.43		0.11		0.66

Heteroskedasticity-consistent t-values in parenthesis. Time dummies are included in all regressions. Institutional quality and dummies for Sub-Saharan Africa and East Asia are included in the OLS regressions. †The parameter is not significant at the 10% level in a one-step GMM estimation. [a]The p-value of Sargan's test for overidentifying restrictions. [b]The p-value of a test for second-order serial correlation in the residuals of the differenced equation.

Table 5: Investment regressions

Dependent variable	The share of gross domestic investment in GDP			
Sample	56 countries		45 countries	
Estimation method	FE	GMM	FE	GMM
Regression	5.1	5.2	5.3	5.4
Aid	0.714	1.119	0.554	0.977
	(3.77)	(4.02)	(2.77)	(7.98)
Aid^2	−0.808	−1.841†	−1.862	−3.011
	(1.62)	(3.33)	(1.91)	(4.49)
ΔAid	−0.398	−1.295	−0.309	−0.731
	(2.56)	(8.29)	(2.00)	(13.1)
ΔAid^2	0.675	2.378	3.70	3.641†
	(2.10)	(8.73)	(3.06)	(6.32)
Fdi	0.185	−1.696	0.111	−0.940†
	(0.37)	(4.25)	(0.34)	(3.26)
Fdi^2	0.968	18.515	7.586	12.388†
	(0.16)	(3.96)	(1.49)	(2.64)
Inflation	0.015	0.034†	−0.006	−0.025†
	(1.35)	(2.38)	(0.79)	(2.92)
Openness	0.012	0.02	0.025	0.024
	(1.19)	(1.98)	(3.07)	(4.42)
Growth rate in GDP per capita	0.609	0.568	0.565	0.496
	(7.03)	(6.67)	(6.84)	(4.79)
ln(initial GDP per capita)	0.173	0.161	0.185	0.193
	(9.17)	(4.04)	(12.25)	(15.4)
Human capital			−0.027	−0.034
			(2.46)	(3.08)
Effect of aid at median	0.759	1.223	0.658	1.146
	(3.55)	(3.98)	(2.83)	(7.55)
Degrees of freedom	199	199	155	155
$\hat{\sigma}_{\varepsilon} \times 100$	3.77	4.04	2.99	2.63
Sargan test[a]		0.38		0.33
Serial correlation[b]		0.61		0.99

Heteroskedasticity-consistent t-values in parenthesis. Time dummies are included in all regressions. †The parameter is not significant at the 10% level in a one-step GMM estimation. [a]The p-value of Sargan's test for overidentifying restrictions. [b]The p-value of a test for second-order serial correlation in the residuals of the differenced equation.

domestic investment does not respond to foreign direct investment when judged by the FE regressions, but the GMM regressions show crowding-out effects. It is not possible to say *a priori* whether foreign direct investments substitute or complement domestic investment. Borensztein et al. (1998) find signs of threshold effects depending on the level of human capital. In our regressions, crowding-out effects related to fdi seem to be a general phenomenon in all countries.[22]

Human capital is also a substitute for domestic investment, as often found in other studies, and we find roughly the same parameter estimates in the two regressions. In addition, the response to openness, the growth rate in income, and the level of income seem fairly constant across the samples and estimation methods.

In all regressions in Table 5 we find a significant positive impact of aid on investment, as expected. Furthermore, there are strong transitory effects of aid. This leads to smaller responses to changes in the aid flow within the first four years. Yet, in the longer run the responses are quite large. From the FE results we find a response between 2/3 and 3/4 at the median. In contrast, the response in the GMM regressions exceed unity at the median.[23] Altogether, the evidence supports that aid is effective in increasing capital accumulation.

The investment and growth equations underlying the results in Table 4 and 5 make up a simultaneous system from which we conclude that aid is in general effective in furthering growth.[24] There are, however, decreasing marginal returns to aid, captured through level effects from squared aid in the investment regression. There is also level dependence on investment in the reduced form of the growth relation due to the functional specification of the relationship between investment and growth. The aid-growth relationship therefore depends not only on the level of aid, but also on the levels of all the regressors in the investment function. They include key policy indicators.

There are, in other words, interaction effects at work between aid and policy in the system presented here. Yet, these effects impact through investment and are more intricate than the Burnside-Dollar aid-policy interaction. In any case, given that the interaction in our model depends on an *ad hoc* choice of logarithmic transformation of gross domestic investment relative to GDP (gdi), great care is required in drawing structural implications from this result.

5 Conclusion

Aid effectiveness is likely to remain a contentious area of debate. Substantial resources are involved, and the widespread perception that aid has been ineffective in fostering growth at the macro level has led to aid fatigue in many donor countries. In this paper we have investigated what modern cross-country growth regressions can tell about the effect of aid on aggregate growth. We find that aid increases the growth rate, and this conclusion is not conditional on the policy index established by Burnside and Dollar (2000).

[22]The turning points in the polynomials are at 0.054 and 0.045 for regressions (5.2) and (5.4), respectively. These fdi shares are above 99% of the sample values. We have estimated models with interaction effects between human capital and fdi as in Borensztein et al. The interaction term was not significant.

[23]Levy (1987) and Feyzioglu et al. (1998) also find signs of crowding-in, although they do not consider a level dependence in the response.

[24]It is beyond the scope of the present paper to estimate jointly the two equations. Moreover, as we model most of the explanatory variables as endogenous we should ideally present a non-linear system with five or six equations.

Using a fairly standard growth model capturing non-linear effects between aid and growth, the empirical specification, with most support by data, does not include an aid-policy interaction term. We therefore believe to have substantiated that it is premature to rely on policy indexes, such as the one proposed by Burnside-Dollar, in the allocation of aid.

We also note that empirical conclusions about aid effectiveness, based on cross-country growth regressions, depend on poorly understood non-linearities and critical methodological choices. As such, lack of robustness should not come as a surprise. On this background, it might be tempting to discard cross-country growth regressions altogether. Yet, some regularities do seem to exist across countries. The focus in this paper has been on whether there is regularity in the impact of aid across countries. This seems to be the case.

The diversity of developing countries in their natural endowments and cultural and socioeconomic characteristics is another recurrent theme in cross-country comparisons of aid effectiveness. In this paper the effect hereof on the growth impact of aid is captured through the introduction of country specific effects in the regressions. Moreover, aid allocation issues are taken into account by inclusion of aid as an endogenous regressor. It emerges that these two factors have strong implications for the empirical results.

Finally, we reconfirm the empirical support for the hypothesis that aid impacts on growth via investment. This effect is shown to be potent, while an alleged negative effect on total factor productivity has only weak support in the data.

The above observations underline that better theoretical explanations about the aid-investment-growth processes are required before we can derive satisfactory empirical specifications and formulate useful testable hypotheses.

A Data appendix

Data series

Variable name	Description	Source
Aid	Official development assistance as a share of GDP	OECD-DAC (1998)
Assassinations	Number of assassinations per 100,000 population	Easterly and Levine (1997)
Budget surplus	Budget surplus (share of GDP	Burnside and Dollar (2000)
Ethnic fract.	Index of ethnolinguistic fractionalization, 1960	Easterly and Levine (1997)
Fdi	Foreign direct investment (share of GDP)	WDI (1997)
Financial depth	M2 (share of GDP), lagged one period	Burnside and Dollar (2000)
Gdi	Gross domestic investment (share of GDP)	WDI (1997)
GDP	Growth rate and initial level of real per capita GDP	WDI (1997)
Gov. consumption	General government consumption (share of GDP)	WDI (1997)
Human capital	Mean school years of education at the primary and secondary level	Nehru et al. (1995)
Inflation	Log differences of CPI	Burnside and Dollar (2000)
Inst. quality	Institutional quality; security of property rights and efficiency of the government bureaucracy	Knack and Keefer (1995)
Openness	Indicator variable for trade openness	Sachs and Warner (1995)
Policy	Index of economic policy. Policy = 1.28 + 6.85 Budget surplus - 1.4 Inflation + 2.16 Openness	Burnside and Dollar (2000)

Countries in the sample
Countries with an asterisk are not included in the 45 country sample.

Algeria	Ethiopia	Malawi	Somalia*
Argentina	Gabon*	Malaysia	Sri Lanka
Bolivia	Gambia, The*	Mali	Syrian Arab Rep.*
Botswana*	Ghana	Mexico	Tanzania
Brazil	Guatemala	Morocco	Thailand
Cameroon	Guyana*	Nicaragua*	Togo*
Chile	Haiti	Niger*	Trinidad and Tobago*
Colombia	Honduras	Nigeria	Tunisia
Costa Rica	India	Pakistan	Turkey
Cote d'Ivoire	Indonesia	Paraguay	Uruguay
Dominican Republic*	Jamaica	Peru	Venezuela
Ecuador	Kenya	Philippines	Zaire
Egypt, Arab Rep.	Korea, Rep.	Senegal	Zambia
El Salvador	Madagascar	Sierra Leone	Zimbabwe

B Instruments in the regressions in Tables 3 – 5

D(k) indicates that the first-differences of the variable, lagged k periods, is used as instrument while G(k_1, k_2) implies that the variable, lagged at least k_1 periods and including up to k_2 lags when possible, is used as instrument. The human capital variable is only used as instrument in the regressions in which the variable is included as regressor.

	Table		
Variable	3	4	5
Growth rate in GDP per capita	G(2,3)	G(2,3)	G(2,3)
Aid	G(2,3)		G(2,3)
Aid^2	G(2,3)		G(2,2)
Inflation	G(1,2)	G(1,2)	G(1,2)
Openness	D(0)		D(0)
Assassinations	D(0)		
Ethnic. × Assassinations	D(0)		
ln(1+aid)		G(2,3)	
ln(1+aid)^2		G(2,3)	
ln(gdi)		G(2,3)	
ln(1+fdi)		G(2,3)	
Gdi		G(2,3)	
Fdi		G(2,3)	G(2,3)
Fdi^2		G(2,3)	G(2,2)
ln(initial GDP per capita)	G(1,2)	G(1,2)	G(1,2)
Gov. consumption	G(1,3)	G(1,3)	G(1,3)
Financial depth		G(1,2)	G(1,2)
Human capital		D(1),G(1,1)	D(1),G(1,1)

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