

The Effect of Aid on Growth

Evidence from a Quasi-Experiment

Sebastian Galiani

Stephen Knack

Lixin Colin Xu

Ben Zou

The World Bank
Development Research Group
Human Development and Public Services Team
and Finance and Private Sector Development Team
May 2014



Abstract

The literature on aid and growth has not found a convincing instrumental variable to identify the causal effects of aid. This paper exploits an instrumental variable based on the fact that since 1987, eligibility for aid from the International Development Association (IDA) has been based partly on whether or not a country is below a certain threshold of per capita income. The paper finds evidence that other donors tend to reinforce rather than compensate for reductions in IDA aid following threshold crossings. Overall, aid as a share of gross national income (GNI) drops about 59 percent on

average after countries cross the threshold. Focusing on the 35 countries that have crossed the income threshold from below between 1987 and 2010, a positive, statistically significant, and economically sizable effect of aid on growth is found. A one percentage point increase in the aid to GNI ratio from the sample mean raises annual real per capita growth in gross domestic product by approximately 0.35 percentage points. The analysis shows that the main channel through which aid promotes growth is by increasing physical investment.

This paper is a product of the Human Development and Public Services Team and Finance and Private Sector Development Team, Development Research Group. It is part of a larger effort by the World Bank to provide open access to its research and make a contribution to development policy discussions around the world. Policy Research Working Papers are also posted on the Web at <http://econ.worldbank.org>. The authors may be contacted at sknack@worldbank.org.

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be cited accordingly. The findings, interpretations, and conclusions expressed in this paper are entirely those of the authors. They do not necessarily represent the views of the International Bank for Reconstruction and Development/World Bank and its affiliated organizations, or those of the Executive Directors of the World Bank or the governments they represent.

The Effect of Aid on Growth: Evidence from a Quasi-Experiment¹

Sebastian Galiani (University of Maryland)

Stephen Knack (The World Bank)

Lixin Colin Xu (The World Bank)

Ben Zou (University of Maryland)

JEL code: O1, O4.

Key words: aid effectiveness, growth, causal effect and quasi-experiment.

1. Introduction

¹ Galiani: Department of Economics, University of Maryland, College Park, MD 20742, and NBER. Knack and Xu: World Bank – Development Research Group, 1818 H Street, N.W., Washington DC 20433. Zou: Department of Economics, University of Maryland, College Park, MD 20742. Emails: Galiani, galiani@econ.umd.edu; Knack, sknack@worldbank.org; Xu, lxu1@worldbank.org; Zou, zou@econ.umd.edu. We are grateful for valuable comments by George Clarke and Yingyao Hu, and seminar participants at the 2013 Southern Economics Association Annual Meeting and the University of Toronto.

Whether foreign aid causes economic growth in recipient countries is a highly debated research question. Following the influential studies by Boone (1996) and Burnside and Dollar (2000), many others have emerged, but a basic consensus is still absent. Easterly et al. (2004) show that the key finding of Burnside and Dollar (2000) – namely that aid contributes to growth but only where economic policies are favorable – is not robust to the use of an updated and enlarged dataset. Rajan and Subramanian (2008) and Arndt, Jones and Tarp (2010) are only two of many recent papers that review the bulk of the existing literature yet arrive at differing conclusions. Identification of the causal effect of aid on growth has been elusive so far due to foreign aid being endogenous in growth models. An instrumental variable is needed to address these problems. However, as Clemens et al. (2012) conclude in their recent assessment: “the aid-growth literature does not currently possess a strong and patently valid instrumental variable with which to reliably test the hypothesis that aid strictly causes growth.”

In this paper we contribute to this literature by instrumenting, in an economic growth equation, the endogenous foreign aid variable exploiting a plausible quasi-experiment created by the income threshold set by IDA (International Development Association), the World Bank’s program of grants and concessionary loans to low-income countries. Exploiting this new instrument, we are able to plausibly investigate the causal effect of aid and growth.

This income threshold has been used as a key criterion in allocating scarce IDA resources since 1987, and is adjusted annually only to take into account inflation. Other major donors also appear to use the IDA threshold as an informative signal, and we show that total aid declines significantly once a recipient country crosses the IDA income threshold from below. The IDA threshold is nevertheless an arbitrary income level which does not necessarily represent any structural change in economic growth. Threshold crossing is thus a plausibly valid instrumental variable for variations in aid

over years for a recipient country in a panel data model that controls for initial income levels and also includes country and period effects (we group years into 8 three-year periods).

A possible concern with the identification strategy exploited in this study is that some countries might cross the threshold by having a series of large positive shocks that are eventually reversed, making the exclusion restriction invalid.² This should not necessarily be the case since our estimated empirical growth model can account for the differential timing at which countries cross IDA threshold. In our analysis we exploit only the data for the countries that cross the threshold from below during the period studied while our growth model allows countries to grow at different rates over time (by allowing for country-specific effects on growth and by allowing conditional convergence). Additionally, countries start at the beginning of the sample period from different levels below the threshold. Hence, the differential timing at which countries cross the IDA threshold from below exploited for identification in our study does not have to be driven by unobservable shocks.³ It could be accounted for by our empirical growth model. Nevertheless, we extensively investigate this threat to our identification strategy by implementing a battery of tests and robustness checks. Importantly, we use an alternative instrumental variable based on a smoothed income trajectory which is plausibly uncorrelated with the country specific idiosyncratic shocks and obtain similar results. All of the evidence gathered does not point toward

² On average, however, our sample of countries grew faster after crossing the IDA threshold than before, consistent with the fact that developing countries in general exhibited better performance in the latter part of our 1987-2010 sample period.

³ Although this is true for crossing from below, it is unlikely to be true for the smaller set of countries crossing from above the threshold; at least those countries were displaying systematic negative growth rates such that the country fixed effects in the growth model were negative. Moreover, IDA policies are premised on the expectation of growth and eventual graduation, and there is no corresponding set of formal policies for “de-graduation”: instances of crossing the threshold from above are dealt with in a more ad hoc fashion. Crossing from above and from below may therefore have highly asymmetric effects on aid, and in turn on subsequent growth. Thus, our study focuses only on the countries that cross the IDA threshold from below.

rejecting our identification strategy.

Using a sample of 35 countries that crossed the IDA threshold from below between 1987 and 2010, we find that a one percent increase in the aid to GNI ratio raises the annual real per capita short term GDP growth rate by 0.0312 percentage points. The mean aid to GNI ratio at the crossing is 0.09, so a one percentage point increase in the aid to GNI ratio raises annual real per capita GDP growth by approximately 0.35 percentage points. Our effects are about 1.75 times as large as those reported by Clemens et al. (2012). Using OLS, they find that a one percentage point increase in aid/GDP (at aid levels similar to our sample mean) is followed by at most a 0.2 percentage-point increase in growth of real GDP per capita. We find similar effects of aid on growth to the ones reported by Clements et al. (2012) without instrumenting foreign aid. We also present evidence consistent with the fact that OLS estimates suffer from attenuation bias due to measurement error in aid, which is exacerbated when the variability in the aid to GNI ratios is exploited to identify the effect of foreign aid on economic growth in a fixed effect or first-differenced growth equation commonly used in the literature. Thus, one should expect that 2SLS using a valid instrument produces larger estimates than OLS. This could also be the case if economic growth affects aid levels.

The sizable effect of foreign aid on economic growth we find may also be attributable in part to the fact that our sample consists of a group of similar low-income countries that are financially constrained, where aid could have the largest impact. Prior to crossing the IDA threshold, the countries we study tend to have relatively large amounts of aid and low capital levels. Aid is likely to be relatively effective in this context. Although we focus on a small group of countries, our results have strong policy relevance since the sample is composed of low-income countries. We also show suggestive evidence that our results might have meaningful external validity to the remaining poor countries as they grow closer to the IDA threshold.

Investment appears to be the channel through which aid affects growth. We show the investment rate drops following the reduction in aid. Increasing the aid to GNI ratio by one percentage point increases the investment to GDP ratio by 0.54 percentage points. The magnitude of the effects on growth and investment is consistent with the average capital stock to GDP ratio for the sample countries, which we estimate to be approximately 2.

As in most of the literature relying on panel data, we estimate the short-run effect of aid on economic growth, an effect that mainly operates through physical investment. In the long run, aid could affect growth through several other channels, but its identification requires exogenous changes in aid over a very long period of time. Our instrument does not provide such exogenous variability to estimate that parameter.⁴

The remainder of the paper is organized as follows. Section 2 provides a brief review of past studies testing the causal effect of foreign aid on growth. Section 3 describes the data and the sample. Section 4 presents the effect of IDA threshold-crossing on the volume of aid received. Section 5 introduces the empirical model and presents our basic results. Section 6 provides a host of robustness checks. Section 7 discusses the external validity of our findings. Section 8 then presents our conclusions.

2. Previous Aid-Growth Studies

Identifying the causal effect of foreign aid on economic growth is fraught with difficulties. First, aid relative to GNI is likely measured with error.⁵ The problem of measurement error is exacerbated as the estimated model is often demeaned or first

⁴ Regressing the average growth rate over a long period of time onto the average aid on that period does not identify the long-term effect of aid on economic growth, even if aid were exogenous in that equation.

⁵ Even if aid/GNI did not display measurement error, GNI itself could not be strictly exogenous in a growth equation.

differenced in order to eliminate the country fixed effects (Griliches and Hausman, 1986). Second, identification might be confounded by unobserved factors that determine both economic growth and aid. Third, growth itself could also affect aid. In response to these potential problems, previous studies have introduced different instrumental variables to identify the causal effect of aid on growth, in some cases using cross-sectional data and in others panel data. In this section we briefly review the two major identification strategies previously exploited in the literature.

Studies that use cross-sectional data often rely on population size, economic policies and donor-recipient political connections as instruments for aid (e.g., Boone, 1996; Burnside and Dollar, 2000; Rajan and Subramanian, 2008). These cross-country instruments are likely to violate the exclusion restriction since they are correlated with observable and plausibly also unobserved country-level characteristics that also contribute to economic growth. For example, population size can affect economic growth through channels other than aid (Bazzi and Clemens, 2013). Donor-recipient ties (e.g. colonization, trade or migration) that are correlated with aid flows can also affect growth indirectly through the institutional environment (Acemoglu, Johnson, and Robinson, 2001) or other channels.

Other studies relying on panel data rule out the impact of time-invariant determinants of economic growth by either first differencing the data or by conditioning on country fixed effects. These studies tend to focus more on the short term effect of aid on growth. Many studies in this category adopt a dynamic panel model and employ difference GMM or system GMM estimators. They instrument for current aid with lagged values of income and aid, as well as with other standard cross-country regressors (e.g., Hansen and Tarp, 2001 and Rajan and Subramanian, 2008). However, recent studies show that GMM estimators of dynamic panel models using all mechanical instruments are unstable and potentially biased in finite samples, due to the problem of many and weak instruments (Roodman, 2007, 2009a, 2009b; Bazzi

and Clemens, 2013; Bun and Windmeijer, 2010). System GMM estimators, in addition, might also suffer from the lack of valid exclusion restrictions.⁶

We contribute to the literature by proposing a plausibly valid instrument for foreign aid. The IDA income threshold is exogenously determined and applicable to all recipient countries, and hence uncorrelated with their current characteristics and historical backgrounds. Controlling for a continuous measure of per capita income, crossing the IDA threshold from below is found to significantly reduce aid levels.

3. Data and Sample

The data used in this study are primarily from two sources. Income, investment, economic growth, and other country characteristics are from the World Bank's World Development Indicators (WDI).⁷ Aid data are obtained from the Development Cooperation Directorate (DAC) of the OECD.⁸ Following much of the previous literature, aid is measured by total net Official Development Assistance (ODA) disbursements as a share of GNI, in current US dollars.

We identify 35 countries that crossed the IDA income threshold from below between 1987 and 2010.⁹ Table 1 shows the names and years of crossing for these countries.

⁶ A few other recent studies exploit donor-recipient connections interacted with over-time variations in total donor contributions. For example, Werker et al. (2009) use the political connections between OPEC countries and other Islamic countries and changes in oil prices to identify how aid money is spent. They find a small and marginally significant effect of aid on growth. Nunn and Qian (2013) find that humanitarian aid extends civil war by using variation over time in crop harvests to instrument for the amount of humanitarian aid that a country receives.

⁷ <http://databank.worldbank.org/ddp/home.do?Step=12&id=4&CNO=2>, accessed and extracted in August, 2012. The WDI dataset is usually updated 4 times a year. It not only adds the most up-to-date data, but also revises historical data, some of them from many years back. Most of the revisions are minor.

⁸ Data are from DAC Table 2a, available at <http://stats.oecd.org/Index.aspx?DatasetCode=TABLE2A#>, accessed in August, 2012.

⁹ Sao Tome and Principe crossed the threshold in 2009. It has only 2 periods of data in the sample and is thus automatically dropped from the analysis and hence also from the sample.

For countries that crossed the threshold more than once, in our baseline specification we consider only the first crossing in defining the instrumental variable. We then show, however, that our results are robust to changes in this criterion. Following the convention of the literature, we smooth out fluctuations in the annual data by using period averages. Due to the length of our panel dataset, and (more importantly) because IDA has a three-year replenishment cycle, we group years into 8 three-year periods that roughly coincide with the IDA replenishment periods.¹⁰ The first period, with data from calendar years 1987-1989, corresponds roughly to IDA8, covering fiscal years 1988-1990 (July 1, 1987 to June 30, 1990). The final period, with data from 2008-2010, roughly corresponds to IDA15 (July 1, 2008 to June 30, 2011). Donors pledge contributions for each replenishment period, rather than annually. Moreover, policies for allocating IDA funds (e.g. the relative weights assigned to poverty, quality of economic policies, and quality of governance) among eligible recipients are often modified between IDA periods but never within an IDA period. For this reason country allocations should be more correlated from one year to the next within an IDA period than across two replenishment periods. The 3-year IDA periods are therefore a natural way of grouping the data. The timing of actual graduations from IDA also tends to coincide with the end of replenishment periods. The baseline sample contains 247 country-period observations.¹¹

Table 2 shows the summary statistics for the baseline sample. Real per capita GDP of the sample countries grew at an average annual rate of 2.9%. Investment on average accounted for 25% of GDP. ODA equaled about 8% of GNI for a typical country in a typical year in the sample. Of total ODA, about 9% is from IDA, 67% is from DAC

¹⁰ Recent studies that use panel data often group years in 4- or 5-year periods. As Temple (1999, 132) observes, “The question of when to test for growth impacts plagues the entire growth literature, not just aid-growth research. Empirical research on the determinants of growth cannot escape the selection of a fixed observation period, but “selecting the time intervals over which to study growth ... is a question that remains largely unsettled.” (excerpted from Clemens et. al., 2012). We nevertheless follow the convention of the literature by using non-overlapping periods.

¹¹ Appendix Table E lists the definitions and sources of data for variables used in this paper.

countries, 2% is from non-DAC countries, and 23% is from multilateral agencies other than IDA.

4. The IDA Threshold and Foreign Aid

Beginning in 1987, a major criterion for IDA eligibility has been whether or not a country is below a certain threshold of per capita income, measured in current US dollars. This “operational threshold” was established for the purpose of rationing scarce IDA funds. Figure 1 shows the evolution of the IDA threshold converted in current US dollars between 1987 and 2010. It was originally set at \$580, and has been adjusted annually only for inflation. By 2010, the threshold had increased to \$1175.

Once a country has exceeded the IDA income threshold and is judged to be creditworthy, it is considered on track for “graduation” from IDA. Allowance is made for the possibility of income fluctuations, so lending volumes typically are reduced (and repayments accelerated) only after a country has remained over the threshold for three consecutive years. Thus, in most cases threshold crossing will result in reductions of IDA flows beginning in the next replenishment period, not in the current one (World Bank, 2010, 2012). The decline in aid from IDA is amplified by similar behavior from other donors. Some agencies such as African Development Bank (AfDB) and Asian Development Bank (AsDB) explicitly use the IDA income threshold in their own aid eligibility criteria. Other donors often view crossing the IDA income threshold as a signal that countries are in less need of aid and cut their own aid, reinforcing the decline in aid from IDA (Moss and Majerowicz, 2012). As a result, although IDA usually contributes less than 10% of the total aid to a typical recipient, crossing the IDA threshold may have a sizable effect on total aid.

The relevance of IDA threshold crossing as an instrument for aid can be tested by looking at its effects on total aid and aid from different donors. We distinguish among four groups of donors: IDA, DAC (OECD Development Assistance Committee)

bilateral donors, non-DAC bilateral donors, and other multilateral donors. Lagged aid is the main explanatory variable in our growth regressions, so our instrumental variable is a dummy indicating whether the country has crossed the IDA threshold at least two periods earlier. Throughout the paper we use t to represent a specific year and s to represent a specific period. We define $Crossing_{i,s-2}$ equal to 1 if a country's first threshold crossing during the sample period took place at least two periods before period s , where s includes years $t-2$, $t-1$, and t . Otherwise, $Crossing_{i,s-2}$ equals 0. We estimate the following equation:

$$Aid_{jis-1} = \beta_1 y_{is-1} + \beta_2 Crossing_{is-2} + \beta_3 Pop_{is-1} + \lambda_i + \tau_s + v_{jis} \quad (1)$$

The dependent variable Aid_{jis-1} is the log of average ratio of aid from donor type j to GNI or the log ratio of average total aid (i.e., the sum of aid from all donor sources) to GNI for country i in period $s-1$, that is, $Aid_{jis-1} = \ln[(\sum_{k=3}^5 \frac{ODA_{jit-k}}{GNI_{it-k}})/3]$.¹² y denotes log real per capita GDP measured in constant 2000 US dollars. y_{is-1} is measured as log real per capita GDP in the second year of the last period $s-1$ and hence it is equal to y_{it-4} . Pop_{is-1} is the log average population of period $s-1$. $Crossing_{i,s-2}$ is defined as earlier. This second lag is introduced because the IDA graduation process – including cuts in new lending and acceleration of repayments – typically begins only three years after a country crosses the threshold, i.e. in the next replenishment period. The crossing status lagged one period relative to aid also allows time for other donors to respond to threshold crossings.

Table 3 reports the results of estimating Equation 1. For Column 1 to Column 5,

¹² We follow the convention of the majority of the literature and measure both GNI and ODA in current US dollars. A minority of studies, such as Boone (1996), use GNI in purchasing power parity terms, however.

respectively, the dependent variables are the one-period lag of the logarithm of aid share of GNI from (1) IDA, (2) DAC countries, (3) non-DAC countries, (4) multilateral agencies except for IDA, and (5) all donors.

To be conservative, we use two alternative methods to conduct statistical inference throughout the paper. We first report robust standard errors clustered at the country level, which allow for arbitrary within-country correlation. There are 35 countries in our sample. Standard asymptotic tests might over-reject the null hypothesis under the presence of few clusters (Bertrand et al., 2004). Although 35 clusters is not a small number, for robustness we also report the p-value from the wild bootstrap-t procedure following Cameron et al. (2008).¹³ Either approach yields very similar statistical inferences.

We find that following IDA threshold-crossing, the IDA to GNI ratio dropped, on average, by about 92% (i.e., $1 - e^{-2.5}$). Other donors also cut their aid substantially. Estimates of the coefficients associated with threshold crossing are negative and substantial in magnitude. Except for aid from non-DAC donors, the estimated coefficients are also statistically significant at conventional levels. The total aid to GNI ratio dropped, on average, by 59% (i.e., $1 - e^{-0.88}$). Higher income levels are also a strong predictor of aid: a one percent increase in real per capita GDP is associated with reductions in aid of about 8.6 percent from IDA, 1.4 percent from DAC countries, 4.7 percent from non-DAC countries, 2.5 percent from other multilateral agencies, and 1.5 percent for the overall ODA to GNI ratio.

We test whether our results are robust to controlling for a quadratic relationship

¹³ To calculate the wild bootstrap p-value, we first calculate the Wald statistic w_0 associated with the estimate $\hat{\beta}_0$ using the original sample. We then estimate $\hat{\beta}_b$ and its standard error \widehat{se}_b for each wild bootstrap sample b out of B ($=1000$) bootstrapped samples: $w_b = (\hat{\beta}_b - \hat{\beta}_0)/\widehat{se}_b$. The p-value is computed as follows: first we locate in the distribution of the w_b the percentile of w_0 , α . Then, if $\alpha \leq 0.5$, the p-value is equal to 2α while if $\alpha > 0.5$, then the p-value is equal to $2(1 - \alpha)$.

between aid and log initial income level, with results shown in the Appendix in Table A. The estimated coefficients on the IDA threshold crossing dummy all increase slightly (in absolute value), and the quadratic specification does not improve the fit between aid and income. Most notably, the coefficients for log initial income level and its square are not statistically significant for total aid/GNI (see Column 5, Table A).

We conduct a placebo test to further ensure that these effects are not a statistical artifact. Specifically, we replace the true IDA threshold value with a fake threshold equal to 50% of the true value, and re-estimate equation 1 using a threshold-crossing dummy variable based on this false threshold.¹⁴ Table 4 reports the results of this falsification test. In the analysis we retain only country-period observations prior to the period in which countries cross the actual threshold, so the regression sample is unaffected by the effect of actually crossing the true threshold.¹⁵ Crossing the false threshold has no significant effect on aid, and its coefficient has an opposite sign of the coefficient associated with the true threshold value.

5. Foreign Aid and Economic Growth

5.1 Econometric models

We postulate the following model in order to test the null hypothesis that foreign aid does not affect economic growth:

$$g_{is} = \beta_1 y_{is-1} + \beta_2 Aid_{is-1} + \mathbf{X}_{is} \cdot \beta_3 + \lambda_i + \tau_s + \varepsilon_{is}, \quad (2)$$

where, as before, s denotes non-overlapping 3-year periods. Period s includes years

¹⁴ 50% of the true value is an appropriate level for the placebo test. Few countries have income levels below alternative fake thresholds that are much smaller than 50%. Fake thresholds that are much closer to the true level predict the actual crossings too well, defeating the purpose of a placebo test.

¹⁵ For sample countries with per capita GNI always above the fake threshold, the crossing dummy is replaced with 0.

$t, t-1, t-2$. y denotes log real per capita GDP. g_{is} , constructed as $(y_{it} - y_{it-3})/3$, is the arithmetic average real GDP per capita growth rate of country i in period s . y_{is-1} is measured as the log real per capita GDP in the second year of the previous period (i.e., y_{it-4}).¹⁶ We expect β_1 to be negative. The initial income level captures conditional convergence – as a country gets richer, it grows more slowly, *ceteris paribus*. Aid_{is-1} is the log of average aid received by country i as a share of GNI in the previous period.¹⁷ We use the one-period lag of aid instead of contemporaneous aid in order to allow time for aid to take effect, following Clemens et al. (2012). X_{is} is a vector of time-varying variables, which in our baseline specification includes the logarithm of population and it is assumed to be strictly

¹⁶ Notice that, by construction, y_{is-1} is not mechanically correlated with the dependent variable. Some studies in the literature use per capita real GDP in purchasing power parity terms to measure income level and to calculate growth (e.g., Boone, 1996). Real per capita GDP based on current exchange rates (in constant dollar terms, and using the Atlas method) and real per capita GDP in PPP terms are highly correlated: in our sample, the correlation is over 0.95. Growth rates constructed from the two versions are essentially the same. We use per capita GDP based on current exchange rates (in constant dollars) because there are fewer missing observations in the WDI database than for the PPP measure. Using instead the PPP measure we obtain almost identical results for our basic specifications in Table 5.

¹⁷ The measure of aid is slightly different from most of the literature which often use the aid to GDP or GNI ratio as the main explanatory variable. We take the log of aid since previous evidence suggests that the marginal effect of aid on growth is decreasing. The logarithmic form is a parsimonious way to introduce concavity while preserving our ability to identify aid's causal impact with only one exogenous binary instrumental variable. However, note that instrumented aid still takes on a large number of values on its domain, since each country's aid is shifted by the instrument starting from different values (over time). The logarithmic specification is admittedly less flexible than a quadratic specification; in particular, it does not allow the marginal effect of aid to change its sign. Clemens et al. (2012), however, find that the effect of aid on growth does not turn negative until aid exceeds roughly 15% of GDP. In our sample, over 90% of the observations are below 11% of GDP. Thus a logarithmic specification provides a good approximation over the range of observed values on aid. Additionally, we report as a robustness test in Appendix Table C results from using $Aid_{is-1}^* = (\sum_{k=3}^5 \frac{ODA_{it-k}}{GNI_{it-k}})/3$ (i.e. not logged) as the measure for aid. Aid_{is-1}^* has a positive, quantitatively large, and marginally significant coefficient, despite a lower first stage F statistic. We find that a 1 percentage point increase in the aid to GNI ratio raises annual per capita GDP growth by 0.57 percentage point at the sample mean of the aid to GNI ratio. This estimate is even larger than our baseline result, reported later in Section 5.2.

exogenous (though we do not use its lagged values as instruments in any specification). We check below the robustness of our key results to controlling for other potential growth determinants. λ_i is the country i fixed effect. τ_s is the period s fixed effect.

The standard way to estimate equation (2) is to eliminate the unobservable country-specific effects, λ_i , by including a set of country dummy variables in the model, which is equivalent to demeaned equation (2) and estimate the transformed equation by OLS. This estimator, however, is likely to be inconsistent due to aid being also affected by economic growth, measurement error, and (perhaps also) time-varying unobservable variables. We therefore instrument aid in period $s - 1$ (*i.e.*, Aid_{is-1}) with a dummy variable indicating whether the country has crossed the IDA threshold by the end of period $s - 2$, that is, $Crossing_{i,s-2}$, as defined in Section 4. To address the endogeneity of the initial income level y_{is-1} , we instrument the initial income level with further lags of the income level.

Our instrumental variable is based on per capita (nominal) GNI crossing the IDA threshold two periods earlier. Per capita (nominal) GNI level in period $s - 2$ is correlated with the idiosyncratic shock to (real) economic growth of that period, ε_{is-2} .¹⁸ Thus, estimating equation 2 by means of the fixed effects estimator, which first de-means the equation, mechanically introduces a correlation between the instrumental variable and the demeaned error term, $\tilde{\varepsilon}_{is} = (\varepsilon_{is} - \bar{\varepsilon}_i)$. However, if ε_{is} is not serially correlated, the correlation between $\tilde{\varepsilon}_{is}$ and ε_{is-2} will be small if the time dimension of the panel is large. Our sample has 8 periods, which is not considered short in the literature. We will also show below that we do not reject the null hypothesis of no serially correlation of the error terms in equation (2). Note,

¹⁸ This correlation could be weak, however, since our instrumental variable is a dichotomous variable and the error term only affects the latent process behind the binary variable.

nevertheless, that since ε_{is-2} is negatively correlated with $\ddot{\varepsilon}_{is}$, $Crossing_{i,s-2}$ is also probably correlated with the demeaned error term and, hence, the 2SLS estimator of the demeaned equation will likely under-estimate, *ceteris paribus*, the true effect of aid on economic growth.

We propose two approaches to circumvent this potential statistical problem. The first approach relies on a smoothing method of the latent process that determines our instrumental variable. Specifically, we do the following. We take a panel of 130 developing countries that appear in the official DAC aid recipient country list at any time between 1987 and 2010, other than the 35 countries in our original sample.¹⁹ We demean all the series in our extended panel (165 countries in total) by projecting the annual log of nominal per capita GNI onto a set of country fixed effects, denoted \hat{y}_i . We then take the residuals, \hat{e}_{it} . For each of the 35 countries in our working sample, we construct a set of weights $w_j \in \{w_1, w_2, \dots, w_J\}$ bounded between 0 and 1 for the 130 donor countries added to the dataset such that the following distance function is minimized:

$$D_i = ||\mathbf{e}_i - \sum_j w_j \cdot \mathbf{e}_j||, \quad (3)$$

where $||\cdot||$ is the Euclidian distance operator. The vector \mathbf{e} includes the residuals \hat{e}_{it} . For each country i , we use all the years in our sample because that minimizes the influence of a given observation around the period of crossing the IDA threshold. Denote the optimal weight assigned to country j as w_{ij}^* . We then define $\hat{e}_{it} = \sum_j w_{ij}^* \cdot e_{jt}$, and construct the predicted per capita nominal GNI as $\hat{y}_{it} =$

¹⁹ Since the both our sample and the extended dataset are unbalanced panels, for each of the 35 countries in our sample we only use a panel of balanced available donors.

$\exp(\hat{y}_i + \hat{e}_{it})$.²⁰ By the nature of construction, \hat{y}_{it} is plausibly uncorrelated with the error in equations (2).²¹ Thus the predicted crossing of the IDA threshold based on \hat{y}_{it} is also likely to be uncorrelated with the error term, satisfying the exclusion restriction needed for identification. Accordingly, we also exploit in our analysis the predicted crossing two periods earlier, $Crossing_{is-2}^{pred}$, as the instrumental variable for Aid_{is-1} . There are 10 countries out of 35 for which we predict a different period of crossing than their respective actual period of crossing.²²

The second approach we adopt to circumvent the threat to our identification strategy is to first-difference equation 2 and estimating the following equation:

$$\Delta g_{is} = \beta_1 \Delta y_{is-1} + \beta_2 \Delta Aid_{is-1} + \Delta \mathbf{X}_{is} \cdot \beta_3 + \tau_s + \Delta \varepsilon_{is}, \quad (4)$$

In using $\Delta Crossing_{is-2}$ to instrument ΔAid_{is-1} , our identification strategy exploits only the sharp variability in aid at the period after crossing the IDA threshold. Under treatment heterogeneity, both in terms of the effect of threshold-crossing on aid and of the latter on economic growth, this strategy will identify a particular local average causal effect. Instead, we can also use just $Crossing_{is-2}$ to instrument for ΔAid_{is-1} . Note that $\Delta \varepsilon_{is} = \varepsilon_{is} - \varepsilon_{is-1}$.

²⁰ This algorithm is in the spirit of the synthetic control approach discussed in Abadie et al. (2011), but its sole purpose here is to provide a set of weights to smooth income trajectories from country specific idiosyncratic shocks.

²¹ Exploiting the conditional expectation function of per capita GNI based on the cross country's own data to construct an alternative instrumental variable for aid would not work here because the factors of production, like capital, for example, could be subject to the similar country idiosyncratic shocks that we want to eliminate from the series of output in this robustness check.

²² These 10 countries are: Albania, Angola, Azerbaijan, Bosnia and Herzegovina, Guyana, Indonesia, Kiribati, Peru, Samoa, and Ukraine. Countries for which the predicted and actual periods of crossings differ are more likely to have experienced some abnormalities around the neighborhood of crossing.

Thus, the validity of the exclusion restriction in this case basically requires that the error terms ε_{is} are serially uncorrelated. Therefore, the instrumental variable will be invalid if the unobservable idiosyncratic error term in the growth equation is serially correlated up to two periods. Below we investigate in depth the validity of this assumption. Finally, as another robustness check, we also use $Crossing_{is-2}^{pred}$ as the instrument for aid.

In the first differenced model, even if the error terms in equation 2 were *i.i.d.*, the transformed error terms will not be, and will exhibit first-order serial correlation. Standard GMM inference when using optimal weights takes into account this feature while 2SLS does not. Thus, through the rest of the paper (with the exception of models estimated by GMM), as in the previous section, we rely on two alternative methods to conduct statistical inference. We first report robust standard errors clustered at the country level, which allow for within-country correlation. For robustness, we also report the p-values from the wild bootstrap-t procedure. Both methods imply similar statistical conclusions for the main parameters of the growth equation.

5.2 Baseline results

Column 1 of Table 5 reports the estimate of equation (2) without instrumenting aid while column 2 reports the estimate of equation (4) also without instrumenting aid. Columns 3 through 7 are all estimated by the 2SLS estimator where we instrument only for aid. Column 3 estimates equation (2) using $Crossing_{is-2}$ as the instrument for Aid_{is-1} . Column 4 uses the crossings based on predicted per capita GNI from the smoothing exercise, $Crossing_{is-2}^{pred}$, as the instrumental variable. Finally, columns 5 to 7 report estimates of equation (4) using respectively $\Delta Crossing_{is-2}$, $Crossing_{is-2}$ and $Crossing_{is-2}^{pred}$ as instrumental variables.

The fixed effect model in Column 1 and first difference estimate in Column 2 show that aid is positively correlated with real economic growth. The estimated coefficient is statistically significant at the 5% level but is small in magnitude. A one percent increase in the aid to GNI ratio increases annual real per capita GDP growth by 0.0105 and 0.013 percentage points.

Studies on aid and growth typically calculate the increases in annual real per capita GDP growth rate in percentage *points* implied by a one percentage *point* increase in ODA's share of GNI. Because we take logs of ODA/GNI, the implied effect of a percentage point increase in ODA/GNI depends on its level. We use the average aid to GNI ratio at the period of crossing (i.e., 0.09) because this is the most relevant value given our identification strategy. The OLS estimate in Column 1 suggests that a one percentage point increase in the aid to GNI ratio from the average level at the period of crossing is associated with a 0.12 percentage point increase in real per capita GDP growth. The result in Column 2 implies that a 1 percentage point increase in the aid to GNI ratio from the same level is associated with a 0.14 percentage point increase in growth. These findings are similar to those in Clemens et al. (2012). They address endogeneity of aid simply by lagging it one period, and find that a one percentage point increase in aid/GDP from the sample mean increases annual real per capita GDP growth by 0.1 to 0.2 percentage points in the next (4-year) period.

Columns 3 through 7 are estimated using the 2SLS method. The point estimates of the aid coefficient are more than twice as large as those estimated by OLS. In column 3 we report the estimate of equation (2) using $Crossing_{is-2}$ as the instrument for Aid_{is-1} . We find that a one percent increase in the aid to GNI ratio raises growth by 0.028 percentage points. The coefficient is statistically significant at the 1% level according to cluster-robust standard errors or by the wild bootstrap procedure. The first stage is strong, with an F-statistic of about 16. Initial income is negatively correlated with growth, supporting the hypothesis of conditional convergence. In

column 4 we use the predicted crossings based on the smoothed per capita GNI trajectory, $Crossing_{is-2}^{pred}$, as the instrument. The estimated coefficient associated with Aid_{is-1} increases slightly, as expected, to 0.352 and is statistically significant at the 5% level. The first stage is somewhat weaker, with an F-statistic of 7.4. Interestingly enough, the point estimates of the effect of aid on economic growth in columns 3 and 4 are not very different quantitatively and are not statistically different.

Columns 5 through 7 estimate the first differenced model in equation 4. The coefficients are all larger than those in Column 3 and Column 4. Column 5 uses $\Delta Crossing_{is-2}$ as the instrumental variable for ΔAid_{is-1} . In this specification, we are estimating the coefficient of aid using only the variability from the one period after crossing. The estimated coefficient associated with aid is 0.0475 and is statistically significant at the 5% level, and just misses the 5% level according to the wild bootstrap-t procedure. Higher initial income levels are associated with lower growth, and the coefficient is larger than those in the previous columns. Column 6 uses $Crossing_{is-2}$ as the instrumental variable for ΔAid_{is-1} . The first stage and the estimated coefficients are essentially unchanged from those in column 5. Column 7 uses the predicted crossing, $Crossing_{is-2}^{pred}$, as the instrument. The first stage is very strong, with an F-statistic of 24. The estimated coefficient associated with aid is 0.055 and is statistically significant at the 1% level. All in all, our instrumental variable estimates are robust and consistently larger than the OLS estimates.²³

As we discussed in the previous subsection, for the first differenced model, our instrumental variable approach will be invalid if the unobservable idiosyncratic error term in the growth equation (equation 2) is serially correlated. We formally test for

²³ Appendix Table B re-estimates the model in column 3 of Table 5 while including quadratic and cubic terms of y_{is-1} . The results remain similar.

the presence of serial auto-correlation in the error terms in equation 2 following Arellano and Bond (1991). The Arellano-Bond test for serial correlation tests the n^{th} order of serial correlation of the first differenced error to infer the $(n - 1)^{th}$ order of serial correlation of the error terms in the original equation (see also Roodman, 2009a). We report the p -values of the Arellano-Bond tests for AR(2) after estimations in Columns 5, 6, and 7. None of the tests rejects the null hypothesis of no serial correlation in the errors in equation 2.

So far we have treated Aid_{is-1} as the only endogenous variable. However, the initial income level, y_{is-1} , is also endogenous. In columns 1 and 2 of Table 6 we re-estimate the models in columns 3 and 4 of Table 5, respectively, but also instrumenting y_{is-1} (i.e., y_{it-4}) with y_{it-5} . In column 3 we re-estimate the model in column 6 of Table 5 and uses y_{it-8} to instrument for Δy_{is-1} (i.e., $y_{it-4} - y_{it-7}$). The aid coefficient remains similar. Columns 4 and 5 are estimated by means of the difference GMM estimator, which is widely applied in this literature. In light of the potential problems of many instruments, we use a parsimonious set of instruments (Roodman, 2007, 2009a, 2009b; Bazzi and Clemens, 2013; Bun and Windmeijer, 2010). We use y_{it-8} , y_{it-9} , y_{it-10} as instruments. We use $Crossing_{i,s-2}$ as an instrument in Column 4 and $Crossing_{i,s-2}^{pred}$ in Column 5. With instruments outnumbering endogenous variables, we are able to test the validity of these over-identified restrictions, as a way to test for model specification. Both the Sargan and Hansen tests do not reject the null hypothesis of the validity of the over-identification restrictions in both columns.

Failing to reject the null hypothesis of the over-identification restriction, and failing to detect an AR(1) structure in the error term in equation 2, both suggest that the error terms in the growth equation (equation 2) are serially uncorrelated. Here we provide a third piece of evidence. If the error terms were serially correlated, including lagged values of the dependent variable will likely alter the estimates of the aid coefficient.

We re-estimate the model in Column 3 of Table 5 but include the once-lagged value of the dependent variable as a control variable (Column 6 of Table 6), or its twice-lagged value (Column 7 of Table 7), and then both the once- and twice-lagged values (Column 8 of Table 7). Columns 9, 10, and 11 of Table 7 repeat Columns 6, 7, and 8 but using $Crossing_{i,s-2}^{pred}$ to instrument aid. The estimates of the effect of aid remain similar.²⁴

We find a sizable effect of aid on economic growth. The estimated effects of aid on economic growth on Columns 1 to 5 in Table 6 are all very similar. Taking the point estimate in Column 2 we observe that a one percent increase in aid to GNI ratio increases real per capita GDP growth by 0.0312 percentage points. A one percentage point increase in the aid to GNI ratio from its average value at the period of crossing (0.09) thus raises the growth rate by 0.35 percentage points.

In the short run, the main possible channel through which aid could cause growth is through fostering physical investment. Irrespective of the form aid takes, it constitutes a flow of funds to recipient countries, which (if they are financially and perhaps fiscally constrained) would release resources in the economy that could be invested. Because the countries we study were all financially constrained by definition, this is a relevant scenario. However, our results would not necessarily extrapolate to countries that are more developed and have better access to credit markets.

It is useful then to consider what would be the expected effect of an increase of 1 percentage point in aid if it were fully invested in physical capital. Assuming a linear technology at the aggregate level of the economy, the rate of economic growth would

²⁴ For the model in column 3 of Table 5, we find that the clustered standard errors and the robust standard errors are very similar (results not shown). The similarity between the two sets of standard errors is consistent with the evidence of lack of serial correlation of the error term in equation (2).

increase in the inverse of the capital-output ratio.²⁵ Using the standard perpetual inventory method, we estimate this ratio to be approximately equal to 2 in our sample.²⁶ Thus, one would expect that growth could increase by as much as 0.5 percentage points if all of the aid were invested.

How much aid fosters physical investment is therefore an empirical question, one we now investigate. In Table D of the Appendix we re-estimate the baseline specifications in Table 5 but replacing economic growth with the period average investment to GDP ratio as the dependent variable. The OLS estimates in Column 1 and Column 2 of the effect of aid on investment are statistically insignificant and have the “wrong” sign. Instrumenting investment in Columns 3 to 7, we find that the coefficient associated with aid becomes positive and ranges between 0.5 and 0.8. In one case it is significant at the 10% level but in general it is only marginally significant, with p-values around 0.15. In column 4 we see that a one percent increase in aid to GNI ratio increases the investment to GDP ratio by 0.049 percentage points. Evaluated at the average level of aid to GNI ratio at the period of crossing, an increase of 1 percentage point in the aid to GNI ratio increases the investment to GDP ratio by 0.54 percentage points. Using the estimated capital-output ratio of 2, a 0.54 percentage point increase in physical investment would raise economic growth by 0.27 percentage points, which is not far away from our back-of-the-envelope calculation of the effect of aid on growth.

5.3 Measurement errors in aid

An issue that is overlooked in the aid-growth literature is that the amount of aid that a

²⁵ Note that even under a linear technology the effect of aid on economic growth could be strictly concave since, for instance, the effect of aid on physical investment might be decreasing in aid. Moreover, the aggregate technology could be non-linear.

²⁶ Note also that this figure is also consistent with standard growth accounting assumptions. Assuming a capital per capita depreciation rate of 10 percent per year, and an investment rate of 25 percent of GDP per year, a country with a capital-output ratio of 2 would grow, in per capita terms, at 2.5 percent per year, which is consistent with the figures in our sample.

country receives as a ratio of its GNI is likely to be measured with error. Not all donors report their aid to the DAC in all years. For example, aid from the former Soviet Union and from China in the Mao era to other communist countries was not reported to the DAC. Aid from China and some other emerging donors has increased in recent years and is also not included in the DAC data. Additionally, but better understood, the denominator, GNI, is also measured with sizeable error for many less developed countries (Jerven, 2013). With classic measurement error, the OLS estimate of the effect of aid is biased towards zero. Demeaning or first differencing the model would exacerbate the bias if aid levels are persistent over time.

The natural experiment we exploit in this paper provides a unique opportunity to test the hypothesis that measurement error in foreign aid biases the OLS estimate towards zero. We have shown that the amount of aid a country receives tends to decline substantially following its crossing of the IDA threshold from below. Assuming that the measurement error is *i.i.d.*, it would contribute much less to the total variation in ΔAid_{is} in periods closer to threshold crossings. Thus the OLS estimates of equation 4 using only periods in the neighborhood of the crossings are likely to provide more accurate estimates of aid's effect on growth than the one exploiting all of the variability in aid from all periods. To test this, we re-estimate Equation 4 by OLS and 2SLS (using $Crossing_{i,s-2}$ to instrument aid), successively narrowing the window of periods used in the analysis around the crossing point of each country.²⁷ We expect the OLS estimate of the effect of aid on growth to increase as we narrow the window of estimation. Naturally, given our identification strategy, the 2SLS estimate of the same parameter should remain stable independent of the window used for estimation. We find exactly that in Table 7, Panel B.

²⁷ We rely on first differenced models in this exercise because changing the number of periods also affects the estimation of the country fixed effects, and we want to hold everything constant except for the signal to noise ratio in aid.

Panel A of Table 7 reports the OLS estimates. We start from the original sample, which has a maximum of 7 periods before crossing the threshold and 7 periods after crossing the threshold. Columns 2 through 6 gradually narrow to at most 2 periods before and 2 periods after the crossing point of each country. As we narrow the window, the estimated coefficient associated with foreign aid monotonously and gradually increases. The coefficient in Column 6 is 0.0201, more than 50% larger than that in Column 1. A generalized Hausman test of the null hypothesis that the coefficient associated with Aid_{it-1} is the same in Column 1 and in Column 6 is rejected with a p -value of 0.07. These findings are consistent with the existence of significant measurement error in aid, reinforcing the supposition that the aid to GNI ratio is measured with substantial noise.

5.4 Bunching

Our identification strategy hinges on the large decline in the amount of aid received following the crossing of an arbitrarily given and pre-determined threshold. If countries can manipulate their income data to remain below the IDA threshold, then threshold crossing may not be a valid instrument for aid. Countries with lower expected growth and hence a greater “need” for aid would presumably be the most likely to understate their incomes to remain IDA eligible.

Endogenous manipulation of the income level is not likely to be prevalent for several reasons. First, the GNI estimates used by the World Bank are by no means entirely within a government’s control. The national accounts data produced by national statistical agencies are merely one of several inputs into the World Bank’s income estimates (Jerven, 2013). Governments cannot perfectly predict (1) the adjustments to those national accounts data often made by World Bank staff, (2) the exchange rates used, or (3) the population estimates used in constructing GNI per capita. Second, crossing also depends on the current IDA threshold, and its annual adjustments for global inflation rates cannot be predicted perfectly either. Finally, income level with

respect to the threshold is not the only criterion for IDA eligibility; e.g. countries that cross the threshold from below can remain eligible if they are not judged to be creditworthy for IBRD or private lending. .

Nevertheless, we tested for evidence of manipulation. A histogram on the left side of Figure 2 shows the distance between a country’s current GNI per capita and the contemporaneous IDA threshold. All countries that were ever eligible for IDA between 1987 and 2010 are included, and each GNI per capita value in each country-year is treated as a separate observation. We group country-year observations in 100-dollar bins according to the distance between income level and the contemporaneous IDA threshold. If many governments understate GNI to stay below the IDA threshold, we should observe significant “bunching” of observations just below the threshold, relative to the number of observations just above it. Specifically, we should observe the bin just to the left of the threshold to be abnormally high relative to the neighboring bins. If there is no bunching, the numbers of observations in each bin should cross the threshold of zero smoothly. As shown in the histogram on the left in Figure 2, there is no visual evidence that countries bunch right below the IDA threshold. A formal test confirms this result. Using a density test proposed by McCrary (2008), we find no significant evidence of bunching. The graph on the right in Figure 2 shows the fitted kernel density functions at both sides of the threshold. Contrary to the pattern expected of endogenous manipulation, the density is actually lower to the left of the threshold. The estimated “jump” in density from left to right is the opposite of what we would expect if bunching exists (-0.000291, with standard error equal to 0.000818).

6. Robustness Checks

In this section we present various robustness tests. In all of these tests, we report two sets of results. The first uses $Crossing_{i,s-2}$ as the instrument for aid, and the second uses $Crossing_{i,s-2}^{pred}$.. All of the robustness checks are based on our preferred

specification in Column 3 of Table 5 (or Column 4 of Table 5 when $Crossing_{i,s-2}^{pred}$ is used as the instrument). Results are largely consistent in both sets of results.²⁸

6.1 Omitted variables

Throughout the study, we control for period fixed effects, log of initial income, and log of population. Period fixed effects take account of secular trends that affect all countries similarly. Initial income and population are among the key time-varying factors that affect economic growth. We also control for country fixed effects which account for any time-invariant cross-country variability in economic growth. Other important determinants of growth such as the quality of economic policies and institutions exhibit much more cross-country variation than variation over time within a country, particularly over our relatively short 1987-2010 period. Their impact will thus mostly be captured by the country fixed effects.

We nevertheless test whether other time-varying factors could be confounding the effect of aid on economic growth, by adding to the baseline regression a host of economic and political variables, including the primary school enrollment rate, the Freedom House index of civil liberty and political rights, the World Bank's Country Policy and Institutional Assessments (CPIA ratings), total trade as a percentage of GDP, broad money as a percentage of GDP, inflation as measured by the GDP deflator, and dummies for whether the country is experiencing a banking crisis, currency crisis, or debt crisis. Due to missing values, we add these variables in separate groups to maintain a reasonable sample size for each regression. Table 8 shows the results of these exercises. Columns 1 through 5 use $Crossing_{i,s-2}$ to instrument for aid while Columns 6 through 10 use $Crossing_{i,s-2}^{pred}$. In this small and homogeneous sample that controls for country fixed effects, few of the additional regressors have a statistically significant effect on growth in either set of estimations.

²⁸ Results are also robust to (for example) the model column 6 of Table 5.

In Columns 1 through 5, the first stage remains relatively strong throughout, while the estimated coefficients for aid remain robustly positive, large and significant. In Columns 6 through 10, the first stages are somewhat weaker. However, the aid coefficients remain statistically significant and similar in magnitude to their counterparts in the baseline regressions.

6.2 Timing of crossing

Recall that our instrument is a dummy variable that switches from 0 to 1 two periods after the country crosses the income threshold from below. The countries in our sample all crossed the threshold at some point between 1987 and 2010, but for countries that crossed the threshold in the last and the next-to-the-last periods (i.e. in periods 7 or 8) the instrumental dummy variable is always zero. We keep these countries in the sample because they satisfy our simple rule for sample selection and they provide relevant information for estimating the effects of the control variables. We now check whether our results still hold when we drop these countries.

In Column 1 of Panel A in Table 9, we drop the seven countries that crossed the threshold in the final period of our sample (2008-2010). The point estimate increases and remains statistically significant at conventional levels. In Column 2 we further drop the seven countries that crossed the threshold in the next-to-last period (2005-2007). The coefficient is slightly larger than that in Column 2 and remains statistically significant at the 5% level. The first stage remains strong in each case. The first stage is weaker when we use $Crossing_{i,s-2}^{pred}$ as the instrument in panel B, but the results are qualitatively similar.

As shown in Table 1, a few countries crossed the IDA threshold from below more than once during the sample period. These countries must have crossed the threshold from above after its first crossing from below, then crossed from below again. These cases might be a threat to our identification strategy. If income drops below the

threshold again immediately after the first crossing for any reason other than a decline in aid, the estimated effect of aid might be confounded. In Column 3 of Panel A of Table 9, we drop countries with multiple crossings. The estimated effect of aid changes very little. In Column 4, we use the last threshold crossing (from below) instead of the first one to construct the instrumental variable. The estimated effect of aid on growth again changes very little, relative to the baseline specification. It remains statistically significant in panel A, but in panel B the standard errors increase and we cannot reject the null hypothesis of no effect at conventional levels.

6.3 Other robustness checks

There are two exceptional groups of countries in the sample. First, a few countries were never classified as IDA eligible in the 1987-2010 period due to various reasons, despite having income levels below the threshold for one or more years. We include them in the sample because the IDA income threshold potentially serves as a useful benchmark for donors other than IDA. Second, several countries in the sample benefit from the “small island country exception,” which permits island nations with populations below 1.5 million to remain IDA eligible even after surpassing the income threshold. In Column 5 we drop the three small island countries of Table 9. In Column 6, we drop the four countries that were never eligible for IDA throughout the sample period. The estimated effects of aid are robust to these sample changes.

7. External Validity

Our sample consists of a special group of aid-recipient countries that all successfully crossed the IDA income threshold from below between 1987 and 2010. A natural question is how our results would apply to other aid-recipient countries, particularly those that are still below the IDA cutoff. On the one hand, if the sample countries crossed the IDA threshold level because they have fundamentally different attributes, the results of this paper may have little relevance for those remaining very poor. On the other hand, if the difference between crossing and non-crossing countries is

mainly due to being in different development stages, and the two samples have similar growth patterns conditional on the initial income, then it is conceivable that our results may apply to these countries as well when their income level approaches the IDA threshold.

In this section we investigate whether the crossing countries have systematically higher growth rates (conditional on the initial income level) than the non-crossing countries using a simple regression. We include all country-year observations with per capita GNI level below the threshold, and linearly project the annual real per capita GDP growth onto a dummy variable indicating whether the observation belongs to a country in the crossing sample, controlling for a one-year lag of log per capita real GDP and its quadratic form, as well as for year dummies. When their income levels were still below the IDA threshold, real per capita GDP in countries that eventually crossed were growing on average 1.98% per year. During the same period, real per capita GDP in countries that had not crossed the threshold by 2010 were growing on average 1.11% per year. In Table 10 we show that, after we control for the initial real GDP per capita level (Column 1) as well as its quadratic form (Column 20, the difference in average annual GDP per capita growth between the crossing countries and the non-crossing countries is approximately 0.7 percentage points and not statistically significant. In Column 3, we compare the average annual GDP per capita growth of the two groups of countries within each quartile of the distribution of the lagged income levels. When the income level is in the lowest quartile, countries that eventually crossed the threshold were growing at a much higher rate than those that have not crossed. In other higher quartiles of income level, the differences in annual growth rates between the two groups are small in magnitude and not statistically significant. Thus, for most of the income distribution below the IDA threshold, we do not find significant differences in pre-crossing growth rates between the sample of countries studied in this paper and those still below the IDA threshold.

8. Conclusions

This paper presents new evidence on the effect of foreign aid on the recipient country's economic growth, exploiting the substantial drop in aid after a country crosses an exogenous income threshold set by the World Bank for IDA eligibility. We use a group of countries that have crossed the IDA threshold since 1987 and find that foreign aid has a sizable positive effect on economic growth. Increasing the aid to GNI ratio by one percentage point from average aid to GNI ratio at the period of crossing raises the real per capita GDP growth rate by approximately 0.35 percentage points.

We address various identification concerns, and our results remain robust throughout. Despite focusing on a special group of countries, this group is particularly interesting because it is composed of poor countries for which aid is particularly important since they are financially constrained. Rendering further support to the positive causal effect of aid, we provide evidence that aid also increases the investment rate significantly in our sample. Indeed, a back of the envelope calculation suggests that the increase in physical investment is the main channel through which aid operates in the short-run. Finally, we provide some evidence that suggests that our results may generalize to countries that are still under the IDA threshold, as they grow closer to the threshold.

We estimate a model similar to those in the recent aid-growth literature, and address the identification challenge using a novel instrument for aid, derived from a plausible exogenously-determined aid allocation policy. We also provide a new way of constructing predicted income trajectory using a smoothing technique. Our finding of a positive impact of aid on growth is consistent with several other recent studies, most notably Clemens et al. (2012). Our estimated effect, however, is somewhat larger than in most other studies.

Identification of causal effects at the macroeconomic level is a daunting task (See Samuelson 1948). All causal estimates of country level parameters should be taken cautiously. At the micro level, researchers still need to evaluate on a case by case basis which aid projects work better, if at all. Our evidence only shows that overall foreign aid increases economic growth among poor countries where foreign aid is a large source of funding. Moreover, even at the macro level aid may have heterogeneous effects depending on recipient characteristics, aid modalities, and donor motives (Mekasha and Tarp, 2013).²⁹ Our relatively small and homogeneous sample is not ideal for testing heterogeneous effects of aid. Despite these caveats, we believe our evidence contributes to understand the effect of aid on economic growth in the short-term for poor countries that are financially constrained.

Our results also contribute to the empirical literature on donors' aid allocation decisions across recipient countries (e.g. Alesina and Dollar, 2000; Chong and Gradstein, 2008). They support the conjecture by Moss and Majerowicz (2012) that bilateral donors use IDA policies – and specifically its income eligibility threshold – as an informative signal of recipient need. Patterns of donor “herding” measured by Frot and Santosi (2011) may be partially due to donors' common responses to recipient countries' crossing the IDA income threshold.

Our findings also have implications for IDA graduation policies. The threshold-crossing sample likely consists of growing countries facing financial constraints, perhaps explaining why aid has large positive effects in our study. If aid reductions are followed by declines in growth for this set of countries, arguably the IDA graduation process should be made lengthier. For example, declines in aid and changes in lending terms following threshold crossing could be made more gradual.

²⁹ Bilateral aid in particular may be more effective following the end of the Cold War, if more of it is now motivated by developmental rather than geopolitical concerns (Headey, 2008). Our data are almost entirely post-Cold War.

Consideration should also be given to increasing the income threshold in real terms. Those changes could lead to a more effective use of IDA funds, compared to the alternative of concentrating more aid among the shrinking number of countries projected to remain under the current threshold (Moss and Majerowicz 2012).

References

- Abadie, Alberto, Alexis Diamond, and Jens Hainmueller (2009). "Synthetic Control Methods for Comparative Case Study: Estimating the Effect of California's Tobacco Control Program." *Journal of the American Statistical Association*, 105(490), 493-505.
- Acemoglu, Daron, Simon Johnson, and James A. Robinson (2001). "The Colonial Origins of Comparative Development: An Empirical Investigation." *American Economic Review* 91(5), 1369-1401.
- Alesina, Alberto and David Dollar (2000). "Who Gives Foreign Aid to Whom and Why?" *Journal of Economic Growth* 5, 33-64.
- Angeles, Luis, and Kyriakos C. Neanidis (2009). "Aid Effectiveness: The Role of the Local Elite." *Journal of Development Economics*, 90(1): 120–134.
- Arellano, Manuel, and Stephen Bond (1991). "Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations." *Review of Economic Studies*, 58(2), 277-297.
- Arndt, Channing, Sam Jones and Finn Tarp (2010). "Aid, Growth and Development: Have We Come Full Circle?" *Journal of Globalization and Development* 1(2), 5.
- Bazzi, Samuel and Michael Clemens (2013). "Blunt Instruments: Avoiding Common Pitfalls in Identifying the Causes of Economic Growth." *American Economic Journal: Macroeconomics*, 5(2), 152-186.
- Bertrand, Marianne, Esther Duflo, and Sendhil Mullainathan, (2004) "How Much Should We Trust Differences-in-Differences Estimates?" *Quarterly Journal of Economics* 119, 249–275.
- Boone, Peter (1996). "Politics and the Effectiveness of Foreign Aid." *European Economic Review* 40(2), 289-329.
- Burnside, Craig and David Dollar (2000). "Aid, Policies, and Growth." *American Economic Review* 90(4), 847-68.

- Bun, Maurice J.G. and Frank Windmeijer (2010). "The Weak Instrument Problem of the System GMM Estimator in Dynamic Panel Data Models." *Econometrics Journal* 13(1), 95-126
- Cameron, A. Colin, Jonah Gelbach and Douglas Miller (2008). "Bootstrap-based Improvement for Inference with Clustered Errors." *Review of Economics and Statistics* 90(3), 414-427.
- Chong, Alberto and Mark Gradstein (2008). "What Determines Foreign Aid: The Donors' Perspective." *Journal of Development Economics* 87, 1-13.
- Clemens, Michael A., Steven Radelet, Rikhil R. Bhavnani and Samuel Bazzi (2012). "Counting Chickens When They Hatch: The Short-Term Effect of Aid on Growth." *Economic Journal* 122(561), 590-617.
- Easterly, William, and Ross Levine. 2001. "It's Not Factor Accumulation: Stylized Facts and Growth Models," *World Bank Economic Review* 15(2), 177-219.
- Easterly, William, Ross Levine and David Roodman (2004). "Aid, Policies, and Growth: Comment." *American Economic Review* 94(3), 774-80.
- Frot, Emmanuel and Javier Santiso (2011). "Herding in Aid Allocation." *Kyklos* 64(1), 54-74.
- Griliches, Zvi, and Jerry Hausman. 1986. "Errors in Variables in Panel Data." *Journal of Econometrics* 31(1), 93-118.
- Hansen, Henrik and Finn Tarp (2001). "Aid and Growth Regressions." *Journal of Development Economics* 64(2), 547-570.
- Headey, Derek (2008). "Geopolitics and the Effect of Foreign Aid on Economic Growth: 1970-2001." *Journal of International Development* 20, 161-180.
- Jerven, Morten (2013). "Comparability of GDP Estimates in Sub-Saharan Africa: The Effect of Revisions in Sources and Methods since Structural Adjustment." *Review of Income and Wealth* 59, S16-S36.
- Levine, Ross and David Renelt (1992). "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review* 82(4), 942-963.

- McCrary, Justin (2008). "Manipulation of the Running Variable in the Regression Discontinuity Design: A Density Test." *Journal of Econometrics* 142(2), 698-714.
- Mekasha, Tseday Jemanah and Finn Tarp (2013). "Aid and Growth: What Meta-Analysis Reveals." *Journal of Development Studies* 49(4), 564-83.
- Minoiu, Camelia and Sanjay G. Reddy (2010). "Development Aid and Economic Growth: A Positive Long-Run Relation." *Quarterly Review of Economics and Finance* 50(1), 27-39.
- Moss, Todd and Stephanie Majerowicz (2012). "No Longer Poor: Ghana's New Income Status and Implications of Graduation from IDA." Center for Global Development Working Paper 300, Washington, D.C.
- Nunn, Nathan and Nancy Qian (2013). "Aiding Conflict: The Effect of U.S. Food Aid on Civil War". Manuscript.
- OECD (2012). "Statistics on Resource Flows to Developing Countries."
<http://www.oecd.org/dac/aidstatistics/statisticsonresourceflowstodevelopingcountries.htm>.
- Samuelson, P. (1948). *Economics*. McGraw-Hill.
- Rajan, Raghuram and Arvind Subramanian (2008). "Aid and Growth: What Does the Cross-Country Evidence Really Show?" *Review of Economics and Statistics* 90(4), 643-665.
- Roodman, David (2007). "The Anarchy of Numbers: Aid, Development, and Cross-Country Empirics." *World Bank Economic Review* 21(2), 255-277.
- Roodman, David (2008). "Through the Looking Glass, and What OLS Found There: On Growth, Foreign Aid, and Reverse Causality." Center for Global Development Working Paper 137, Washington DC.
- Roodman, David (2009a). "How to Do xtabond2: An Introduction to Difference and System GMM in Stata." *Stata Journal* 9(1), 86-136.
- Roodman, David (2009b). "A Note on the Theme of Too Many Instruments." *Oxford*

Bulletin of Economics and Statistics 71(1), 135-158.

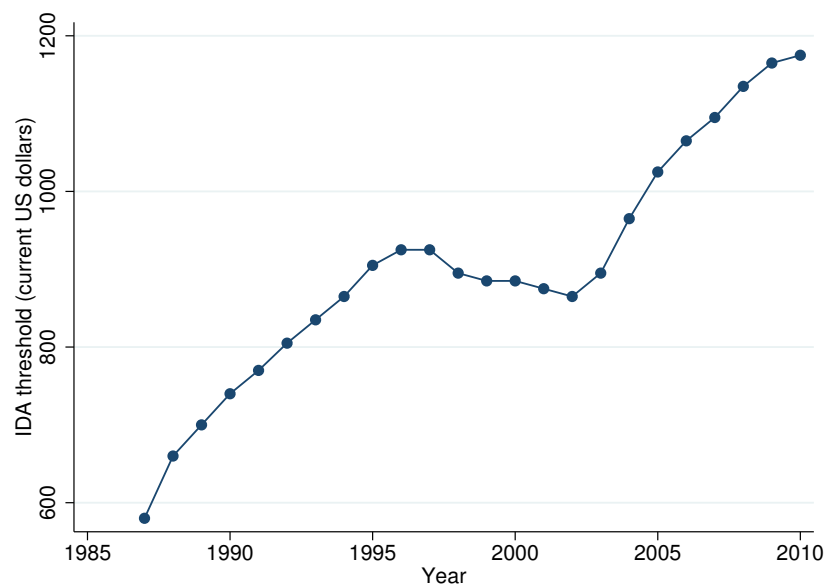
Werker, Eric, Faisal Z. Ahmed and Charles Cohen (2009). “How is Foreign Aid Spent? Evidence from a Natural Experiment.” *American Economic Journal: Microeconomics* 1(2), 225-244

World Bank (2010). “A Review of IDA’s Long Term Financial Capacity and Financial Instruments” (IDA16 Replenishment Report). Washington, DC: The World Bank.

World Bank (2012). “Review of IDA’s Graduation Policy” (IDA16 Mid-Term Review). Washington, DC: The World Bank.

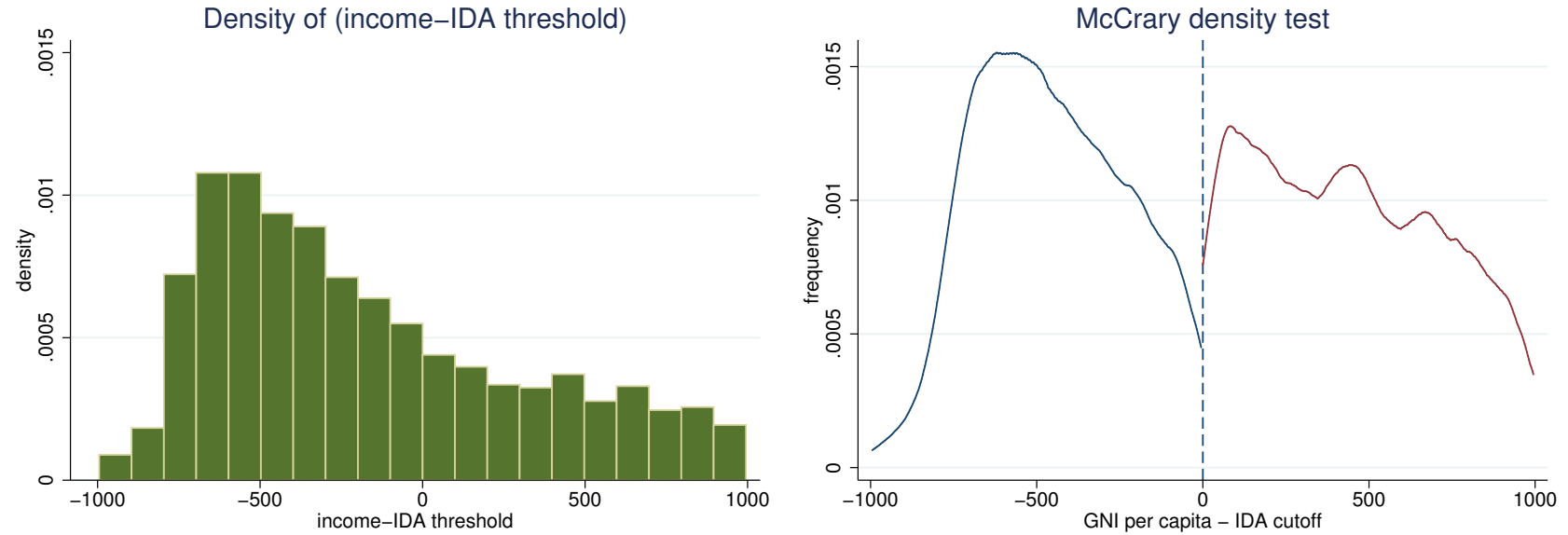
Figures and Tables

Figure 1: IDA Threshold 1987-2010



Note: IDA threshold is originally nominated in current international dollars. We convert it in current US dollars.

Figure 2: Histogram of Income and McCrary Test of Bunching



Note: There are 1,920 country-year observations from 112 countries that were ever on the DAC list between 1987 and 2010. For each country-year observation, we calculate the distance of the current per capita GNI (y_{it}) from the current IDA threshold (\bar{y}_t). We restrict the distance ($y_{it} - \bar{y}_t$) between -1000 and 1000. The graph on the left is a histogram of country-year observations against ($y_{it} - \bar{y}_t$), grouped in 100-dollar bins. The graph on the right shows the McCrary density test. Epanechnikov kernel density function with bandwidth of 100 US dollars. The difference in density between observations just to the left and those just to the right is estimated by fitting two separate kernel density functions. The jump from the just left of the threshold to the just right of the threshold is 2.909×10^{-4} . Bootstrapped standard error is 8.18×10^{-5} . Choice of the kernel functional form is not important, the results are similar to a reasonable range of bandwidths.

Table 1: Sample Countries and Years of Crossing the IDA Threshold

Country Name	Year of Crossing	Country Name	Year of Crossing
Albania	1999	India	2010
Angola	2005	Indonesia	1994
Armenia	2003		2004
Azerbaijan	2005	Kiribati	1988
Bhutan	2004		1992
Bolivia	1997	Moldova	2007
	2005	Mongolia	2006
Bosnia and Herzegovina	1997	Nigeria	2008
Cameroon	2008	Papua New Guinea	2009
China	2000	Peru	1990
Congo, Rep.	2006	Philippines	1994
Djibouti	2007	Samoa	1995
Egypt	1995	Solomon Islands	1997
Equatorial Guinea	1998	Sri Lanka	2003
	2000	Sudan	2008
Georgia	2003	Syrian Arab Republic	1998
Ghana	2009	Timor-Leste	2006
Guyana	1999	Turkmenistan	2002
	2005	Ukraine	2003
Honduras	2000	Uzbekistan	2010

Note: Countries that crossed the IDA threshold from below between 1987 and 2010.

Table 2: Summary Statistics

Variable	N	mean	s.d.	25 th	50 th	75 th
real GDP per capita growth	247	.029	.054	.007	.028	.048
log real GDP per capita 4 years earlire	247	6.635	.551	6.274	6.666	6.988
lag of log(ODA/GNI)	247	-3.282	1.472	-4.473	-2.910	-2.184
lag of log(IDA/GNI)	247	-3.282	1.472	-4.473	-2.91	-2.184
lag of log(DAC/GNI)	247	-10.618	8.022	-21.043	-6.256	-4.689
lag of log(NDAC/GNI)	247	-3.774	1.574	-4.941	-3.356	-2.697
lag of log(Other MLA/GNI)	247	-11.281	6.073	-13.267	-9.246	-6.641
lag of ODA/GNI	247	.081	.094	.011	.054	.113
lag of IDA/GNI	247	.007	.012	0	.002	.009
lag of DAC/GNI	247	.054	.068	.007	.035	.067
lag of NDAC/GNI	247	.002	.005	0	0	.001
lag of other MLA/GNI	247	.019	.027	.002	.009	.024
crossed IDA threshold 2 periods earlier	247	.2308	.4222	0	0	0
lag of Investment/GDP	231	0.253	0.119	0.187	0.235	0.297
log population	247	15.950	2.259	14.765	15.874	17.108
lag of terms of trade (year 2000=100)	167	100.548	15.894	92.328	99.983	104.495
CPIA z-score	238	-.214	.934	-.876	.0192	.439
civil liberty	247	4.306	1.604	3	4	6
political rights	247	4.273	1.981	2	4	6
primary school enrollment	224	97.508	19.290	91.358	101.563	110.337
merchandized trade as % of GDP	247	64.469	31.215	41.355	60.568	83.855
broad money as % of GDP	225	37.383	25.520	18.216	31.825	50.164
inflation (%)	247	94.608	537.018	5.107	8.726	18.506
bank crisis (dummy)	247	.052	.224	0	0	0
currency crisis (dummy)	247	.109	0.313	0	0	0
debt crisis (dummy)	247	.202	.141	0	0	0

Note: Each observation is a country-period. For each variable, the mean, standard deviation, median, 25th percentile, and 75th percentile are reported.

Missing values for ODA and ODA by donor are treated as zeros, following the precedent of Arndt, Jones and Tarp (2010) (Page 14). In this sample there are no missing values in total ODA. Zero values in aid by donor are replaced with 1 dollar before taking logarithm. See Appendix Table D for more details in construction and sources of these variables.

Table 3: IDA Threshold and Aid

	(1)	(2)	(3)	(4)	(5)
	IDA	DAC	NDAC	MLA	ODA
$Crossing_{is-2}$	-2.485 (1.371)*	-0.961 (0.238)***	-2.222 (1.776)	-0.750 (0.302)**	-0.876 (0.216)***
<i>Wild cluster bootstrap-t p-value</i>	0.058	0.000	0.192	0.004	0.000
y_{is-1}	-8.587 (1.691)***	-1.443 (0.420)***	-4.739 (1.964)**	-2.508 (0.865)***	-1.535 (0.324)***
<i>Wild cluster bootstrap-t p-value</i>	0.000	0.004	0.018	0.024	0.000
Country FE	X	X	X	X	X
Period FE	X	X	X	X	X
N	247	247	247	247	247
N countries	35	35	35	35	35

Note: Each observation is a country-period. Dependent variables are the log average share of aid in GNI by donor in the last period and share of total aid in GNI in the last period. There are 35 countries in the sample. Country fixed effects, period fixed effects, and log population in the last period are controlled in all columns. $Crossing_{is-2}$ is a dummy variable indicating whether the country crossed the IDA cutoff at least two periods earlier. y_{is-1} is the log real GDP per capita in the second year of the last period, y_{it-4} . Cluster-robust standard errors are in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table 4: IDA Threshold and Aid - Placebo Threshold at 50% of the True Level

	(1)	(2)	(3)	(4)	(5)
	IDA	DAC	NDAC	MLA	ODA
$Crossing_{is-2}$	3.068 (1.867)	0.404 (0.661)	2.565 (2.396)	-0.118 (0.383)	0.299 (0.514)
<i>Wild cluster bootstrap-t p-value</i>	0.006	0.672	0.042	0.712	0.708
y_{is-1}	-12.29 (3.778)***	-2.251 (0.859)**	-8.808 (4.367)*	-4.622 (1.507)***	-2.245 (0.657)***
<i>Wild cluster bootstrap-t p-value</i>	0.000	0.032	0.000	0.000	0.004
Period FE	X	X	X	X	X
Country FE	X	X	X	X	X
N	162	162	162	162	162
N countries	34	34	34	34	34
F-statistics on $Crossing_{is-2}$					0.57

Note: Each observation is a country-period from countries that crossed the IDA threshold between 1987 and 2010. Country-period observations included in the sample are prior to the period of crossing the real threshold. There are 34 countries and 162 observations in the regression. Dependent variables are one period lag of average shares of ODA in GNI by donor. Country and period fixed effects, and log population in the last period are controlled in each column. F-statistic on $Crossing_{is-2}$ is reported in Column 5. y_{is-1} is log per capita real GDP in the second year of the last period, y_{it-4} . Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table 5: Baseline Results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Main Specification</i>	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid_{is-1}	0.0105 (0.00455)**	0.0133 (0.00615)**	0.0281 (0.0100)***	0.0352 (0.0147)**	0.0475 (0.0239)**	0.0485 (0.0177)***	0.0552 (0.0190)***
<i>Wild cluster bootstrap-t p-value</i>	0.020	0.032	0.006	0.008	0.052	0.000	0.000
y_{is-1}	-0.0675 (0.0246)***	-0.161 (0.0231)***	-0.0371 (0.0256)	-0.0249 (0.0322)	-0.0976 (0.0516)*	-0.0957 (0.0387)**	-0.0835 (0.0415)**
<i>Wild cluster bootstrap-t p-value</i>	0.090	0.000	0.298	0.496	0.082	0.000	0.140
Period FE	X	X	X	X	X	X	X
Country FE	X		X	X			
First differenced		X			X	X	X
IV			X	X	X	X	X
IV from predicted income				X			X
IV first differenced					X		
N	247	212	247	247	212	212	212
Number of countries	35	35	35	35	35	35	35
First atage F statistic (Kleibergen-Paap Wald)			16.50	7.385	19.52	16.16	24.06
AR(2) p-value					0.729	0.830	0.824

Note: Each observation is a country-period. The dependent variable is the period average real per capita GDP growth rate. Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported. See text for more details.

Table 6: Alternative Specifications

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
<i>Main Specification</i>	2SLS	2SLS	2SLS	GMM	GMM	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS
Aid_{it-1}	0.0258 (0.00966)***	0.0312 (0.0138)**	0.0427 (0.0182)**	0.0298 (0.0122)**	0.0308 (0.0133)**	0.0198 (0.00984)**	0.0229 (0.0101)**	0.0205 (0.00909)**	0.0331 (0.0149)**	0.0359 (0.0152)**	0.0377 (0.0155)**
<i>Wild cluster bootstrap-t p-value</i>	0.008	0.010	0.018			0.042	0.020	0.012	0.000	0.000	0.000
y_{it-1}	-0.0525 (0.0226)**	-0.0431 (0.0290)	-0.137 (0.0679)**	-0.128 (0.0554)**	-0.136 (0.0529)***	-0.0540 (0.0184)***	-0.0543 (0.0217)**	-0.0518 (0.0201)**	-0.0326 (0.0282)	-0.0334 (0.0281)	-0.0245 (0.0261)
<i>Wild cluster bootstrap-t p-value</i>	0.054	0.158	0.026			0.012	0.020	0.020	0.874	0.844	0.916
Period FE	X	X	X	X	X	X	X	X	X	X	X
Country FE	X	X				X	X	X	X	X	X
First differenced			X	X	X						
IV for y_{it-1}	X	X	X	X	X	X	X	X	X	X	X
Predicted crossing		X			X				X	X	X
lagged dependent variables						1	2	1,2	1	2	1,2
N	247	247	212	212	212	245	229	229	245	229	229
Number of countries	35	35	35	35	35	35	35	35	35	35	35
First atage F statistic (Kleibergen-Paap Wald)	8.098	3.601	11.46	4.453	6.164	5.951	6.520	6.448	3.263	4.083	4.103
Sargan test for overidentification (<i>p</i> -value)				12	12						
Hansen test for overidentification (<i>p</i> -value)				0.330	0.174						
AR(2) <i>p</i> -value				0.275	0.106						

Note: Each observation is a country-period. The dependent variable is the period average real per capita GDP growth rate. Instrumental variable for y_{it-1} is y_{it-5} all columns except for Columns 3, 4, 5. y_{it-1} is instrumented by y_{it-8} in Column 3, and is instrumented by y_{it-8} , y_{it-9} , and y_{it-10} in Columns 5 and 6. Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. *p*-values from the wild cluster bootstrap-t procedure are reported. See text for more details.

Table 7: Narrowing Periods

Panel A: OLS - first differenced	(1)	(2)	(3)	(4)	(5)	(6)
# of maximal periods around the crossings	7	6	5	4	3	2
Aid_{is-1}	0.0133 (0.00615)**	0.0133 (0.00615)**	0.0137 (0.00640)**	0.0142 (0.00631)**	0.0154 (0.00814)*	0.0201 (0.00946)**
<i>Wild cluster bootstrap-t p-value</i>	0.032	0.032	0.040	0.026	0.142	0.098
y_{is-1}	-0.161 (0.0231)***	-0.161 (0.0232)***	-0.162 (0.0232)***	-0.163 (0.0235)***	-0.161 (0.0256)***	-0.157 (0.0298)***
<i>Wild cluster bootstrap-t p-value</i>	0.000	0.000	0.000	0.000	0.000	0.000
Period FE	X	X	X	X	X	X
N	212	211	203	188	165	133
Number of countries	35	35	35	35	35	35
Test for Aid_{is-1} ((6)-(1), p -value)						0.069
Panel B: 2SLS - first differenced	(1)	(2)	(3)	(4)	(5)	(6)
# of maximal periods around the crossings	7	6	5	4	3	2
Aid_{is-1}	0.0485 (0.0177)***	0.0481 (0.0177)***	0.0460 (0.0181)**	0.0442 (0.0157)***	0.0427 (0.0192)**	0.0527 (0.0222)**
<i>Wild cluster bootstrap-t p-value</i>	0.002	0.002	0.000	0.000	0.014	0.006
y_{is-1}	-0.0957 (0.0387)**	-0.0969 (0.0389)**	-0.103 (0.0397)***	-0.107 (0.0369)***	-0.113 (0.0441)**	-0.104 (0.0488)**
<i>Wild cluster bootstrap-t p-value</i>	0.008	0.008	0.006	0.004	0.012	0.040
Period FE	X	X	X	X	X	X
N	212	211	203	188	165	133
Number of countries	35	35	35	35	35	35
First stage F statistics	16.159	16.353	15.741	19.946	16.577	19.971
Test for Aid_{is-1} ((6)-(1), p -value)						1.000

Note: Each observation is a country-period. The dependent variable is the period average real per capita GDP growth rate. The growth equation is first differenced before estimation. IV in the first differenced equation is $Crossing_{is-2}$. Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table 8: Adding Covariates

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	IV is $Crossing_{is-2}$					IV is $Crossing_{is-2}^{synth}$				
	baseline	schooling	political	CPIA	econ cond	baseline	schooling	political	CPIA	econ cond
Aid_{is-1}	0.0281*** (0.0100)	0.0307*** (0.0110)	0.0287*** (0.0102)	0.0336*** (0.0105)	0.0308*** (0.0110)	0.0352** (0.0147)	0.0393*** (0.0152)	0.0368** (0.0158)	0.0383*** (0.0148)	0.0456** (0.0205)
<i>Wild cluster bootstrap-t p-value</i>	0.006	0.004	0.002	0.000	0.008	0.008	0.008	0.002	0.022	0.050
y_{is-1}	-0.0371 (0.0256)	-0.0402 (0.0273)	-0.0361 (0.0262)	-0.0232 (0.0241)	-0.0119 (0.0269)	-0.0249 (0.0322)	-0.0245 (0.0332)	-0.0222 (0.0343)	-0.0153 (0.0321)	0.0101 (0.0377)
<i>Wild cluster bootstrap-t p-value</i>	0.298	0.234	0.314	0.438	0.496	0.486	0.548	0.636	0.840	0.552
log population	-0.0086 (0.0738)	-0.0149 (0.0753)	-0.0114 (0.0754)	0.0423 (0.0767)	0.0133 (0.0556)	0.0161 (0.0859)	0.0203 (0.0869)	0.0149 (0.0879)	0.0584 (0.0903)	0.0571 (0.0858)
primary school enrolment rate		-0.0003 (0.0004)					-0.0003 (0.0005)			
Freedom House civil liberty index			0.0023 (0.0073)	-0.0036 (0.0062)	0.0038 (0.0063)			0.0021 (0.0078)	-0.0045 (0.0061)	0.0021 (0.0071)
Freedom House political rights index			0.0013 (0.0042)	0.0004 (0.0040)	-0.0018 (0.0039)			0.0026 (0.0044)	0.0011 (0.0039)	-0.0001 (0.0041)
World Bank CPIA-Z score				0.0151* (0.0082)					0.0156* (0.0082)	
total trade as percentage of GDP					0.0007 (0.0005)					0.0006 (0.0005)
broad money					-0.0003 (0.0006)					-0.0002 (0.0006)
inflation (GDP deflator)					-0.0000** (0.0000)					-0.0000** (0.0000)
bank crisis during the period					0.0056 (0.0117)					0.0045 (0.0134)
currency crisis during the period					-0.0023 (0.0097)					0.0023 (0.0110)
debt crisis during the period					-0.0095 (0.0162)					-0.0080 (0.0154)
Period FE	X	X	X	X	X	X	X	X	X	X
Country FE	X	X	X	X	X	X	X	X	X	X
N	247	224	247	238	225	247	224	247	238	225
Number of countries	35	34	35	35	33	35	34	35	35	33
First stage F stats	16.495	14.469	16.389	16.459	13.647	7.385	7.909	6.590	7.732	5.259

Note: Each observation is a country-period. The dependent variable is the period average real per capita GDP growth rate. All columns are estimated using 2SLS. Columns 1 through 5 use actual crossings as instrument. Columns 6 through 10 use predicted crossings as instrument. Standard errors clustered at the country level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table 9: Model Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: IV is $Crossing_{is-2}$	excl. last xing	excl. last 2 xing	multiple crossings	last crossings	small islands	non IDA
Aid_{is-1}	0.0413** (0.0172)	0.0451** (0.0186)	0.0257*** (0.00991)	0.0241** (0.0112)	0.0273*** (0.00929)	0.0299** (0.0120)
<i>Wild cluster bootstrap-t p-value</i>	0.050	0.022	0.008	0.024	0.006	0.012
y_{is-1}	-0.0194 (0.0337)	-0.0200 (0.0366)	-0.0717*** (0.0263)	-0.0440 (0.0320)	-0.0396 (0.0251)	-0.0194 (0.0259)
<i>Wild cluster bootstrap-t p-value</i>	0.642	0.712	0.016	0.350	0.250	0.510
Period FE	X	X	X	X	X	X
Country FE	X	X	X	X	X	X
N	193	151	208	247	225	220
Number of countries	28	21	30	35	32	31
First stage F stat	8.635	20.06	18.48	19.04	14.39	11.97
	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: IV is $Crossing_{is-2}^{synth}$	excl. last xing	excl. last 2 xing	multiple crossings	last crossings	small islands	non IDA
Aid_{is-1}	0.0580** (0.0294)	0.0883 (0.0570)	0.0248* (0.0138)	0.0258 (0.0159)	0.0324*** (0.0124)	0.0382** (0.0172)
<i>Wild cluster bootstrap-t p-value</i>	0.044	0.000	0.022	0.008	0.008	0.020
y_{is-1}	0.00745 (0.0493)	0.0387 (0.0861)	-0.0736** (0.0332)	-0.0411 (0.0406)	-0.0308 (0.0289)	-0.00346 (0.0345)
<i>Wild cluster bootstrap-t p-value</i>	0.930	0.632	0.020	0.508	0.358	0.904
Period FE	X	X	X	X	X	X
Country FE	X	X	X	X	X	X
N	193	151	208	247	225	220
Number of countries	28	21	30	35	32	31
First stage F stat	3.401	1.905	6.438	8.158	7.958	5.946

Note: Each observation is a country-period. The dependent variable is the period average real per capita GDP growth rate. Sample restrictions are marked in the short handle in each column. All columns are estimated using 2SLS. Panel A uses actual crossings as the instrumental variable. Panel B uses predicted crossings as the instrumental variable. Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table 10: External Validity

	(1)	(2)	(3)
Crossing sample = 1	0.00669 (0.00669)	0.00672 (0.00698)	
Crossing sample = 1 \times 1 st quartile of y_{it-1}			0.03078 (0.00606)***
2 nd quartile of y_{it-1}			0.01327 (0.00868)
3 rd quartile of y_{it-1}			-0.00049 (0.01047)
4 th quartile of y_{it-1}			0.00739 (0.01018)
y_{it-1}	0.00799 (0.00656)	0.00940 (0.13174)	0.01848 (0.14883)
y_{it-1}^2		-0.00012 (0.01133)	-0.00085 (0.01294)
Year FE	X	X	X
N	1303	1303	1303

Note: Each observation is a country-year. The dependent variable is annual log per capita real GDP growth. There are 78 countries that were ever eligible for IDA between 1987 and 2010 as well as the 35 countries in our baseline sample. The key variable of interest is a dummy variable indicating whether the country belongs to the crossing sample. The sample consists of country-year observations between 1987 and 2010 that have per capita GNI level below the IDA threshold. Year fixed effects are controlled. Log real GDP per capita in the last year and its quadratic terms are included in the regressions. Standard errors are reported in parentheses, clustered at the country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Tables

Table A: IDA Threshold and Aid with Quadratic Log Initial Income Levels

	(1)	(2)	(3)	(4)	(5)
	IDA	DAC	NDAC	MLA	ODA
$Crossing_{is-2}$	-2.960 (1.264)**	-1.020 (0.272)***	-2.747 (1.725)	-1.027 (0.420)**	-0.940 (0.243)***
<i>Wild cluster bootstrap-t p-value</i>	0.012	0.000	0.096	0.002	0.000
y_{is-1}	-30.28 (21.24)	-4.133 (3.995)	-28.67 (17.17)	-15.12 (8.215)*	-4.462 (3.120)
y_{is-1}^2	1.562 (1.464)	0.194 (0.277)	1.724 (1.147)	0.909 (0.555)	0.211 (0.217)
Country FE	X	X	X	X	X
Period FE	X	X	X	X	X
N	247	247	247	247	247

Note: Each observation is a country-period. Dependent variables are the log average share of ODA in GNI by donor in the last period, Aid_{is-1} . 35 countries are in the sample. Country fixed effects, period fixed effects, and log population in the last period are controlled in all columns. Standard errors are in parentheses, clustered at the country level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t are also reported.

Table B: Baseline Results with Polynomials of Initial Income Level

	(1)	(2)	(3)
Aid_{is-1}	0.0281*** (0.0100)	0.0297*** (0.0105)	0.0342** (0.0148)
<i>Wild cluster bootstrap-t p-value</i>	0.006	0.008	0.028
Polynomials of y_{is-1} included	1	1,2	1,2,3
Period FE	X	X	X
Country FE	X	X	X
Observations	247	247	247
# of Countries	35	35	35
First stage F statistic	16.495	14.935	10.560

Note: Column 1 replicates Column 3 of Table 5. Column 4 and Column 5 adds quadratic and cubic terms of y_{is-1} . Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table C: Functional Form of Aid

	(1)	(2)
Aid_{is-1}^*	0.573**	0.525**
	(0.264)	(0.251)
<i>Wild cluster bootstrap-t p-value</i>	0.044	0.060
y_{is-1}	-0.0211	-0.0381
	(0.0475)	(0.0384)
<i>Wild cluster bootstrap-t p-value</i>	0.804	0.454
Period FE	X	X
Country FE	X	X
Observations	247	247
# of Countries	35	35
First Stage F statistic	8.062	4.111

Note: $Aid_{is-1}^* = \sum_{k=3}^5 (ODA_{it-k}/GNI_{it-k})/3$ is the period average aid to GNI ratio in the last period. There are 212 country-period observations from 35 countries. 2SLS estimator is used in both columns. In both columns, ΔAid_{is-1}^* is instrumented with $\Delta Crossing_{is-2}$, Δy_{is-1} is also treated as endogenous. y_{it-8} is used as an additional instrumental variable. Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported.

Table D: Effects of Aid on Investment

<i>Dep var (Inv/GDP)_{is-1}</i>	(1)	(2)	(3)	(4)	(5)	(6)	(7)
<i>Main Specification</i>	OLS	OLS	2SLS	2SLS	2SLS	2SLS	2SLS
<i>Aid_{is-1}</i>	-0.0166 (0.0150)	-0.0103 (0.0158)	0.0580* (0.0350)	0.0490 (0.0333)	0.0542 (0.0511)	0.0831 (0.0624)	0.0719 (0.0465)
<i>Wild cluster bootstrap-t p-value</i>	0.374	0.560	0.086	0.120	0.308	0.164	0.116
<i>y_{is-2}</i>	-0.0638 (0.0392)	-0.0962*** (0.0339)	0.0308 (0.0514)	0.0194 (0.0523)	-0.0503 (0.0409)	-0.0298 (0.0461)	-0.0378 (0.0399)
<i>Wild cluster bootstrap-t p-value</i>	0.172	0.006	0.588	0.728	0.244	0.486	0.512
Period FE	X	X	X	X	X	X	X
Country FE	X		X	X			
First differenced		X			X	X	X
IV			X	X	X	X	X
IV predicted				X			X
IV first differenced					X		
Equation first differenced		X			X	X	X
N	206	171	206	206	171	171	171
Number of countries	34	34	34	34	34	34	34
First atage F statistic (Kleibergen-Paap Wald)			9.223	9.714	10.94	4.724	10.51

Note: Each observation is a country-period. The dependent variable is the period average investment to GDP ratio. Standard errors clustered at the country level are reported in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. p -values from the wild cluster bootstrap-t procedure are reported. See text for more details.

Table E: Construction and Sources of Key Variables

Variable	Notation	Source*	Description
Period	τ_s		Each period consists of 3 consecutive years. The first period is from 1987 to 1989.
IDA threshold		WB	Denoted in current US dollars, available since 1987.
Crossing 2 periods earlier	$Crossing_{is-2}$		Country i crossed the IDA cutoff for the first time in the sample at least two periods earlier.
Foreign aid	Aid_{is}	WDI/DAC	$Aid_{is} = \sum_s (ODA/GNI)/3$. Total net Official Development Aid (ODA) in current US dollars is from the DAC. GNI in current US dollars is from the WDI.
Initial income level	y_{is-1}	WDI	Real per capita GDP in 2000 constant US dollars in the second year of the last period, y_{it-4} .
Real per capita GDP growth	g_{is}	WDI	Denote real per capita GDP for country i in year t as y_{it} , annual real per capita GDP growth is $\ln(y_{it}) - \ln(y_{it-1})$. Period real per capita GDP growth is the mathematical average of annual real per capita GDP for years in the period.
Aid by donor	Aid_{jis}	DAC	Donor groups (j) include IDA, DAC countries, non- DAC countries, and multilateral agencies (MLA) except for IDA.
Investment		WDI	Gross capital formation as ratio of GDP. Investment in a period arithmetic average of annual gross capital formation as ratio of GDP.
Population ⁺		WDI	Population
Primary school enrollment ⁺		WDI	Gross primary school enrollment ratio. It is the total enrollment in primary education, regardless of age, expressed as a percentage of the population of official primary education age.
Trade ⁺		WDI	Measured as merchandise trade as percentage of GDP.
Money supply ⁺		WDI	Broad money as percentage of GDP
Inflation ⁺		WDI	GDP deflator (percentage annual)
Crisis ⁻		WB	Dummy variables indicating whether there is any bank, currency, or debt crisis during the years within the period.
Political rights ⁺		FH	Freedom House political rights indicator. It ranges from 0 to 7, with a higher number indicating less political rights.
Civil liberties ⁺		WDI	Civil liberties indicator. It ranges from 0 to 7, with a higher number indicating less civil liberty.
CPIA ⁺		WB	Public sector management and institutions cluster average. 1=low to 6=high.

* WB is short for the World Bank; WDI is short for the the World Development Indicators from the World Bank; DAC represents the OECD Development Assistance Committee. FH is short for the Freedom House

⁺ averaged within each period.

⁻ summed over each period.