Does Health Aid Matter?

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Abstract

This paper examines the relationship between health aid and infant mortality, using data from 118 countries between 1973 and 2004. Health aid has a statistically significant effect on infant mortality: doubling per capita health aid is associated with a 2 percent reduction in the infant mortality rate. For the average country, this implies that increasing per capita health aid by US$1.60 per year is associated with 1.5 fewer infant deaths per thousand births. The estimated effect is small, relative to the targets envisioned by the Millennium Development Goals.

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I. INTRODUCTION

Foreign aid is widely believed to improve health outcomes in developing countries.[1] Although a large literature has failed to provide robust evidence that aid promotes economic growth (Rajan and Subramanian, 2005a, Roodman, 2004), foreign aid is often credited with saving lives by providing vaccines, eradicating deadly diseases, and improving medical services. This belief stems in part from successful large scale health interventions funded with international assistance.[2]

The belief that aid improves health despite having little or no effect on growth is consistent with evidence that economic growth plays a limited role in explaining health outcomes. Many countries have shown remarkable improvements in health with little or no economic growth and vice versa (Cutler, et. al., 2006, Acemoglu and Johnson, forthcoming). Existing estimates suggest that economic growth explains less than half of the overall improvements in health in the past 50 years in developing countries (Bloom, et. al., 2004, Fogel 1994, WHO, 1999). Hence, although previous studies fail to find an effect of aid on growth, there remains hope that aid improves health outcomes directly.

Aid's effect on health outcomes also relates to the long-standing debate about the effectiveness of aid in general. Skeptics argue that aid can adversely affect a country's

[1] For example, see Kristof (2006).

[2] One of several examples is the national diarrheal control program in Egypt. At a cost of US $43 mn (60 percent of which was funded by international donors), this program increased the use of life-saving oral rehydration therapy, which reduced infant diarrheal deaths by 82 percent between 1982 and 1987. See Levine et. al., 2004 and Soares (2007) for success stories of public health programs.

competitiveness (Rajan and Subramanian, 2005b, Younger, 1992), encourage dependency and reduce incentives to adopt good policies (Bauer, 1982), overwhelm the management capacity of governments (Kanbur, et. al., 1999) or be used inefficiently to benefit the political elite (Bauer, 1971, Friedman, 1958). On the other hand, advocates continue to argue that aid leads to improved outcomes in poor countries by relaxing resource constraints and directly improving health service delivery (Levine, et. al., 2004). For example, Sachs (2005) advocates a massive scaling up of aid to help countries achieve the Millennium Development Goals (MDGs). In addition, some studies contend that particular types of aid, such as short-term aid or multilateral aid, can promote economic growth (Clemens, et. al., 2004, Reddy and Minoiu, 2006).

Given the micro-level evidence on the success of selected public health intervention programs, the limited role of economic growth in explaining health improvements, and the ongoing debate over aid effectiveness, it is important to understand the relationship between foreign aid and health outcomes. Despite the vast empirical literature considering the effect of foreign aid on growth, there is little systematic empirical evidence at the macro-level on how overall aid affects health, and none (to our knowledge) on how health aid affects health.[3] This is surprising, given the recent attention devoted to promoting health in developing countries. The adoption of the MDGs signaled a clear shift in the orientation of donors to prioritize aid towards poverty-reducing objectives, including improved health outcomes, and

[3] Only few existing papers (Boone, 1996, Masud and Yontcheva, 2005, Fielding et. al., 2005 and Burnside and Dollar, 1998) have examined the impact of overall foreign aid on infant mortality or life expectancy. In addition to looking at the impact of health aid, our paper differs from these existing papers in (i) employing additional identification strategies (ii) testing for effects of aid conditional on regions, periods, policies and institutions

(continued…)

many multilateral and bilateral donors have already made explicit commitments to scale up aid significantly over the medium term.[4]

The main contribution of this paper is to present new, systematic and comprehensive cross-country evidence on the effect of health aid on infant mortality. These two variables are more likely to be closely related than overall aid and growth, which have been the focus of the bulk of the existing aid literature.[5] To the best of our knowledge, this paper presents the first macro study of the effect of health aid on health outcomes.

Infant mortality is our primary health indicator for four reasons. First, data on infant mortality are available for a large set of countries and are more reliable than other indicators, such as life expectancy, child mortality and maternal mortality.[6] Second, infant mortality is more sensitive than life expectancy to changes in economic conditions, and is considered to be a flash indicator of the health conditions of the poor (Boone, 1996). Third, reductions in infant and child mortality largely explain the substantial improvements in life expectancy over the last fifty years in poor countries (Cutler et. al., 2006). Finally, past studies indicate

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(iii) using a significantly larger sample, and finally (iv) exploring health spending as a possible channel through which foreign aid could affect health outcomes.

[4] The G5 at its 2005 summit at Gleneagles, Scotland committed to an increase in total aid for an amount of US $50 billion, half of which would be devoted to doubling aid to Sub-Saharan Africa by 2010 (Bourguignon and Leipziger, 2006).

[5] There has been an attempt in the literature to narrow the definition of aid in order to examine the effect of short-term and developmental aid on growth (e.g. Clemens et. al., 2004, Reddy and Minoiu, 2006).

[6] The estimates of life expectancy are not reliable because they are based on predictive equations since most developing countries lack complete vital registration systems. Moreover, mortality reductions reflected in changes in life expectancy took place among different age groups in different countries, hence it is not a suitable measure for comparing health changes between countries (Deaton, 2006, Cutler, et. al., 2006). Data on other health indicators like child and maternal mortality are scarce.

that in developing countries, infant mortality depends on access to medicines and health facilities, water and sanitation, fertility patterns, maternal health, maternal and infant nutrition, maternal and infant disease exposure, and female literacy in addition to per capita GDP and economic inequality.[7] Therefore, infant mortality is a proxy for a broad set of human development outcomes.

Two identification strategies are employed to estimate the effect of aid on health outcomes. The first is OLS with a rich set of control variables, on a sample that pools all country-year observations. The second strategy is based on a dynamic panel data model with country fixed effects, and is estimated using the Generalized Method of Moments (GMM). In this model, all predetermined and endogenous variables are instrumented by their appropriate lags, to avoid introducing a spurious correlation between these variables and the error term. GMM estimation requires a sufficiently large number of observations to provide robust estimates. We rely on a substantially larger dataset than previous studies on aid, covering 118 countries between 1973 to 2004.[8]

The main finding in the paper is that health aid has a discernible effect on infant mortality. On average, a doubling of per capita health aid is associated with a 2 percent reduction in infant mortality. For the average country in our sample, this implies that increasing per capita health aid from US$1.60 to $3.20 per year will lead to roughly 1.5 fewer infant deaths per

[7] See among others, Filmer and Pritchett, 1999, Wagstaff, 2000, Wolpin, 1997, Cutler et. al., 2006, Pritchett and Summers, 1996, Easterly, 1999, Galiani et. al., 2005.

[8] The overall development aid sample covers 1960-2004. The maximum coverage of data in previous studies is in Rajan and Subramanian (2005a), who include 61–81 countries from 1960–2000.

thousand births, which is small relative to the MDGs targets.[9] In addition, there is weaker evidence that health aid has become more effective in reducing infant mortality since 1990, and that it is more effective in countries with higher quality policies and institutions.

If both health aid and overall aid primarily relax government budget constraints, they should have similar effects on health outcomes. In order to assess whether there is indeed something specific about health aid which explains its relationship with health outcomes, we also examine the effect of *overall aid* on health outcomes. In our preferred specification, the estimated effect of overall aid is half that of health aid and is not statistically significant. This result is consistent with health aid being more likely than overall aid to be directed towards projects which have a direct impact on health outcomes.

Finally, we examine the effect of aid on health spending, which is one channel through which aid may reduce infant mortality. Data on health spending are limited, but suggestive evidence indicates that doubling health aid is associated with a 7 percent increase in health spending per capita (which is statistically significant). For a typical country, this implies that a one dollar increase in health aid per capita is associated with a more than US$1.50 increase in health spending per capita. On the other hand, the estimated effect of overall aid on health spending is smaller and statistically insignificant. The results are consistent with increased health spending being one channel through which health aid reduces infant mortality.

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[9] The MDGs target is that under 5 child mortality will be reduced by two-thirds of its 1990 level by 2015. We assume the same target for the reduction in (under one year) infant mortality from 81 to 27 deaths per 1000 births for the average country.

In summary, the results suggest that the well-known “micro-macro paradox”—where aid is demonstrably effective in specific cases but has little effect in the aggregate— does not fully apply in the case of health aid. The numerous success stories of international assistance from bilateral and multilateral donors appear to be borne out, to some extent, in the aggregate data. Health aid constitutes only 6 percent of overall aid and the findings indicate that increased allocation of aid towards health purposes in the future could be associated with better health outcomes.

The outline of the paper is as follows. Section II presents the empirical specifications, Section III discusses the data and shows simple descriptive statistics, Section IV presents results on the relationship between health aid and infant mortality, Section V discusses the impact of health aid in different environments, and Section VI presents preliminary evidence on aid and health spending. Section VII concludes.

II. Empirical Framework

A. Ordinary Least Squares

We follow the bulk of the previous literature and average our annual data over five-year periods, to reduce annual fluctuations and measurement error. Our most basic OLS regression equation specifies infant mortality as a function of aid in the previous period, as follows:

$$\log IM_{rt} = \alpha \log A_{rt-1} + \gamma \log IM_{rt-1} + \beta X_{rt-1} + \delta_1 HIV_{rt} + \delta_2 W_{rt} + v_t + \varepsilon_{rt} \qquad (1)$$

Where IM_{rt} is the infant mortality in aid recipient country r in period t, A_{rt-1} is the aid per capita in country r during the previous period, IM_{rt-1} is one-period lagged infant mortality, and X_{rt-1} is a vector of other control variables lagged one period. Lagged infant mortality and the other control variables are introduced in the model to capture the country's initial health and economic status. HIV_{rt} and W_{rt} are scalars indicating the incidence of HIV/AIDS, and the presence of a war in country r at time t. v_t is a vector of period dummies, which captures universal time trends. The parameter α gives the percent change in infant mortality due to a one percent increase in the previous period's aid per capita. α is identified by using both across- and within-country variation. [10]

B. Dynamic Panel Data Models with Fixed Effects

The OLS results are biased if lagged aid is correlated with the unobserved component of health outcomes. If countries receive more health aid as infant mortality increases, this implies a positive correlation between health aid and the error term, which would underestimate the beneficial effect of aid. Another potential source of bias is measurement error. Since the health aid data is reported by donors, any measurement error is likely to be uncorrelated with the characteristics of the recipient country, which would imply that any beneficial effect of aid would be further underestimated.

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[10] The results in the paper are similar if we use the ratio of aid to GDP (in logs) as the explanatory variable (Table 5 below). In addition, the estimated effect of health aid on infant mortality is unchanged if we drop HIV/AIDS from the model (results available upon request).

Country fixed effects can be introduced in the model to control for unobserved country-specific and time-invariant factors determinants of infant mortality. The fixed effects regression is specified as:

$$\log IM_{rt} = \alpha \log A_{rt-1} + \gamma \log IM_{rt-1} + \beta X_{rt-1} + \delta_1 HIV_{rt} + \delta_2 W_{rt} + s_r + v_t + \varepsilon_{rt} \qquad (2)$$

Where s_r is a vector of country fixed effects which denotes time-invariant differences in infant mortality across countries, implying that α is identified by within-country changes in aid over time.

Three main concerns remain after controlling for country-specific heterogeneity. First, the residual may contain time-*varying* and country specific factors that affect infant mortality, such as initial access to health clinics, clean water, and the fertility rate in poor households. If these time varying, country specific factors are correlated with aid, then the estimated coefficient of interest, α, would be biased. For example, if countries tend to receive more aid as the quality of their health facilities declines, then α would be biased towards zero and underestimate the beneficial effect of health aid. Second, in panel data models with a lagged dependent variable, predetermined variables, and fixed effects, the within-estimators of the lagged dependent and predetermined variables are inconsistent. This inconsistency derives from the presence of the lagged error term in the residual, after subtracting within-country means. Finally, the presence of classical measurement error in health aid would bias the OLS coefficient towards zero. Because equation (2) would provide inconsistent estimates, it is not estimated.

One common method used to address these three sources of bias in the presence of fixed effects is to estimate a system of moment equations using the Generalized Method of Moments (GMM). The following regression equations are estimated using a system GMM specification (Blundell and Bond, 2000, Bond, 2002):

$$\log IM_{rt} = \alpha \log A_{rt-1} + \gamma \log IM_{rt-1} + \beta X_{rt-1} + \delta_1 HIV_{rt} + \delta_2 W_{rt} + s_r + v_t + \varepsilon_{rt} \qquad (3)$$

$$\Delta \log IM_{rt} = \alpha(\Delta \log A_{rt-1}) + \gamma(\Delta \log IM_{rt-1}) + \beta(\Delta X_{rt-1}) + \delta_1 \Delta HIV_{rt} + \delta_2 \Delta W_{rt} + \Delta v_t + \Delta \varepsilon_{rt} \qquad (4)$$

Lagged differences of the endogenous variables, $(\log IM_{rt-1} - \log IM_{rt-2}), (A_{rt-1} - A_{rt-2})$, $(X_{rt-1} - X_{rt-2})$ are used as instruments in the level equation (3). Lagged levels of the endogenous variables, $IM_{rt-2,} A_{rt-2}, X_{rt-2}$ are used as instruments in the first differenced equation, (4). HIV_{rt} and W_{rt} are assumed to be exogenous. System GMM obtains the estimated coefficients by solving the appropriately weighted set of the moment conditions based on equations (3) and (4).

We use system GMM rather than first difference GMM (Arellano-Bond, 1991), which estimates only equation (4), because exploiting the additional moment conditions for the equations in levels provides a dramatic improvement in efficiency and reduction in finite sample bias when the dependent variable is persistent (Blundell and Bond, 2000). This is the case in our data, as the coefficient on lagged infant mortality is close to one.[11] Because the infant mortality series is close to a random walk, lagged levels of infant mortality are weak instruments for first differences. As a result, the first-difference GMM estimator suffers from problems associated with weak instruments, such as substantial finite sample bias. The system GMM specification is estimated using the xtabond2 command in Stata (Roodman, 2005).[12]

The system GMM estimator entails the following assumptions (Blundell and Bond, 2000)[13]:

$$\begin{aligned}
&E(s_r) = E(\varepsilon_{rt}) = E(s_r\varepsilon_{rt}) = 0 \\
&E\varepsilon_{rs}\varepsilon_{rt} = 0, s \neq t \\
&E(IM_{r1}\varepsilon_{rt}) = 0, t = 2,......., T \\
&E(A_{r1}\varepsilon_{rt}) = 0, t = 2,.........., T \\
&E(\Delta IM_{r2}s_r) = 0 \\
&E(\Delta A_{r2}s_r) = 0
\end{aligned} \tag{5}$$

The last four equations in (5) constitute the initial conditions underlying the system GMM estimates. These conditions assume that the initial *levels* of aid and infant mortality are uncorrelated with all future unobserved shocks in infant mortality, and that the initial *changes* in infant mortality and aid are uncorrelated with the unobserved country fixed

[11] Since we have a large cross-section of countries (118 countries) and relatively small number of time periods (seven periods), the asymptotic properties of the estimators are based on the cross-sectional dimension becoming large.

[12] The robust two-step GMM procedure is used, which includes Windmeijer's correction for finite sample bias.

[13] For simplicity, we only lay out the initial condition assumptions required for the consistency of estimates of the coefficients on lagged infant mortality and aid. Similar initial conditions also apply to the predetermined variables in the model, such as per capita income, population and fertility.

effects. These assumptions are strong. However, of the set of estimators that control for unobserved country effects in the presence of a lagged dependent variable (difference GMM and the within-estimator), the system GMM estimator is likely to provide the most accurate estimates.

III. A First look at the Data

The data on health and overall aid are both taken from the OECD, but are derived from two different sources. The data on net Official Development Assistance (ODA) are obtained from the Development Assistance Committee (DAC). The OECD database also provides data on ODA commitments by purpose, taken from the Creditor Reporting System (CRS). According to the OECD, the term "purpose of aid" signifies the sector of the recipient's economy that the aid activity is designed to assist, such as health, energy, or agriculture. Aid activities are classified into 26 broad three-digit sector/purpose categories, each of which is further classified into 5-digit purpose codes. The three and five digit codes corresponding to the health sector are shown in Table A1.

The CRS data suffer from two limitations. First, the CRS collects data on donor commitments rather than disbursements, although the two are strongly correlated.[14] Second, aid totals in CRS are significantly less than those in the DAC, reflecting the underreporting of aid in the CRS data. The extent of underreporting in the CRS varies by sector, donor and time period. (Development Assistance Committee, 2002). However, since health aid is

[14] Data on health aid disbursements are available from 1990 to 2004, and the correlation coefficient between disbursements and commitments over this period is 0.66.

reported by donors, there is no reason to believe that the underreporting is systematically related to characteristics of the recipient.[15]

Aid is defined as the sum of grants and concessionary loans (loans with a grant element of at least 25 percent, based on a 10 percent reference rate of interest). Net ODA to a recipient is the difference between the value of aid disbursed by all donors and the return of unspent balances and principal repayments of earlier loans. Aid flows are converted into constant 2003 US dollars using the DAC deflator.

We confine the sample of aid recipient countries to developing countries based on 2005 GNI per capita, as classified by the World Bank.[16] Outliers were trimmed manually and also according to the Hadi (1992) procedure.[17] The final sample consists of 465 country-period observations.

Data on infant mortality come from the United Nations (UN, 2004).[18] The infant mortality rate represents the number of infants who die before reaching the age of one year, per 1000

[15] Donor-recipient pairs for which data on health aid are not reported are omitted from the analysis. As a robustness check, we reran the analysis treating non-reported health aid as zero. The estimated effect of health aid on infant mortality is qualitatively similar to the results reported in the paper.

[16] Countries with GNI per capita below US $10,725 in 2005 are categorized as developing countries, according to the World Bank's income classification (World Bank, 2006).

[17] The Hadi procedure dropped outliers based on within-country infant mortality, at the 5 percent level of significance. In addition, the top and bottom one percent of within-country values of log health aid were omitted from the analysis (a total of 24 country-year pairs were dropped).

[18] World Development Indicators (WDI) also has data on infant mortality. We prefer to use the UN data due to substantially wider coverage in terms of countries and years. The two sources are highly correlated, as the correlation coefficient is 0.99 in the roughly half of the sample observations for which WDI data are available.

live births in a given year. The HIV/AIDS prevalence rate, as measured by the number of reported AIDS cases per 100,000 people, is taken from Papageorgiou and Stoytcheva (2006). All the variables and the data sources are described in detail in Table A3. The list of countries in the sample is shown in Table A4, and Table A5 shows the summary statistics for all the variables used in the paper.

Figure 1 shows trends in the total amount of reported health aid (right scale) and overall aid (left scale) during each five year period between 1960 and 2004. Health aid is only available beginning in the 1970–1975 period. Reported health aid constitutes a very small fraction of overall aid, with the share ranging between 0.5 and 7 percent. Figure 1 shows that health aid increased during 1973-2004. Overall aid also increased for most of the period, though the increase was at a much slower rate after 1980–84.[19] Figure 2 shows that both health aid and overall aid have been decreasing in per capita terms, at least since 1975.

Figure 3 looks at the various components (or "purposes") of health aid for 2000–04**.** Health policy and administrative management is the largest component, constituting about 30 percent of total aid, followed by basic health care (25 percent), infectious diseases control (15 percent), medical services (9 percent) and basic health infrastructure (6 percent). Over time, the health aid allocated towards health policy and administrative management has

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19 The aid data from DAC and CRS do not include private health aid, which has become more important and now exceed half the levels of health ODA reported in the CRS database. For example, the Global Fund To Fight AIDS, Tuberculosis and Malaria, approved grants of about \$6 bn between 2003 and 2006 in 136 countries to support aggressive interventions against these three diseases (http://www.theglobalfund.org/en/). Similarly, the Bill and Melinda Gates Foundation has committed more than \$6 billion between 1995 and 2005 in global health grants to organizations worldwide.

decreased whereas medical services and basic health care have become more important (not shown).

Figure 1. Health Aid and Overall Aid Trends
(2003 US$ billion)

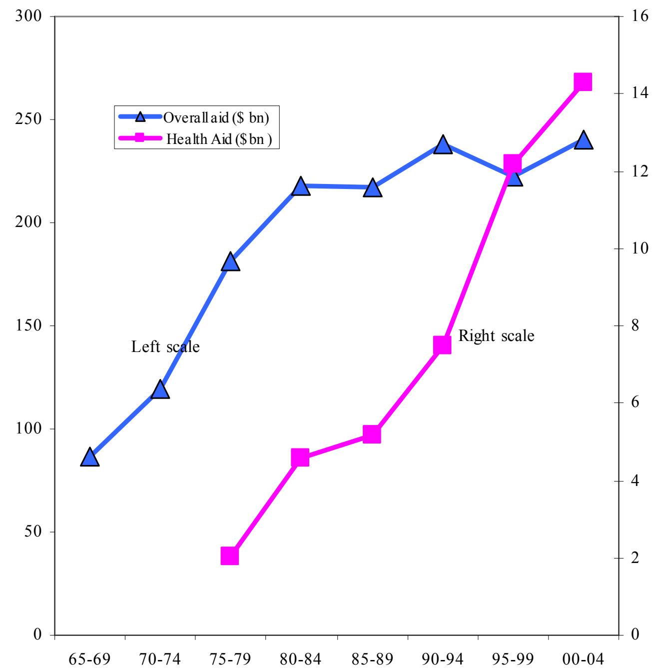


Figure 2. Overall Aid and Health Aid Per Capita Trends
(2003 US$)

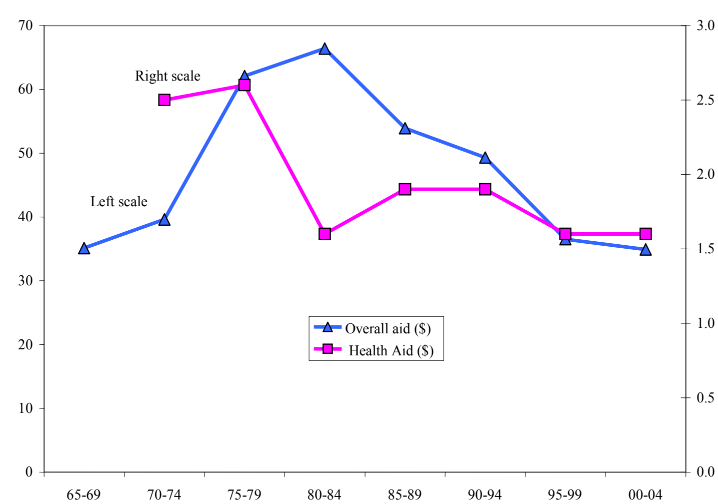


Figure 3. Components of Health Aid, 2000–04
(In percent of total health aid)

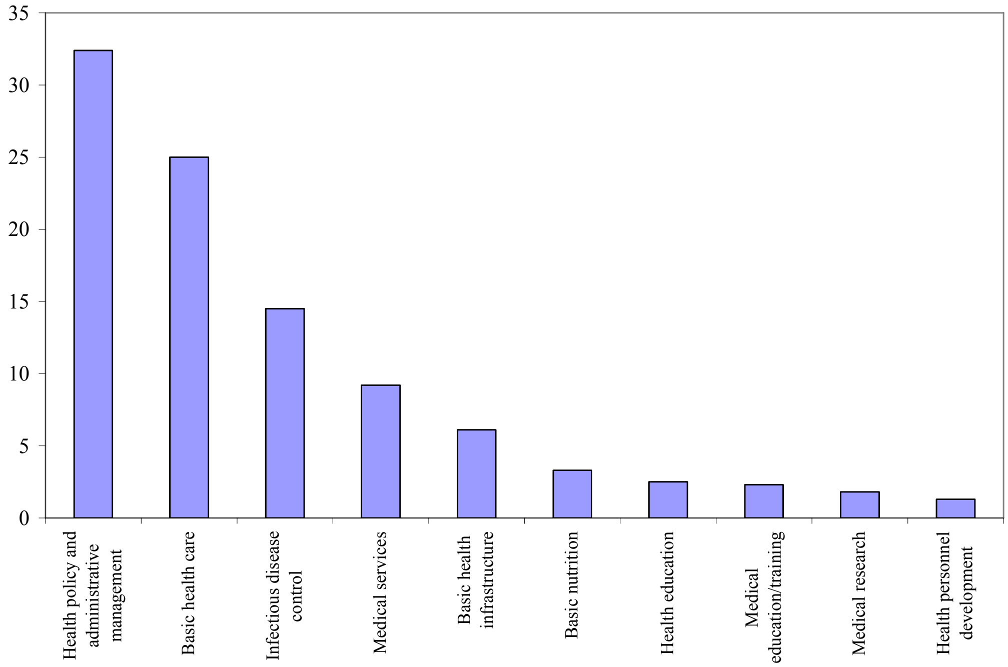


Table A2 examines the three largest CRS purposes for 2000–04 in greater detail. The CRS data contains a variable called "short description" which can be used to better understand the broad purposes described in Figure 3. Table A2 lists the ten most important descriptions in the three largest CRS purposes shown in Figure 3.[20] Some of the largest categories under "health policy and administrative management" include health aid by the World Bank to three large states in India—Uttar Pradesh, Rajasthan and Tamil Nadu-targeted towards health systems development. Under "basic health care", major projects include health aid given for "young child health" and "child survival". Finally, health aid given for "infectious diseases control" is targeted largely to immunization programs devoted to polio eradication, and

[20] Some of the short descriptions in the data are identical to the broader purpose and do not convey additional information.

immunization programs for specific countries like India. Although the short descriptions of health aid contain limited information, the table suggests that a significant portion of health aid is directed to specific projects in particular regions.

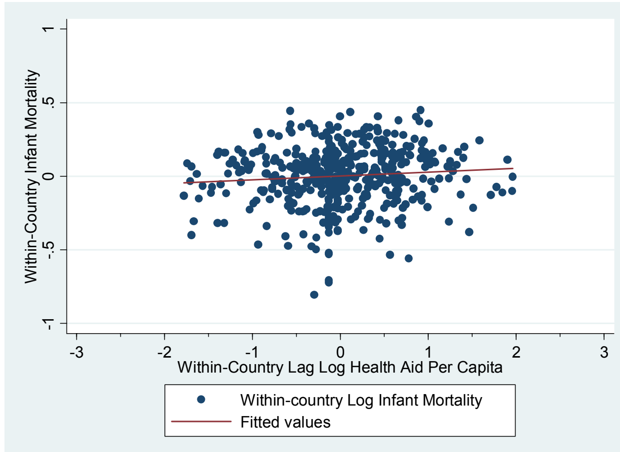
Bilateral aid constitutes about 70–90 percent of health aid, and the fraction is relatively stable over time. Health aid is comprised predominantly of grants, as the loan component varies between 3 and 10 percent (not shown).

Finally, before proceeding to the regression analysis, we examine the bivariate relationship between infant mortality and health aid. Figure 4 shows a weak positive correlation between health aid and infant mortality, after controlling for country and year fixed effects. This positive association likely reflects the endogeneity of aid, as more aid flows to countries when health indicators are worsening. Of course, the scatter plot is only suggestive, and the next section presents results from regression analysis that includes additional control variables.

IV. HEALTH AID AND INFANT MORTALITY

This section examines the effect of per capita health aid on infant mortality. Our main focus is on infant mortality as the primary health indicator, for reasons discussed above. In the basic specifications, we analyze the effect of increasing per capita health aid during a given five-year period on health outcomes in the following period.

Figure 4: Scatter Plot of Infant Mortality and Health Aid, 1975–79 to 2000–04
(In deviations from country-specific means)



Health aid is averaged over five-year periods. The scatter plots show the relationship between health aid in a given period and health outcomes in the following periods. The plots are based on regressions that control for country fixed effects and period dummies.

The regression results for the impact of health aid on infant mortality are shown in Table 1. The dependent variable is the log of the average number of infant deaths (per thousand births) during a five-year period. The key explanatory variable is the log of the average amount of health aid per capita received during the previous period.[21] All the regressions include period dummies, the war dummy, and additional controls—lagged infant mortality, lagged population, lagged per capita income, lagged fertility rate, and the prevalence of HIV/AIDS. Since we are controlling for the prevalence of AIDS in the current period, the estimates do not capture the effect of health aid on health outcomes through any

[21] We truncate the log per capita health aid variable at 25 cents, which is approximately the 25th percentile, to reduce the influence of negative outliers and measurement error. The estimated coefficients are attenuated towards zero and weakly significant when the variable is not truncated. Table A6 shows the estimated coefficients for truncation at various percentiles, and demonstrates how the magnitude of the estimated effect increases as we truncate observations at the lower tail.

contemporaneous effect on AIDS prevalence rates. The standard errors in all reported regression results are robust to heteroskedasticity and are clustered within country.

Specification I shows the OLS regression results without country fixed effects. The estimated coefficient on lagged aid per capita is negative and statistically significant (at the 5 percent level) in the OLS specification. Doubling aid reduces infant mortality in the next 5-year period by approximately 1 percent.

Specification II shows the results from the system GMM estimation. In this case, identification is based on the lags of health aid (in addition to the lags of other predetermined variables). Two and three period lagged levels of health aid and the other predetermined variables, when available, are used as instruments in the difference equation whereas one and two period lagged differences are used in the level equations.[22] The GMM results indicate a statistically significant effect of health aid in reducing infant mortality. Doubling health aid within a country reduces infant mortality in the next 5-year period by about 2 percent. The beneficial effect is precisely estimated with the 95 percent confidence interval ranging from 0.5 to 3.6 percent. The Hansen's test for over- identifying restrictions passes at the 1 percent significance level. In addition, the null hypothesis of no two-period serial correlation in the residuals cannot be rejected. The magnitude of the GMM estimate of the effect of health aid in reducing infant mortality is higher than that of the OLS estimate, which is consistent with a positive correlation between the unobserved components of infant mortality and health

[22] The lags are included as "GMM-style instruments" (Roodman, 2005).

aid.[23] This implies that increased health aid is allocated to countries when health outcomes are worsening.

Turning to the coefficients on the other explanatory variables in Table 1, infant mortality is highly persistent, as the coefficient on lagged infant mortality is close to one.[24] The coefficient on lagged per capita income is negative and significant at the 1 percent level. This is consistent with higher levels of income leading to improved public health infrastructure, such as water and sanitation, better nutrition, better housing and the ability to pay for health care (Cutler, et. al., 2006, Pritchett and Summers, 1996). The coefficient on HIV/AIDS is positive (and statistically significant at the l percent level in the OLS regression), suggesting that a greater prevalence of AIDS is associated with higher infant mortality.[25, 26]

[23] The increased magnitude of the GMM estimate relative to the OLS estimate may also be attributable to noise in the per capita health aid variable, which would attenuate the OLS estimates towards zero.

[24] This may not necessarily translate into an explosive long-run effect of health aid. The long-run effect is not very meaningful in our framework since there are only a small number of time periods and the asymptotic properties of the estimator is based on the cross-section dimension tending to infinity. Since the magnitude of lagged infant mortality is close to one, we also estimate an alternative specification where the dependent variable is the change in log infant mortality, and obtain qualitatively similar results (results available upon request).

[25] The sign on lagged fertility is negative (but insignificant) in the GMM specification, where higher fertility is associated with lower infant mortality. The effect of changes in fertility on infant mortality has been a subject of debate in the health literature. In fact, there is little evidence that declines in fertility have a net positive impact on infant and child survival (LeGrand and Phillips, 1996). For example, Bongaarts (1987) using cross-country evidence finds that the percentage of birth intervals of less than 24 months that are associated with high infant-health risks rises as fertility falls.

[26] We also included lagged female literacy as additional control in the two key specifications. The estimated coefficient was negative, but statistically insignificant, and the coefficient on aid was unchanged. Women's education is considered an important determinant of infant mortality (Cutler et. al., 2006). However, female literacy may be highly correlated with other control variables, such as lagged infant mortality.

Discussion of the results

As there are no previous studies on the effect of health aid on health outcomes, it is difficult to place these results in context. However, the estimated percentage impact of health aid on infant mortality reported above can be recast as the number of infants saved for a given increase in health aid, for the average country in the sample. The average infant mortality rate in the health aid sample is approximately 73 per 1,000 live births. The GMM coefficient estimate in Table 1 implies that doubling health aid reduces infant mortality by approximately 2 percent. The average amount of annual per capita health aid is US$1.60. Therefore, for the average country, increasing per capita health aid from US$1.60 to $3.20 is associated with about 1.5 fewer infant deaths per 1,000 live births. Since the average number of live births per year is 1 million, the estimated effect translates to approximately 1,560 fewer infant deaths per year for a typical country. For the world as a whole, the estimates imply that doubling health aid would save approximately 170,000 infants per year.

Table 1. Estimated Effect of Health Aid on Infant Mortality, 1975–2004

Dependent variable :	Log Infant mortality rate (per 1000)	
	OLS	System GMM
Lagged Log Health Aid Per Capita	-0.0110**	-0.0206**
	(0.005)	(0.008)
Lagged Log Infant Mortality	1.0408***	1.0004***
	(0.021)	(0.055)
Lagged Log Per Capita Income	-0.0169**	-0.0986***
	(0.008)	(0.025)
Lagged Log Population	-0.0094**	-0.0175
	(0.004)	(0.013)
Lagged Log Fertility Rate	0.028	-0.0191
	(0.033)	(0.064)
War Dummy	0.0053	-0.0325
	(0.012)	(0.023)
HIV AIDS rate	0.0021***	0.0012
	(0.000)	(0.001)
Hansen Test: P-value		0.467
AR1 Test: P-value		0.009
AR2 test: P-value		0.765
Number of Countries	118	118
Number of Observations	465	465

Standard errors are denoted in parentheses, and clustered at the country-level.
The regressions include country and period fixed effects.
All variables are averages over five year periods (except for war dummies).
***, ** and * denote significance at 1, 5 and 10 percent respectively.
In the GMM specifications, one period lags of aid per capita, infant mortality, population, fertility, and per capita GDP are treated as endogenous; two lags are used as instruments.

The estimates also suggest that the effect of doubling health aid on reducing infant mortality, controlling for other factors, is small relative to the goals envisioned by the MDGs. The MDGs call for the under-five child mortality rate to fall by two-thirds by 2015, relative to its level in 1990. Assuming the same target for infant mortality, the calculations suggest that a massive increase in health aid would be needed to achieve the MDG target by 2015.[27] Specifically, the estimates imply that an annual flow of US$5.8 billion of health aid would be needed per country by 2015 in order to achieve the target. This would imply raising the current annual flow of health aid to an average country by a factor of 15. These calculations should be interpreted with caution, however, since the underlying estimates used to derive these figures approximate the effect of marginal rather than large changes in aid.[28]

The estimates of the effect of health aid are based on OLS and GMM regressions. If donors' health aid decisions reflect expectations of recipient's future economic conditions that are correlated with future infant mortality, then the estimates are biased. It is difficult to know the direction of this bias. To the extent that health aid is motivated by altruism, however, donors may provide more health aid to countries whose unobserved health outcomes are worsening.[29] In this case, the estimated coefficient on health aid would be biased towards

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[27] The step-by-step calculations are shown in the working paper version available upon request.

[28] These estimates are not comparable to MDG costing studies that exist for several African countries (e.g., see the MDGs Needs Assessment Synthesis Report for Ethiopia at www.et.undp.org/rcs/Doc/MDG%20synthesis 20January%203 202006.pdf). The primary difference is that while the costing exercises *assume* parameter estimates and *simulate* the cost of attaining the MDGs, we *estimate* elasticities from the data and use it to derive the amount of aid required to achieve a given reduction in infant mortality. On the other hand, while these costing exercises are country-specific, our estimates represent an average across countries.

[29] Table A7 shows that when we drop the additional determinants of infant mortality from the estimations in Table 2, the estimated coefficient on health aid is biased upwards, implying a positive correlation between health aid and the observed determinants of infant mortality. To the extent that the unobserved determinants are

(continued…)

zero, and underestimate the magnitude of the true beneficial effect of health aid on infant mortality.

Aid given specifically for health purposes should have a larger effect on health outcomes than overall aid, if there is a greater probability that these resources are spent on health specific projects (as also suggested by Table A2). However, there is a view that aid is fungible (Rajan and Subramanian 2005a), and to the extent that different types of aid are not tied to specific purposes, they primarily relax the government's budget constraint, and therefore have similar effects on economic and social outcomes. Hence, we examine the effect of overall aid on health outcomes to assess whether there is something specific about "health aid" that affects health, and thus shed light on the degree to which health aid is as fungible as overall aid.

The regression results for the impact of overall aid on infant mortality are shown in Table 2. Specification I shows the OLS regression results without country fixed effects. The estimated coefficient on lagged aid per capita is negative and statistically significant (at the 5 percent level) in the OLS specification. The magnitude of -0.01 implies that a doubling of aid is associated with a one percent reduction in infant mortality. Specification II shows the GMM estimates, where the identification is based on the lags of aid. As in the health aid estimation, two and three period lagged levels of these variables are used as instruments in the difference equation whereas lagged and twice-lagged differences are used in the level equations. The

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positively correlated with observables, the estimates underestimate the beneficial effect of health aid on infant mortality.

estimated coefficients are also close to -0.01 but are no longer statistically significant in the GMM specifications. The Hansen's test of over identifying restrictions passes and the hypothesis of no second order correlation in residuals cannot be rejected.[30]

The estimated effects of overall aid are slightly more beneficial than three of the four previous studies that have examined the effect of overall aid on infant mortality, and far more precisely estimated than all four. Boone (1996), using a fixed effects specification, finds a harmful and statistically insignificant effect of aid on infant mortality with a coefficient estimate of 0.165 (se = 0.61). Masud and Yontcheva (2005) also find a harmful but statistically insignificant effect in a fixed effects specification. The magnitude of the coefficient on bilateral aid per capita is 0.006 (se = 0.648), which is closer to our estimate, but the standard errors in that paper are much higher. Burnside and Dollar (1998) also find a harmful and insignificant effect of overall aid to GDP on infant mortality, using instrumental variables, with a coefficient estimate of 0.02 (se=0.16). Finally, Fielding et. al., 2005 finds a statistically significant and beneficial effect of overall aid on child (less than 5-year) mortality, with a relatively large magnitude of the effect of -0.14 (se = 0.05). However, the results are based only on a single cross-section of 48 countries (in different time periods).

To summarize, we fail to find a robust effect of overall aid in reducing infant mortality. The effect is precisely estimated, relative to previous studies, and is close to zero.

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[30] Because data on overall aid extends to 1960, the number of observations is higher in Table 2 (700 compared to 465 in Table 1). For robustness, we also restricted the overall aid regressions to the health aid sample. The estimated coefficients in the GMM specification is -0.0175 and is statistically insignificant,. Thus, maintaining a consistent sample does not produce robust results for the impact of overall aid on infant mortality.

Table 2. Estimated Effect of Overall Aid on Infant Mortality, 1965–2004

Dependent variable : Log Infant mortality rate (per 1000)		
	OLS	System GMM
Lagged Log Aid Per Capita	-0.0100*	-0.0139
	(0.005)	(0.011)
Lagged Log Infant Mortality	1.0343***	1.0523***
	(0.019)	(0.036)
Lagged Log Per Capita Income	-0.0267***	-0.0654***
	(0.008)	(0.020)
Lagged Log Population	-0.0093**	-0.0117
	(0.004)	(0.012)
Lagged Log Fertility Rate	0.0118	-0.0318
	(0.030)	(0.036)
War Dummy	0.0183	-0.0098
	(0.014)	(0.017)
HIV AIDS rate	0.0020***	0.0011*
	(0.000)	(0.001)
First Stage F-stat		
Hansen Test: P-value		0.768
AR1 Test: P-value		0.001
AR2 test: P-value		0.768
Number of Countries	118	118
Number of Observations	700	700

Standard errors are dentoted in parentheses and clustered at the country-level. .
The regressions include country and period fixed effects.
All variables are averages over five year periods (except for war dummies)
***, ** and * denote significance at 1, 5 and 10 percent respectively.
In the GMM specification, the lags of aid per capita, infant mortality, population, fertility and per capita GDP are treated as endogenous; two lags are used as instruments.

Robustness checks

One common criticism of GMM estimation is that it confers on the researcher considerable degrees of freedom in determining how many lags of the endogenous and predetermined variables are used as instruments. Table 3 shows that the estimated effect of health aid on infant mortality is robust to using different lag structures as instruments. The Hansen's test for over identifying restrictions and the AR2 test for no second order serial correlation pass in all the specifications.

Table 3. Estimated Effect of Health Aid on Infant Mortality, GMM Robustness Checks

Number of lags	1	2	3	4	All
Dependent variable :	Log Infant Mortality (per 1000)				
Lagged Log Health Aid Per Capita	-0.0207***	-0.0206***	-0.0179***	-0.0199**	-0.0196**
	(0.008)	(0.008)	(0.007)	(0.008)	(0.008)
Hansen Test: P-value	0.237	0.467	0.571	0.483	0.785
AR2 test: P-value	0.817	0.765	0.802	0.925	0.9
Number of Instruments	59	79	94	104	109
Number of Countries	118	118	118	118	118
Number of Observations	465	465	465	465	465

See notes to Table 1.
***, ** and * denote significance at 1, 5 and 10 percent respectively.

Table 4 shows the results when per capita health aid is expressed in levels rather than logs. The estimated coefficient from the GMM specification is roughly -0.01, implying that a one dollar increase in per capita health aid lowers infant mortality by 1 percent, and is statistically significant**.** The magnitude of the estimated effect is consistent with Table 1.[31] Often, aid is measured as a percentage of GDP rather in per capita terms. Table 5 presents results using health aid to GDP as the main independent variable. The estimated effect of health aid on infant mortality is similar to the basic estimates in Table 1.

Table 4. Estimated Effect of Health Aid on Infant Mortality Levels, 1975–2004

Dependent variable :	Log Infant Mortality (per 1000)	
	OLS	GMM
Lagged Health Aid Per Capita (2003 US$)	-0.0049**	-0.0084***
	(-0.002)	(-0.003)
Hansen Test: P-value		0.493
AR2 test: P-value		0.827
Number of Instruments		79
Number of Countries		118
Number of Observations	465	465

The controls are the same as in Table 1
See notes to Table 1.
***, ** and * denote significance at 1%, 5% and 10% respectively

[31] As discussed below, Table 1 implies that for the average country, a US $1.60 increase in per capita health aid is associated with a 2 percent reduction in infant mortality. In comparison, the estimates in Table 3 imply that a US $1.60 increase in health aid is associated with a 1.6 percent reduction in infant mortality. We also estimated a specification where both infant mortality and health aid are specified in levels. The estimated coefficient on health aid is -0.23 and is statistically significant (results available upon request).

Finally, to reduce the possibility that omitted variables are biasing the OLS estimates, we add additional controls to the estimating equation. Table 6 displays the results. The additional controls include determinants of infant mortality, such as the prevalence of undernutrition, number of physicians, the percentage of the population with access to water and sanitation, and female literacy, as well as regional dummies.[32] The goal is to estimate the partial effect of increasing health aid, controlling for as many predetermined variables as possible. The estimated effect of health aid on infant mortality is similar to that in Table 1.[33]

Table 5. Estimated Effect of Health Aid on Infant Mortality, Health Aid to GDP, 1975–2004

	OLS	GMM
Lagged Log Health Aid to GDP	-0.0103**	-0.0142***
	(0.005)	(0.005)
Hansen Test: P-value		0.45
AR2 test: P-value		0.605
Number of Instruments		79
Number of Countries	118	118
Number of Observations	465	465

The controls are the same as in Table 1. See notes to Table 1.
***, ** and * denote significance at 1, 5, and 10 percent respectively.

[32] The data on these variables is obtained from the World Bank (2006). The additional variables, except female literacy, are available for only 2 or 3 years between 1970 and 2004. Hence, the averages of these variables over the period are introduced as country-specific time invariant controls in the OLS specification.

[33] We also estimated the OLS regressions using data on health aid disbursements rather than commitments. The data is available only for 3 periods, and since we use lags, there are only 2 periods with about 100 available observations. For comparison, we also restricted the data on health aid commitments to the same period. The estimated effect of health aid on infant mortality is not statistically different whether we use disbursements or commitments. However, in this small sample, the estimated effect is statistically insignificant in both cases. The estimates are also robust to including a time trend in the empirical specification. Finally, we did not find any significant evidence of non-linearities when we introduced the square of health aid in the basic specification in Table 1.(results are available upon request).

Table 6. Estimated Effect of Health Aid on Infant Mortality: OLS with Additional Controls

	OLS
Lagged Health Aid Per Capita	-0.0096**
	(0.004)
Lagged Log Infant Mortality	1.0130***
	(0.017)
Lagged Log Per Capita Income	0.0053
	(0.008)
Lagged Log Population	-0.0037
	(0.004)
Lagged Log Fertility Rate (births per woman)	0.0673***
	(0.026)
Lagged Log Female Literacy (percent of females age 15 and above)	-0.001
	(0.008)
Lagged Log Undernutrition (% of pop)	0.0176**
	(0.008)
Lagged Log Physicians (per 1000 people)	0.0657***
	(0.019)
Lagged Log Sanitation (% pop with access)	0.0118
	(0.013)
Lagged Log Improved Water Source (% pop with access)	-0.0601***
	(0.021)
War Dummy	-0.0053
	(0.009)
HIV AIDS Rate	0.0015***
	(0.000)
Dummy for Sub-Saharan Africa	0.0041
	(0.018)
Dummy for East Asia	-0.0196
	(0.019)
Dummy for Middle-East and North Africa	-0.0752***
	(0.022)
Dummy for Latin America and Caribbean	-0.0531***
	(0.021)
Number of Countries	110
Number of Observations	448

Standard errors are dentoted in parentheses and clustered at the country-level. .
The regressions include period dummies.
All variables are averages over five year periods (except for war dummies).
Malnutrition, access to improved water and sanitation, number of physicians are country-specific and time-invariant.
***, ** and * denote significance at 1, 5 and 10 percent respectively.

Table 1 examines the short-term effect of health aid on health outcomes, defined as the effect of aid in a given period on health outcomes in the following five-year period. We also examine two alternative specifications where (i) health aid is assumed to have a contemporaneous effect on infant mortality and (ii) aid is assumed to have an effect on infant mortality ten years later. The regression results are shown in Table 6. We find that health aid also has a significant contemporaneous effect on infant mortality (at least in the GMM specification), though the magnitude of the estimated effect is slightly smaller than that in Table 1. Doubling health aid during a given period reduces infant mortality in that period by about 1 percent. There is no robust evidence, however, that health aid is effective in reducing infant mortality over a 10-year period. Ten years may be too long a period to expect to observe an effect of health aid, although the estimates are also less precise due to a smaller sample size.[34] [35]

[34] While infant mortality is our preferred health indicator, health aid may also affect life expectancy. The regression results for the impact of health aid on life expectancy suggest that the estimated coefficient is close to zero and statistically insignificant (available upon request). Although health aid may have a limited effect on adult mortality, this finding remains surprising, given that life expectancy data is derived from infant mortality in many countries (Deaton, 2006). Even outside of Sub-Saharan Africa, where the onset of AIDS has distorted life expectancy measures, the estimated impact of health aid on life expectancy remains close to zero.

[35] The estimated effect of overall aid on infant mortality in Table 2 also withstands various robustness checks (Tables A8 and A9).

Table 7. Estimated Effect of Health Aid on Infant Mortality: Current and Medium-Run Effect

Dependent variable :	Log Infant mortality rate (per 1000)	
	OLS	System GMM
Current Log Aid Per Capita	-0.0085	-0.0127**
	(0.006)	(0.006)
Hansen Test: P-value		0.485
AR2 test: P-value		0.468
Number of countries	118	118
Number of observations	559	559
Twice Lagged Aid Per Capita	-0.0019	-0.006
	(0.006)	(0.007)
Hansen Test: P-value		0.481
AR2 test: P-value		0.154
Number of countries	110	110
Number of observations	361	361

The controls are the same as in Table 1. See notes to Table 1
***, ** and * denote significance at 1, 5 and 10 percent respectively.

V. Health Aid and Health—Regions, Institutions, Periods, Types of Aid

Until now, we have estimated the average impact of health aid across all countries and periods in the sample. One prevalent view in the aid literature is that aid promotes growth in particular environments. In the sections that follow, we estimate how the effect of health aid depends on the region and institutional quality of the recipient, and when it is received. The results are shown in Table 8.[36]

[36] Because including interactions adds endogenous variables, the GMM estimation used to obtain table 10 uses one rather than two lags of the endogenous and predetermined variables. This reduces the number of

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First we examine how the effect of health aid on health outcomes varies by region. Table 8, panel A, suggests (in the GMM specification) that compared to Africa, the magnitude of the estimated effect of health aid on infant mortality is slightly larger in Asia and much larger in a large region that includes the Middle-East and North Africa (MENA), Europe, and Central Asia. However, the differences are not statistically significant and are not apparent in the OLS estimates.[37]

Aid in general may have become more effective since the end of the Cold War, when it became less dictated by political motives (Bourguignon and Leipziger, 2006). In order to see whether the end of the Cold War improved the effectiveness of health aid, we interact per capita health aid with a post-1990 indicator variable in Table 8, Panel B. The results from the GMM specification suggest that the effect of health aid strengthened after 1990, as a doubling of health aid is associated with a 0.8 percent reduction in infant mortality before 1990 and a 2.8 percent reduction after 1990.[38]

Burnside and Dollar (2000) suggest that aid, even if it does not unconditionally help growth, promotes growth in those countries that have better policies and institutions. Table 8 (panel C) report results from specifications in which aid was interacted with World Bank's Country

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instruments in the estimating equation and helps reduce finite-sample bias associated with overfitting the endogenous variables.

[37] We also interact health aid with a dummy for richer countries (defined as average per capita GDP above the median). The richer countries exhibit a stronger relationship between aid and infant mortality, but the difference is not statistically significant.

[38] The increased effectiveness of aid in the post-1990 era could also reflect changes in mechanisms of aid delivery towards system-wide and government led intervention in health, rather than the small and isolated projects typical of the early 1970s.

Policy and Institutions Index (CPIA), a measure of the quality of polices and institutions in a country. Countries whose average CPIA score over the period fall below and above the median are treated as low and high CPIA countries, respectively.

Table 8 shows some evidence, in the GMM specification, that health aid is more effective in reducing infant mortality in countries with higher institutional quality (significant at 1 percent level). In high CPIA countries, doubling health aid leads to a 7 percent decline in infant mortality. However, in the OLS specification, health aid is not demonstrably more effective in high CPIA countries. Furthermore, the existing indices of institutions like the CPIA do not fully capture the institutional characteristics of countries that are especially relevant for the management of aid (e.g., monitoring of aid-related spending, program indicators, etc.). Therefore, the GMM results should be interpreted with appropriate caution.

Finally, we disaggregate health aid into the two primary categories listed in Table A1, to see if the estimated effect of aid varies by category. The first category is general health aid, the largest component of which is health policy and administrative management, which includes aid to health ministries and public health administration. The second is basic health aid, where the large components are basic health care—basic and primary health care programs, supply of drugs, medicines and vaccines, and infectious diseases control. Table 9 shows that both types of health aid have a negative and statistically significant effect on infant mortality. The difference in the estimated effects of the two different types is not statistically significant, however. In addition, we also examine whether the effectiveness of one type of aid depends on the other type of aid received. Columns III and IV show results from a

Table 8. Estimated Effect of Health Aid on Infant Mortality, Interactions

Dependent Variable.	Log Infant Mortality (per 1000)	
	OLS	System GMM-Lags
Panel A: Regions		
Aid per capita (excluded Sub-Saharan Africa)	-0.0183***	-0.0089
	(0.006)	(0.011)
Aid per capita * Asia and Pacific	0.0306**	-0.0026
	(0.012)	(0.023)
Aid per capita * MENA, Europe and Central Asia	0.0136	-0.0266
	(0.016)	(0.033)
Aid per capita * LAC	0.0058	-0.0091
	(0.010)	(0.014)
Hansen Test: P-value		0.493
AR2 test: P-value		0.735
Number of Observations	465	465
Panel B. Periods		
Aid per capita (excluded 1970-1989)	-0.0073	-0.0078
	(0.006)	(0.008)
Aid per capita * 1990-2004	-0.0062	-0.0197**
	(0.008)	(0.009)
Hansen Test: P-value		0.632
AR2 test: P-value		0.854
Number of Observations	465	465
Panel C. Policies and Institutions		
Aid per capita (excluded Low CPIA)	-0.01	0.0024
	(0.008)	(0.011)
Aid per capita * High CPIA	-0.0001	-0.0410***
	(0.009)	(0.014)
Hansen Test: P-value		0.545
AR2 test: P-value		0.814
Number of Observations	460	460

CPIA stands for the Country Policies and Institutions Index developed by the World Bank
Sub-Saharan Africa in the regions interaction, 1970-89 in the period interactions,
and CPIA countries below the median in the CPIA interactions are the excluded categories.
The regressions include the same controls as in Table 1.
One lag of predetermined and endogenous variables are used as instruments
***, ** and * denote significance at 1, 5 and 10 percent respectively.
Standard errors are denoted in parentheses, and clustered at the country-level.

Table 9. Estimated Effect of Types of Health Aid on Infant Mortality, 1975–2004

Dependent variable	Log Infant mortality rate (per 1000)			
	OLS	System GMM	OLS	System GMM
Lagged Log General Health Aid Per Capita	-0.0051	-0.0085*	-0.0085**	-0.0127***
(DAC 5 code=121)	(0.004)	(0.005)	(0.004)	(0.005)
Lagged Log Basic Health Aid Per Capita	-0.0087**	-0.0128**	-0.0132***	-0.0204***
(DAC 5 code=122)	(0.004)	(0.006)	(0.005)	(0.006)
Lagged Log General Health Aid Per Capita interacted with			-0.0054**	-0.0078**
Lagged Log Basic Health Aid Per Capita			(0.003)	(0.003)
Hansen Test: P-value		0.661		0.569
AR2 test: P-value		0.734		0.801
Number of Observations	465	465	465	465

The regressions include the same controls as in Table 1.
One lag of predetermined and endogenous variables are used as instruments
***, ** and * denote significance at 1, 5 and 10 percent respectively.
Standard errors are denoted in parentheses, and clustered at the country-level.

specification where the two types of health aid are interacted. The results are consistent with a beneficial interactive effect, as the negative association between basic health aid and infant mortality is strongest when countries receive a high amount of general health aid.

To summarize, the effect of health aid did not vary across regions, but there is some evidence that health aid has led to relatively larger reductions in infant mortality since 1990 and in countries with better policies and institutions. In addition, there is some evidence that different types of health aid may be complementary.

VI. Aid and Government Spending

Why are overall aid inflows not significantly associated with reduced infant mortality while health aid inflows are? One possible explanation is that overall aid is not allocated towards increased health spending, while health aid is directed specifically towards health purposes.

In other words, health aid may be less fungible than overall aid. In this section, we make a preliminary attempt to explore the effect of aid on health spending. Increased government spending on health is neither a necessary nor sufficient condition for a beneficial effect of aid on health outcomes. Nonetheless, aid advocates often argue that aid will help increase health spending, and higher spending is a natural channel by which higher overall aid might improve health.

First, we estimate the relationship between health aid on health spending. Table 10 shows the results. Data on health spending come from the IMF's fiscal database and are available only for four periods. Since the GMM estimates are unreliable in such a small sample, only the OLS estimates are shown.[39] The OLS results suggest a positive and significant correlation between health aid and health spending. Doubling per capita health aid is associated with a close to 7 percent increase in health spending per capita. For the average country, the estimates imply that US$1.0 increase in per capita health aid is associated with more than a US$1.50 increase in health spending per capita. Hence, the results suggest that health aid "crowds in" health spending by attracting additional domestic resources allocated towards health. This could occur, for example, if aid allocated towards building health facilities required additional doctors and nurses. The beneficial effect of health aid on reducing infant mortality is consistent with an association between the increased health aid and higher health spending.

[39] At least five periods are required in order to carry out the test for no autocorrelation in the residuals, which is a necessary condition for the consistency of GMM estimates.

In contrast, overall aid is associated with an insignificant (though positive) impact on health spending. Thus, the results could suggest that (i) increased overall aid does not tend to be allocated towards health purposes or (ii) even if it is allocated towards health purposes, that overall aid "crowds out" other domestic spending on health, or (iii) that there is relatively greater leakage of overall aid. The results are consistent with the ineffectiveness of overall aid in improving health outcomes.

Table 10. Effect of Aid on Health Spending 1985–2004

Dependent variable: Health spending per capita		
	OLS	OLS
Log Health Aid Per Capita	0.0735**	
	(0.035)	
Log Overall Aid Per Capita		0.05
		(0.031)
Lagged Log Spending Per Capita	0.8285***	0.8235***
	(0.044)	(0.044)
Log Per Capita Income	0.2351***	0.2220***
	(0.072)	(0.070)
Lagged Log Population	0.0046	0.0056
	(0.021)	(0.023)
War Dummy	-0.1504**	-0.1776**
	(0.080)	(0.081)
HIV AIDS rate	0.0005	0.0006
	(0.001)	(0.001)
Number of Countries	108	108
Number of Observations	229	231

Both spending and aid are averages over five-year periods.
The regressions include period dummies.
Standard errors are denoted in parentheses, and clustered at the country-level.
***, ** and * denote significance at 1%, 5% and 10% resectively

VII. Caveats and Conclusions

Although past studies have failed to document robust evidence that aid encourages economic growth, there remains hope among academics, policy makers, and the media that aid serves a critical role by saving lives. This hope is consistent with micro-level evidence of the success of specific public health intervention programs. In addition, economic growth plays a limited role in explaining changes in health outcomes, implying that focusing exclusively on the effect of aid on growth may overlook important health benefits from aid.

Despite the vast empirical literature considering the effect of foreign aid on growth, the hope that aid improves health outcomes is backed by surprisingly little systematic evidence. The main contribution of this paper is to present new, systematic and comprehensive cross-country evidence on the effect of health aid on a key health outcome—infant mortality. To the best of our knowledge, this paper is the first empirical study to examine the effect of health aid on health outcomes.

In a sample of 118 countries from 1970–2004, we find that increased health aid is associated with a statistically significant reduction in infant mortality. The estimated effect of doubling health aid is a 2 percent reduction in infant mortality rates, which is small relative to the goals envisioned by the MDGs. In contrast, we fail to find robust evidence for a statistically significant effect of overall aid in reducing infant mortality. The results are consistent with suggestive evidence that unlike overall aid, health aid is associated with a statistically significant rise in health spending.

The estimates of the effect of health aid on health outcomes need to be qualified because the health aid data are likely to suffer from underreporting. However, health aid is reported by donors, and there is no reason to believe that the cost of accurately reporting aid commitments depends on the recipient. Therefore, it is plausible that measurement error due to the underreporting of health aid is not systematically related to the characteristics of the recipient country. In this case, the estimated effect of health aid would be attenuated, and our estimates would understate the true beneficial effect of health aid, particularly in the OLS specification.

In the GMM estimations, the effect of aid is identified using variation in a country's aid history, while controlling for several predetermined variables. As with GMM estimates in general, the estimates are inconsistent if the initial conditions assumed by the model are violated (Bond, 2002). This could occur, for example, if donors' aid decisions in the initial period partially reflected their expectations of the recipients' economic and social conditions in the future. This concern is ameliorated to some extent by the failure to reject both the null hypotheses of no second order serial autocorrelation in the residuals, and the validity of the over-identifying moment conditions.

Finally, the paper takes a cross-country approach to estimate the effect of foreign aid on health similar to the existing literature on aid and growth. Although the effect of aid is identified using within-country changes in aid and health outcomes over time, the estimated effect is nonetheless an average across a very heterogeneous set of countries. The use of cross-country data to address this question should therefore be considered as a first step, to be complemented by detailed case studies of the nature and effects of health aid in individual countries.

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Appendix Tables

Table A1. List of CRS Purpose Codes

DAC 5 CODE	CRS CODE	DESCRIPTION	Clarifications / Additional notes on coverage
120		**HEALTH**	
121		**Health, general**	
	12110	Health policy and administrative management	Health sector policy, planning and programmes; aid to health ministries, public health administration; institution capacity building and advice; medical insurance programmes; unspecified health activities.
	12181	Medical education/training	Medical education and training for tertiary level services.
	12182	Medical research	General medical research (excluding basic health research).
	12191	Medical services	Laboratories, specialised clinics and hospitals (including equipment and supplies); ambulances; dental services; mental health care; medical rehabilitation; control of non-infectious diseases; drug and substance abuse control [excluding narcotics traffic control (16063)].
122		**Basic health**	
	12220	Basic health care	Basic and primary health care programmes; paramedical and nursing care programmes; supply of drugs, medicines and vaccines related to basic health care.
	12230	Basic health infrastructure	District-level hospitals, clinics and dispensaries and related medical equipment; excluding specialised hospitals and clinics (12191).
	12240	Basic nutrition	Direct feeding programmes (maternal feeding, breastfeeding and weaning foods, child feeding, school feeding); determination of micro-nutrient deficiencies; provision of vitamin A, iodine, iron etc.; monitoring of nutritional status; nutrition and food hygiene education; household food security.
	12250	Infectious disease control	Immunisation; prevention and control of malaria, tuberculosis, diarrheal diseases, vector-borne diseases (e.g. river blindness and guinea worm), etc.
	12261	Health education	Information, education and training of the population for improving health knowledge and practices; public health and awareness campaigns.
	12281	Health personnel development	Training of health staff for basic health care services.

Source. OECD, Development Assistance Committee
http://www.oecd.org/document/21/0,2340,en_2649_34469_1914325_1_1_1_1,00.html

Table A2. Description of Major CRS Purposes

	Donor	Recipient	Short descritption	Percent of total
			Health Policy and Administrative Management, 2000-04	
1	Multiple	Multiple	Health Policy & Admin. Management	8.3
2	IDA	India	Up Health Systems Development	2.9
3	United Kingdom	Pakistan	National Health Facility	2.6
4	Multiple	Multiple	Health Sector Support Project	2.4
5	IDA	India	Tamil Nadu Health Systems Project	2.4
6	IDA	Indonesia	Provincial Health	2.1
7	IDA	Ghana	Second Health Sector Program Support Project	2.1
8	IDA	Indonesia	Health, Nutrition & Population	2.1
9	Netherlands	Ghana	Support To The Ghanaian Ministry Of Health:Implementat Prog. Of Work	2.0
10	IDA	India	Rajasthan Health Systems Development Project	1.9
11	Multiple	Multiple	Other	71.1
			Basic Health Care, 2000-04	
1	Multiple	Multiple	Basic Health Care	11.4
2	IDA	Nigeria	Health Systems Development Project	4.4
3	United Kingdom	India	Healthy Life Services Guarantee Scheme: Basic Health Care	3.0
4	UNICEF	Multiple	Young Child Health	1.8
5	IDA	India	Food And Drugs Capacity Building Project	1.7
6	Australia	Papua New Guinea	Basic Health Services Support Program	1.6
7	United States	Multiple	Child Survival & Health Programs Fund	1.6
8	Denmark	Tanzania	Support To Health Sector Strategic Plan Through Basket Funds	1.5
9	UNICEF	Multiple	Health, General	1.5
10	Multiple	Ghana and Uganda	Health Sector Programme	1.5
11	Multiple	Multiple	Other	70
			Infectious Disease Control, 2000-04	
1	IDA	India	Immunization Strengthening Program	5.8
2	United Kingdom	India	Pulse Polio	5.4
3	United States	Multiple	Polio Immunizations In-Country Activities	3.8
4	IDA	India	India Immunization Strengthening Project	3.0
5	EC	Nigeria	Prime-Partnership To Reinforce Immunization	2.8
6	United Kingdom	India	Polio Eradication Programme	2.6
7	United Kingdom	Multiple	Human Disease Control	2.5
8	Multiple	Multiple	Polio Eradication	2.1
9	United Kingdom	China	China: Projects/Health	1.8
10	United Kingdom	Kenya	Basic Health: Social Marketing	1.8
11	Multiple	Multiple	Other	68.5

Table A3. List of Variables and Data Sources

Variable	Source
Infant Mortality (per 1000 live births)	UN, 2004
Life Expectancy (years)	UN, 2004
Aid ('03 $)	OECD DAC
Health Aid ('03 $)	OECD CRS
Population	IMF, World Economic Outlook, 2006
Wars	Heidelberg Institute for International Conflict Research and World Bank
Instituional quality index (CPIA)	World Bank
Per capita GDP ('03 $)	World Bank, WDI, 2006
Health Spending ($)	IMF Fiscal Affairs Department
HIV AIDS (cases per 100,000)	Papageorgiou and Stoytcheva, 2006
Fertility (children per woman)	UN, 2004
Female Literacy (percentage of females age 15 and above)	World Bank, WDI, 2006
Prevalence of undernourishment (percentage of population)	World Bank, WDI, 2006
Number of phsicians per 1000 people	World Bank, WDI, 2006
Improved water source (% of population with access)	World Bank, WDI, 2006
Improved sanitation facilities (% of population with access)	World Bank, WDI, 2006

Table A4. Countries in Sample

Country	Observations	Country	Observations	Country	Observations
Albania	2	Hungary	2	South Africa	2
Algeria	2	India	6	Sri Lanka	6
Angola	5	Indonesia	6	Sudan	5
Argentina	6	Iran	1	Swaziland	4
Armenia	2	Iraq	1	Syria	3
Azerbaijan	2	Jamaica	4	Tajikistan	2
Bangladesh	6	Jordan	5	Tanzania	6
Belarus	2	Kazakhstan	2	Thailand	6
Benin	6	Kenya	6	Togo	5
Bolivia	5	Kyrgyzstan	2	Trinidad And Tobago	3
Bosnia	2	Lao Pdr	5	Tunisia	6
Botswana	4	Latvia	2	Turkey	6
Brazil	5	Lebanon	5	Turkmenistan	2
Bulgaria	1	Lesotho	4	Uganda	5
Burkina Faso	5	Liberia	2	Ukraine	2
Burundi	5	Libya	1	Uruguay	5
Cambodia	3	Lithuania	2	Uzbekistan	2
Cameroon	5	Macedonia	1	Venezuela	2
Central African Republic	6	Madagascar	6	Vietnam	5
Chad	5	Malawi	5	Yemen	2
Chile	4	Malaysia	4	Zambia	5
China	4	Mali	5	Zimbabwe	3
Colombia	5	Mauritania	6		465
Congo, Dem. Rep. Of	6	Mauritius	5		
Congo, Rep Of	6	Mexico	3		
Costa Rica	3	Moldova	2		
Cote D'Ivoire	5	Mongolia	1		
Croatia	2	Morocco	4		
Cuba	3	Mozambique	5		
Czech Republic	1	Myanmar	6		
Dominican Republic	5	Nepal	5		
Ecuador	5	Nicaragua	6		
Egypt	5	Niger	5		
El Salvador	5	Nigeria	5		
Eritrea	2	Oman	2		
Estonia	2	Pakistan	6		
Ethiopia	6	Panama	5		
Fiji	4	Papua New Guinea	3		
Gabon	4	Paraguay	6		
Gambia	4	Peru	6		
Georgia	2	Philippines	5		
Ghana	5	Poland	2		
Guatemala	5	Romania	2		
Guinea	5	Russia	2		
Guinea-Bissau	4	Rwanda	4		
Guyana	2	Senegal	5		
Haiti	6	Sierra Leone	5		
Honduras	5	Slovakia	1		

Table A5. Sample Summary Statistics

	Observations	Mean	Standard Deviation
Infant Mortality (per 1000 live births)	465	72.75	42.94
Life Expectancy (in year)	465	59.01	10.58
Lagged per capita health aid ('03 $)	465	1.67	2.43
Lagged per capita overall aid ('03 $)	465	48.61	56.52
War Dummy	465	0.09	0.29
HIV AIDS rate (reported cases per 100,000 people)	465	4.22	11.67
Lagged CPIA	465	2.90	1.32
Lagged Per Capita Income ('03 $)	465	1,279.5	1,484.6
Lagged Population	465	4.E+07	1.E+08
Lagged Fertility Rate (children per woman)	465	4.88	1.83
Lagged Female Literacy (percentage of females age 15 and above)	465	40.81	36.74
Lagged Percent of Population Malnourished	455	21.01	16.01
Lagged Physicians per 1000	460	0.73	1.01
Lagged Percent of Population with Sanitation Access	453	53.71	25.95
Lagged Percent of Population with Water Access	455	72.16	19.46
Per Capita Health spending (in '03 $)	297	35.12	59.36

Table A6. Estimated Effect of Health Aid on Infant Mortality, Alternative Truncation

Threshold on Health Aid	$0		$0.05		$0.17		$0.39	
Percentile of Health Aid	0		10		20		30	
	OLS	Sys GMM	OLS	Sys GMM	OLS	Sys GMM	OLS	Sys GMM
Lagged Log Health Aid Per Capita	-0.0046	-0.0069*	-0.0059	-0.0102**	-0.0096**	-0.0172***	-0.0121**	-0.0235***
	0.003	0.004	0.004	0.005	0.005	0.006	0.006	0.008
Hansen Test: P-value		0.303		0.371		0.408		0.479
AR2 test: P-value		0.738		0.704		0.731		0.697
Number of Countries	118	118	118	118	118	118	118	118
Number of Observations	465	465	465	465	465	465	465	465

The controls are the same as Table 1.
The alternative specifications show the results when we truncate the health aid series at various percentiles.
***, ** and * denote significance at 1, 5 and 10 percent respectively.
Standard errors are denoted in parentheses, and clustered at the country-level.

Table A7. Estimated Effect of Health Aid on Infant Mortality Without Lagged Controls

Dependent variable :	Log Infant mortality rate (per 1000)	
	I OLS no controls	with controls
Lagged Log Health Aid Per Capita	0.1403*** (0.041)	-0.0110** (0.005)
Lagged Log Infant Mortality		1.0408*** (0.021)
Lagged Log Per Capita Income		-0.0169*** (0.008)
Lagged Log Population		-0.0094*** (0.004)
Lagged Log Fertility Rate		0.028 (0.033)
War Dummy	0.3351*** (0.181)	0.0053 (0.013)
HIV AIDS rate	0.0068** (0.004)	0.0021*** (0.000)
Number of Countries	118	118
Number of Observations	465	465

See notes to Table 1.
***, ** and * denote significance at 1, 5 and 10 percent respectively.

Table A8. Estimated Effect of Overall Aid on Infant Mortality: GMM Robustness Check

Number of lags	1	2	3	4	All
Dependent variable :	Log Infant Mortality (per 1000)				
Lagged Log Aid Per Capita	-0.0043	-0.0139	-0.0154	-0.0142	-0.015
	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)
Hansen Test: P-value	0.14	0.497	0.953	0.999	0.353
AR2 test: P-value	0.786	0.768	0.792	0.767	0.764
Number of Instruments	81	103	103	103	103
Number of Countries	118	118	118	118	118
Number of Observations	700	700	700	700	700

See notes to Table 2. This table repeats the System GMM specification in Table 2 with different lags.

Table A9. Estimated Effect of Overall Aid on Infant Mortality 1965–2004: Short-Run vs. Long-Run Effect

Dependent variable	Log Infant mortality rate (per 1000)	
	OLS	System GMM
Current Log Aid Per Capita	-0.0073	-0.0025
	(0.006)	(0.012)
First stage F stat		
Hansen Test: P-value		0.605
AR2 test: P-value		0.59
Number of countries	118	118
Number of observations	697	697
Twice Lagged Aid Per Capita	-0.0162***	-0.0230*
	(0.006)	(0.014)
First stage F stat		
Hansen Test: P-value		0.364
AR2 test: P-value		0.73
Number of countries	118	118
Number of observations	617	617

The controls are the same as in Table 2. See notes to Table 2.
***, ** and * denote significance at 1, 5 and 10 percent respectively.