DISCUSSION PAPER SERIES

IZA DP No. 12166

Health Aid, Governance and Infant Mortality

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I Z A Institute of Labor Economics

Initiated by Deutsche Post Foundation

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ISSN: 2365-9793

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ABSTRACT

Health Aid, Governance and Infant Mortality

We investigate the impact of health aid on infant mortality conditional on the quality of governance in 96 recipient countries. Our analysis applies the long difference estimator and instrumental variable estimation, with aid instrumented by donor government fractionalization interacted with the probability of allocating health aid to a recipient nation. The effectiveness of health aid in reducing infant mortality is conditional on good governance (measured either as government effectiveness or control of corruption). Specifically, health aid to a recipient nation that experiences a one standard deviation improvement in government effectiveness reduces infant mortality by about 4 percent. Our findings reaffirm the importance of improving the quality of governance in recipient nations.

JEL Classification: F35, I15

Keywords: health aid, infant mortality, good governance

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'it is health that is real wealth and not pieces of gold and silver'
Mahatma Gandhi (Gandhi and Attenborough 2001: 10).

1. Introduction

Health outcomes differ vastly across countries. For example, life expectancy is 84 years in Japan compared to just 53 years in Nigeria. The number of women dying from pregnancy-related causes (maternal mortality) was 3 per 100,000 in Poland, compared to 1,360 in Sierra Leone. The infant mortality rate (death of infants before reaching one year of age per 100,000) was more than 20 times higher in Pakistan (63 deaths) compared to Australia (3 deaths).[1] Such striking disparities in health outcomes have an enormous impact on lives, society, and the economy. Consequently, health outcomes were the focus of four of the eight Millennium Development Goals (United Nations, 2016) and three of the Sustainable Development Goals (United Nations, 2018).[2]

The importance of health to wellbeing is self-evident and well documented (Røysamb *et al.*, 2003). Physiological wellbeing is an essential human need. Healthy individuals also directly benefit the economy, are more economically productive for longer periods (Arora, 2001) and are less of a burden on healthcare systems (Rasmussen *et al.*, 2005). Poor health stifles economic growth in developing countries and impedes long-run social and economic development (Bloom *et al.,* 2001).

Governments, multilateral organizations, and private donors seek to use aid to improve health outcomes in developing nations. Total development aid was over $197 billion (US dollars) in 2016. Of this amount, $12 billion was designated as health aid (OECD, 2018). Health aid offers the promise of improving health outcomes. Aid can be given as a general

[1] All data relate to 2016 and drawn from World Bank (2018); accessed November 9th, 2018.
[2] The relevant Millennium Development Goals were: Goal 1 - eradicate extreme hunger and poverty; Goal 4 - reduce child mortality; Goal 5 - improve maternal health; and Goal 6 - combat HIV/AIDS, malaria and other diseases. The health related Sustainable Development Goals are: Goal 2 - zero hunger; Goal 3 - good health and wellbeing; and Goal 6 - clean water and sanitation.

transfer to recipient governments, or tied to a specific purpose, such as education or health. Health aid is allocated by donors to finance improvements in basic healthcare, health infrastructure, infectious disease control, and numerous other health related projects. Often aid is targeted to a specific health issue, such as tuberculosis control, health personnel development, or the construction of medical facilities.

The focus of this article is infant mortality. Infant mortality is one of the most important health outcomes, and is a particularly pressing issue in some regions. Reducing infant mortality is a policy objective of many developing countries. For example, Vietnam has targeted reductions in infant mortality as a key objective of national health policy (Glewwe *et al*., 2004). Similarly, Tanzania has developed programs targeting reductions in infant mortality as part of its national health strategy (Makani *et al.,* 2015). Many African countries have historically high levels of infant mortality, accounting for the top 13 countries with the highest infant mortality rates in 2017 (World Bank, 2018). Developing nations rely heavily on external resources to fund various health interventions. For instance, in 2015, more than 85% of health expenditure in Mozambique originated from aid from foreign donors (World Health Organization, 2018).

Infant mortality can be a drain on a developing country's growth. Indeed, a case can be made that scarce funds may be better spent preventing childhood related deaths than covering healthcare-related costs to the elderly (Joyce *et al*., 1988). Reducing infant mortality is also an area of interest to many donors (Berthélemy and Tichit, 2004; Younas, 2008). Hence, recipients that strive to reduce infant mortality are likely to attract additional aid.

In this article we make both conceptual and empirical contributions to the study of the impact of aid on infant mortality. Our main contribution is to investigate the impact of good governance on health aid effectiveness. Prior studies have reported mixed results of the effectiveness of aid on health. One reason for this is that they assume that aid will be effective in the average recipient country. However, aid may be ineffectual in countries that are plagued with weak governance, becoming effective only in countries that have good governance. While definitions of good governance vary, we follow the approach of Kaufman *et al*. (2011), treating governance as a broad term that relates to the process and capacity of government.[3] We operationalize this by considering the moderating role of *government effectiveness*. Specifically, our modelling investigates the interaction between health aid and government effectiveness. For robustness, we also explore the interaction of health aid and control of corruption, as another dimension of good governance. This conditionality is in keeping with the aid on growth conditionality literature stimulated by Burnside and Dollar (2000), who argue that aid stimulates growth in countries that pursue good policies.[4] Some prior studies explore the impact of democracy on aid effectiveness (e.g., Kosack, 2003). However, there is relatively little research on the moderating role of governance. One exception is Dietrich (2011), who explores the effectiveness of aid on immunization, conditional on corruption. Our focus on infant mortality and government effectiveness complements this important but under-researched area.

Our estimation procedure also involves two novel applications of recent developments in identification. First, in contrast to extant studies that estimate fixed effects models, we use long differences to remove country specific unobservable effects. Instead of fixed effects (mean differencing) or first differences of annual data, our approach is to use longer, five-year differences. This method is more appropriate as infant mortality changes slowly and it also accounts for measurement error in a better way (Griliches and Hausman, 1986). To tackle reverse causality in the aid and health association, aid and its interaction with governance is lagged by a further five years. However, this approach may not estimate the causal effect due

[3] Kaufman *et al*. (2011, p. 222) define governance as: "the traditions and institutions by which authority in a country is exercised. This includes (a) the process by which governments are selected, monitored and replaced; (b) the capacity of the government to effectively formulate and implement sound policies; and (c) the respect of citizens and the state for the institutions that govern economic and social interactions among them."

[4] The *development* aid and growth conditionality results are fragile (see Doucouliagos and Paldam, 2010). In contrast, we find that *health* aid and infant mortality conditionality gives robust results.

to time varying omitted variables that simultaneously influence both infant mortality and (lagged) aid. Hence, we address this issue using identification based on exclusion restrictions recently proposed by, among others, Nunn and Qian (2014) and Dreher and Langlotz (2017). Specifically, we instrument health aid by donor government fractionalization interacted with a recipient country's probability of receiving aid (see section 4.1, for detailed discussion on this identification strategy).

The effectiveness of aid on health has been questioned, with mixed and fragile results reported (*e.g.*, Williamson, 2008; Mishra and Newhouse, 2009; Nunnenkamp and Öhler, 2011; Wilson, 2011; Glassman and Temin, 2016; and Tarverdi and Rammohan, 2017). We show that these conflicting findings can be resolved by making aid effectiveness conditional on good governance and by appropriately addressing endogeneity through instrumental variable estimation. Our results show that the impact of health aid on infant mortality is conditional on good governance; health aid reduces infant mortality in countries with good governance.

The paper is structured as follows. Section 2 reviews the extant evidence. In Section 3 we discuss the importance of good governance to health aid effectiveness. We then discuss the econometric methods and data in Section 4. The baseline findings are presented and discussed in Section 5. Section 6 presents the instrumental variable estimates. The final section concludes the paper.

2. Can health aid improve health?

Researchers have addressed this question in two ways. One line of inquiry investigates the effects of health aid on health-related *spending* in recipient countries. A second stream in the literature looks at the direct effects of health aid on health *outcomes*.

2.1 Health aid, health spending, and health outcomes

A meta-analysis review of 47 econometric studies by Gallet and Doucouliagos (2017) establishes that spending on health reduces infant mortality, with an elasticity of -0.13. Additional spending on health should thus improve health outcomes, on average. Donors give aid to supplement the recipients' own spending. Hence, aid should increase health spending. However, whether it does so depends on the fungibility of aid. Aid fungibility arises when donor funding substitutes for, rather than complements, the health expenditure of recipient governments (Farag *et al.*, 2009). For instance, health aid tied to a specific use may well be invested as intended. However, recipient governments may divert some of their own health expenditure to other, non-health related projects.[5] In this instance, aid could have a negligible effect on health. Farag *et al.* (2009) find that displacement occurs at higher rates in low-income countries. The displacement of aid could be so large that health spending contracts or aid fuels conflict or war (Grossman, 1992), thus potentially–and unintentionally–increasing infant death.[6] In this respect, the quality of institutions in general, and governance in particular, in a recipient country may be a key factor to the effectiveness of aid.

2.2 Health aid and infant mortality

A second area of aid effectiveness research focuses on evaluating the effectiveness of health aid on various health outcomes. For example, Hsiao and Emdin (2015) find that targeted health aid reduces malaria and HIV mortality but has no effect on tuberculosis mortality. Odokonyero and Marty (2017) find that health aid reduces both the severity and burden of disease in

[5] While funds may end up in the military or rents for the elites, the displacement need not be so nefarious. Some funds may be spent on education or general infrastructure, which may in the long-run have a positive effect on health.

[6] Aid could worsen health outcomes in poorly governed nations. For example, aid could be directed to the military, invested to benefit elites (Kosack, 2003) or in other ways that may have no effect or even an adverse effect on the health of a country's citizens if aid inflames conflict. Crost *et al.* (2014) show that increases in total aid can cause greater loss of life in developing countries, such as the Philippines. Navia and Zweifel (2003) find that aid can *increase* infant mortality in autocratic regimes.

populations at-risk. By their nature, some health outcomes will be more responsive to increases in aid. Clemens *et al*. (2007) argue that the elimination of vaccine-preventable diseases is very responsive to increases in health aid. This is due to the relatively simplistic nature of vaccine-program implementation, with funding for vaccines and medical personnel often the only barrier preventing the vaccination of individuals in vulnerable communities. Health aid is, therefore, able to make a relatively immediate impact on the incidence of such diseases. Anyanwu and Erhijakpor (2009) point out that maternal mortality is less responsive to health aid due to the larger range of factors that influence maternal health (*e.g.*, health infrastructure, medical training, sanitation, and nutrition).

Turning to our main health issue of interest, several studies investigate the effectiveness of aid on reducing infant mortality. Infant mortality is a particularly pertinent measure of health in developing countries (Mishra and Newhouse, 2009). Infant mortality is highly sensitive to changes in economic conditions, is based on objective empirical data rather than predictions (such as those utilized in life expectation estimates), and its impact is manifest on a broad range of other health outcomes, such as life expectancy.

The evidence base contains varied findings. For example, Mishra and Newhouse (2009) find that a doubling of health aid reduces infant mortality by 1.1%. Pickbourn and Ndikumana (2018) find that a one percent increase in health aid (as a share of GDP) results in a 0.24 to 0.36 percent reduction in infant mortality caused by diarrhea. Similarly, Kotsadam *et al.* (2018) find that the presence of projects funded by health aid in certain areas decreases infant mortality by 1%, in comparison to areas with no projects. Yogo and Mallaye (2015) find a large effect of health aid on child mortality in selected Sub-Saharan Africa countries, showing that a one percent increase in health aid decreases child mortality by 64%. Kizhakethalackal *et al.* (2013) find that health aid is significant and effective at reducing infant mortality, especially in populations where infant mortality is initially low and less so when infant mortality is high.

Bendavid and Bhattacharya (2014) use cross-country panel data to show that a 1% increase in health aid leads to a 0.14 per 1,000 live births decline in infant mortality. Finally, Dietrich (2011) finds that aid increases immunization and that corruption plays a moderating role.

In contrast, Williamson (2008) finds that health aid is statistically insignificant in influencing five primary health indicators, with health aid not having a statistically significant impact on infant mortality. Similarly, Wilson (2011) finds that health aid has no aggregate effect on infant mortality. Tarverdi and Rammohan (2017) find that aid does not reduce infant mortality but that the quality of governance does; though their analysis does not consider conditionality.

3. Aid and governance conditionality

The focus of our investigation is whether the effectiveness of health aid on health is conditional upon the quality of the recipient country's governance. The reasoning behind this hypothesis is that countries with good governance are more likely to deliver effective health interventions. We consider three reasons why this might be so.

3.1 Willingness and capacity to respond to preferences

Well-governed states as more likely to effectively respond to citizens' preferences. Given the primacy of health to individuals' wellbeing, we expect that good governance will facilitate the production of good health. Consequently, citizens' demand for improved health will be more readily accommodated in those countries with good governance. However, this is not just a matter of democracy responding to the median voter. Indeed, the links between democracy and health are not robust. For example, Ross (2006) finds that democracy has little or no effect on infant mortality. Nations with good governance will tend to be more effective at formulating and carrying out health related policies. The development of policies and, more importantly, their implementation, requires capacities that are more likely to exist with good governance. Emerging evidence suggests that good governance improves health, though the channels vary across countries; see Klomp and de Haan (2008) and references cited therein.

We expect that well-governed states will be in a better position to use domestic funds and foreign aid to deliver improved health and are more likely to deliver policies that match citizens' preferences.[7] States that are poorly governed are more likely to waste and to misallocate aid; corruption is an extra dimension discussed below. Government effectiveness is critical to the provision of vaccination and immunization. See, for example, Ortega *et al.* (2017) who find that more effective governments are more efficient in reducing infant mortality. Tarverdi and Rammohan (2017) find that overall governance reduces infant mortality. However, Ortega *et al.*, do not consider the effect of aid and neither study considers conditionality.

3.2 Corruption

Corruption involves the use of public funds for private benefit, diverting scarce funds. Good governance reduces corruption and thus provides greater prospects for the delivery of domestic health expenditure and aid expenditure to their intended allocations. The health care sector is often vulnerable to corruption, diverting funds, affecting the quality of drugs and other health services, and influencing health outcomes (Mostert *et al*., 2015; Cohen and Petkov, 2016). Needless to say, such activities reduce health aid effectiveness.

Nevertheless, arguments have been advanced that aid may be more effective in more corrupt recipient nations. For example, Dietrich (2011) argues that some aid may be used

[7] Health is also affected by income, demographics, lifestyle choices, and behavior (Gallet and Doucouliagos, 2017). Some of these factors, most notably income and lifestyle choices, are influenced by the quality of institutions. Institutions affect both the incentives to invest in health and can also shape attitudes and lifestyle norms (Bambra *et al*., 2005; Herrick, 2007; Szreter and Woolcock, 2004). Behavioral choices may then serve as a channel through which aid interacts with governance to improve health.

effectively in corrupt nations if compliance with donor priorities is cheaper in some sectors than others. If recipients can strategically use aid effectively in the health sector, they signal to donors that they are worthy of receiving more aid (see Dietrich, 2011). On the other hand, Fielding (2011) argues that control of corruption reduces the need for aid.

3.3 Investment in public goods

Investment in health has a public good component. For example, the positive spillovers of many health interventions, such as hygiene and vaccinations, are well known. Because of these externalities, health investments are likely to be underprovided by the free market in recipient nations. Donor health aid can fund some of these health public goods, potentially decreasing infant mortality. Nevertheless, the public good component of health extends beyond this. Citizens in nations with poor governance are less likely to trust political processes. They are also less likely to be willing to pay taxes and otherwise invest in global and local public goods (Ostrom, 2000; Uslaner, 2002). Hence, the quality of institutions can impact health through the willingness to contribute to public goods such as health. Greater willingness to contribute to public goods makes it more likely that health aid will be used effectively to improve health outcomes.

Given the above arguments, we expect aid to be more effective in delivering improved health outcomes in states with good governance. In this article we investigate whether health aid, on its own, is effective at reducing infant mortality, compared to aid's effectiveness conditional upon the quality of governance in the recipient nation. We measure the quality of governance using data on government effectiveness and control of corruption; see definitions in section 4.2 below. Conditionality means that states with low government effectiveness (e.g., Somalia, the Democratic Republic of the Congo, and Equatorial Guinea) will be less effective in allocating and using scarce health aid to reduce infant mortality than states with high government effectiveness (e.g., Botswana and Uruguay).

4. Methods and data

In this section we first present the methods adopted for the empirical investigation and then we discuss the data.

4.1 Estimation Methods and Identification

Our analysis commences with a baseline model that regresses the change in infant mortality on lagged aid, lagged aid interacted with governance, and a set of covariates:

$$(1) \qquad \Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it},$$

where Δ is the difference operator so that Δ_5 denotes five-year differences (that is $M_{it} - M_{it-5}$). M denotes the logarithm of infant mortality, Aid is the logarithm of health aid, Gov is a measure of the quality of governance (government effectiveness or corruption), **X** is a vector of controls (discussed below), λ_t denotes year fixed effects which account for universal time trends, and i and t denote the recipient country and time period, respectively. The reason for taking long (five-year) rather than first differences (year on year) is that, in most cases, infant mortality changes incrementally on an annual basis;[8] the first difference estimator is less informative in this situation (Angrist and Pischke, 2009 and Allegretto *et al*., 2017).

Our main measure of health aid is the amount disbursed, which is the most appropriate measure for investigating the effectiveness of aid. Aid commitments can change or be

[8] For example, between 2003 and 2012, Cape Verde's infant mortality rate decreased from 23.8 to 22.4. This change reflects an annual average change of just -0.14. For all countries in our sample, the median annual change in infant mortality is -1.4. In contrast, the median long difference change is five times larger at -7.

postponed. Hence, disbursements are more likely to affect health outcomes than aid commitments. We measure aid disbursed in three ways: log health aid per capita, log total dollar value, and aid as a share of GDP.

The **X** vector includes country-year varying variables to control for factors that are considered to be correlated with the change in infant mortality and health aid. These include the share of domestic health expenditure in GDP, female literacy (the percentage of females ages 15 and above who are literate), access to physicians (the number of doctors per 1,000 people), sanitation (the percentage of the population with access to improved sanitation facilities), safe water (the percentage of the population with access to safe drinking water), and the initial level of infant mortality. In addition, we also include the logarithm of the population to proxy for country size and the size of the recipient nation, and the logarithm of per capita GDP to proxy for the initial level of economic development. The initial values of infant mortality and per capita GDP also account for factors similar to conditional convergence in growth regressions; a country with an initial higher incidence of infant mortality is expected to perform better, on average, relative to a country with a lower incidence of infant mortality.

Equation (1) does not account for country fixed effects. The standard and conventional ways of eliminating such fixed effects are within or mean differencing (e.g., Mishra and Newhouse, 2009; Williamson, 2008; Bendavid and Bhattacharya, 2014) and first-differencing estimations. Although these approaches eliminate country fixed effects, the presence of measurement errors in the variables might exacerbate the (downward) bias in estimates due to correlation between the observed right-hand side variables and the new transformed disturbance term (Woodridge, 2002). Griliches and Hausman (1986) proposed long-differencing to minimize this bias. They also showed that estimates obtained from a long differenced equation have an instrumental variable interpretation of the level equation. We take five-year differences of all variables (except the initial log GDP per capita and the initial infant mortality, which we include to control for conditional convergence). However, it is important to note that this approach will not account for two other sources of endogeneity: reverse causality and time varying omitted variables. To address reverse causality we lag, by five further years, the differenced aid and its interaction with governance. The resulting equation (2) is:[9]

(2) $$\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 L_5 \Delta_5 Aid_{it} + \beta_2 L_5 \Delta_5 (Aid_{it} * Gov_{it}) + \delta \Delta_5 \mathbf{X}_{it} + \lambda_t + v_{it}.$$

Here L is the lag operator.

Nevertheless, this long differencing (and then lagging aid) may not address endogeneity with respect to time varying omitted variables. Although several studies, such as Williamson (2008) and Mishra and Newhouse (2009), have used lagged values of aid as instruments for contemporaneous aid, the validity of this approach is questionable as both infant mortality and lagged aid may be influenced by omitted variables in the regression equation. It is worth noting that our Equation (2), in which we directly include lagged aid (and its interaction), is similar to the approach taken by these authors; although we take longer, five-year lags. To appropriately address endogeneity, we need identification based on exclusion restrictions.

Our excludable instrument is donor government fractionalization interacted with the probability of a country receiving health aid. This identification is proposed by Dreher and Langlotz (2017) and is based on the following argument. Government fractionalization increases the overall budget of the donor government, which in turn increases the aid budget. For example, compared to a single ruling political party, it is more difficult to reduce expenditure when a government is formed by a coalition of different political parties since each

[9] This specification can also be rewritten as:
$$\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 \Delta_5 Aid_{it-5} + \beta_2 \Delta_5 (Aid_{it-5} * Gov_{it-5}) + \delta \Delta_5 \mathbf{X}_{it} + \lambda_t + v_{it}$$

party of the coalition will resist pressure to cut expenditure in its own constituents. Fragmentation in the legislature has a similar effect (see Roubini and Sachs, 1989; Annett, 2001; Dreher and Langlotz, 2017 and references therein). More broadly, political, social and ethnic fragmentation will tend to increase the size of the government's overall budget. If the share of aid in total government expenditure remains the same, then an increase in overall government budget will also increase aid allocated to recipient countries. Hence, this can be interpreted as a shock in donor countries that is exogenous to recipient countries conditional on the control variables.[10]

Our identification compares infant mortality in health aid recipient countries by higher donor government fractionalization to lower donor government fractionalization. Causal inference requires the assumption that donor government fractionalization influences infant mortality in recipient countries only through health aid (conditional on the set of control variables). One concern about this exclusion restriction is that there may be other changes over time that are spuriously correlated with donor government fractionalization which may confound the 2SLS estimates; this is addressed by the inclusion of time-fixed effects. However, since the donors' identity is more or less the same for all health aid recipient countries, the instrument only varies over time and therefore it will be collinear with time fixed effects. In order to control for time effects and to improve the strength of the first stage, we interact donor government fractionalization with a country's probability of receiving health aid. The latter is constructed as the ratio of the number of years a recipient received aid from a given donor divided by the total number of years the donor allocated aid to any recipient in the sample, which is time invariant but varies across countries. Therefore, the interacted instrument varies by both country and year. A similar identification approach has been employed by, among

[10] The factors that cause government fragmentation in donor nations (e.g., ideological, ethnic, linguistic, religious differences, and inequality) are uncorrelated with infant mortality in developing nations.

others, Werker *et al*. (2009), Nunn and Quin (2014), Ahmed (2016), and Dreher and Langlotz (2017).[11] Bun and Harrison (2018) provide an econometric theoretical justification of the IV constructed as the interaction of an exogenous variable with an endogenous variable. As argued by Nunn and Quin (2014), this instrumenting approach is conceptually similar to a difference-in-differences estimation strategy, with the only difference being that the treatment is measured as a continuous rather than a binary variable. To see this, note that the first-stage estimates compare health aid in countries that frequently receive health aid from donors, to countries that rarely receive health aid from donors.

The first step in constructing the IV is to use donor and recipient level data to estimate (using OLS) the following 'zero-stage' regression:

$$(3) \qquad Aid_{ijt} = \gamma_1 \left(DF_{jt} * P_{ij} \right) + \lambda_t + \alpha_i + \varepsilon_{it},$$

where i, j, and t index the ith recipient, jth donor, and time period t, *DF* is donor government fractionalization, *P* is the probability of receiving aid, and λ_t and α_i denote time and country fixed effects. We then use the fitted values of Equation (3) to aggregate up to the recipient level.[12] That is, we use the estimated relationship between aid and donor government fractionalization using data at the individual donor-recipient level and then aggregate up to derive the fitted value of aid at the recipient level from all donors. These calculated fitted values (*Fitted Aid*) are our IV. In estimating a zero-stage regression and then aggregating up, we follow Frankel and Romer (1999), Rajan and Subramanian (2008), and Dreher and Langlotz (2017).

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[11] Werker *et al.* (2009) interact the price of oil with whether a recipient nation is Muslim. Nunn and Qian (2014) interact US wheat production with a country's tendency to receive US food aid.

[12] The estimate for γ is 2.752 and the associated *t*-statistic (using standard errors clustered at the donor level) is 3.03.

4.2. Data

Infant mortality

Infant mortality data comes from the World Bank (2018) and is defined as the number of infants dying before reaching one year of age, per 1,000 live births in a given year.

Aid

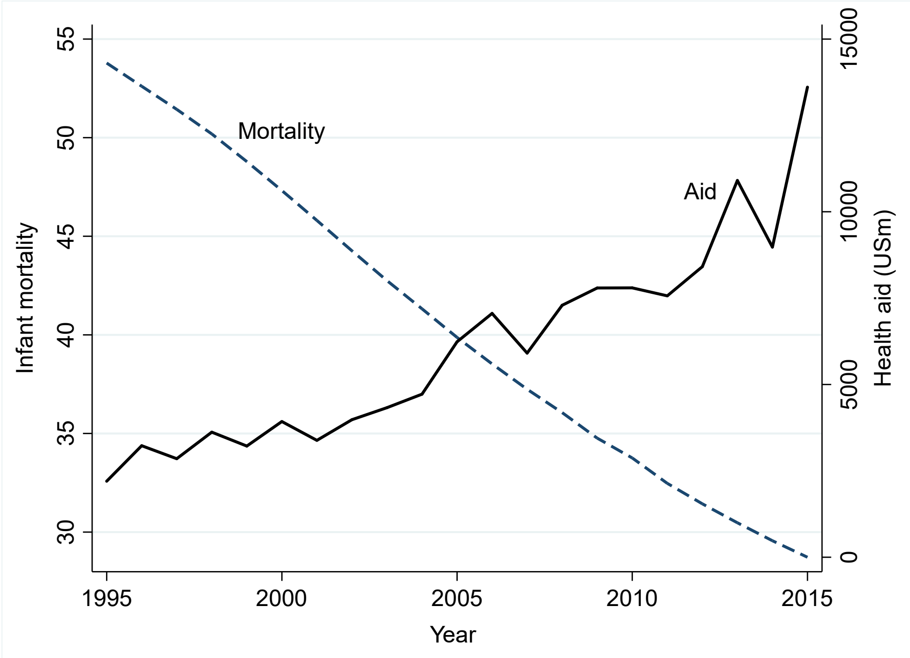
Data on health aid and total aid are extracted from the OECD. Aid is measured in constant 2014 United States dollars. Health aid data is taken from the OECD Creditor Reporting System (CRS), which identifies aid commitments by purpose.[13] We use data from all Development Assistance Committee (DAC) donors.

The sample of aid recipient countries is confined to developing countries classified by the OECD (2016) as those with a per capita income below 12,276 United States dollars in 2010. We commenced with 168 countries. However, due to missing data on some of the covariates, particularly the measure of government effectiveness, the number of countries is reduced to 96 in the empirical analysis. A list of countries is included in the Appendix, Table A1.

Figure 1 traces the path of total health aid (right axis) and average infant mortality (left axis), for all recipient nations, from 1995 to 2015. These patterns do not imply causality and there is significant variation between nations in the data.

[13] While our data source is identical to Mishra and Newhouse (2009), the sample periods differ. Mishra and Newhouse (2009) use data from 1975 to 2004, while we use data from 1995 to 2015. Although CRS commitments by purpose are available for the period 1975 to 1995, health-specific data by recipient country are unavailable for this period. Private correspondence with OECD confirms that CRS data are unavailable prior to 1995. Moreover, governance data is only available since 1995.

Figure 1. Aid and infant mortality, all recipient nations, 1995-2015



Notes: Health aid includes basic and general health aid, in real 2014 US dollars. Infant mortality is the average across all recipients per 1,000 live births.

Donor fractionalization

Data on donor government fractionalization is drawn from The Database of Political Institutions (Beck *et al*., 2001). We use the Govfrac series, which is defined as: "The probability that two deputies picked at random from among the government parties will be of different parties."

Governance

The data on governance comes from Kaufman *et al*. (2011). Our primary measure of governance is Kaufman *et al*.'s measure of government effectiveness. This variable is constructed to reflect: "the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies." (p. 233). As part of robustness, we also consider the interactions between health aid and control of corruption. We use the Corruption Perception Index (CPI) from Transparency International. The CPI: "ranks countries and territories by their perceived levels of public sector corruption according to experts and businesspeople, uses a scale of 0 to 10, where 0 is highly corrupt and 10 is very clean."[14] Both measures capture an important aspect of the quality of governance. Although the two measures are highly correlated (in our data, the correlation is 0.849), government effectiveness is conceptually a more meaningful measure in terms of assessing aid effectiveness. Our interest is on whether aid funding for health is used effectively by recipients. As the above definition states, government effectiveness quantifies the capacity of recipient governments to implement and deliver effective policies.

The government effectiveness score ranges from -2.5 to 2.5, with higher scores representing greater government effectiveness. Figure 2 traces the annual average government effectiveness score for all recipient nations. Government effectiveness oscillates, deteriorating in the early part of our sample period, then rising until 2009, and subsequently deteriorating again in recent years.

[14] https://www.transparency.org/research/cpi/overview (accessed on 10 May, 2017).

Figure 2. Annual average government effectiveness score, all recipient nations, 1995-2015

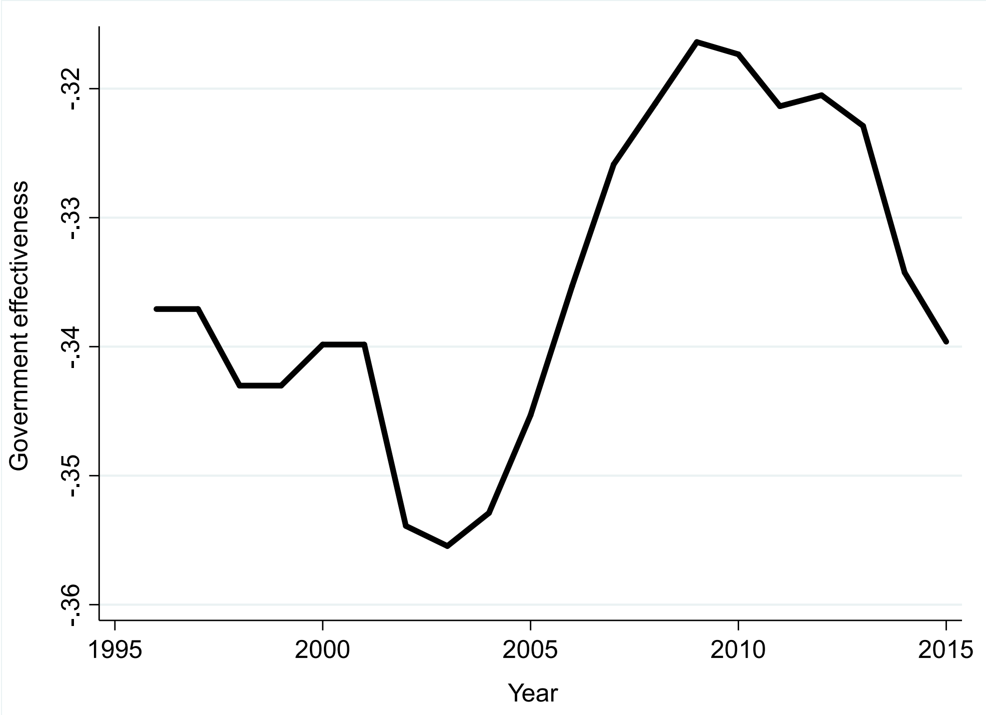


Table 1 compares the average government effectiveness, infant mortality, and the total value of health aid, for all recipients by government effectiveness decile in our sample. Both infant mortality and total health aid are inversely correlated with government effectiveness.

Table 1
Aid, infant mortality, and government effectiveness

Decile	(1) Government effectiveness score	(2) Infant mortality (per 1000)	(3) Total health aid ($ million)
1	-1.29	73.39	59.61
2	-0.98	60.87	48.23
3	-0.78	50.31	46.69
4	-0.61	47.13	59.84
5	-0.44	40.67	64.26
6	-0.20	37.50	50.40
7	0.00	31.01	52.85
8	0.34	19.87	28.39
9	0.85	19.31	7.96
10	2.43	8.02	1.62

Note: Deciles based on government effectiveness.

Control variables

The other variables included in our specification – domestic health expenditure as a share of GDP, female literacy, per capita GDP, population, access to physicians, sanitation, and access to clean water – are all taken from the World Bank Development Indicators (2016). The Appendix presents data sources and descriptive statistics for the variables used in the analysis; see Table A2.

5. Results

5.1 OLS estimation

Table 2 presents the OLS estimates of Equation (1). As noted in the methodology section, the dependent variable is expressed as the long-run change in infant mortality, calculated as the difference in infant mortality over five years. All the explanatory variables are lagged five years to accommodate potential reverse causality. Health aid is measured in per capita terms in Columns (1) to (4), and as total value of aid and as a share of GDP in Columns (5) and (6), respectively.

We find that health aid disbursed has a negative coefficient though this is not statistically significant across all regressions. Nevertheless, aid is effective in reducing mortality conditional on governance. When interacted with government effectiveness, aid has a statistically significant negative coefficient; see Columns (3) to (6).[15] This confirms that aid is more effective at reducing infant mortality the better the quality of the recipient's governance as measured by government effectiveness. The results are robust to different combinations of the control variables (e.g., excluding domestic health expenditure, and excluding doctors, sanitation, and water).

[15] The aid terms are jointly statistically significant. If the sample is partitioned into observations below and above the median score of government effectiveness, the coefficient on aid is: -0.004 (*t*-statistic = -1.68, *p*-value =0.095, n=390) for above the median score and 0.003 (t-statistic = 0.75, p-value 0.455, n=454) for below the median score.

Table 2
Health aid and infant mortality. Dependent variable is the log of infant mortality differenced over 5 years. OLS regressions.

Variables	(1) Log aid pc	(2) Log aid pc	(3) Log aid pc	(4) Log aid pc	(5) Log total aid	(6) Aid/GDP
Aid	-0.001	-0.005**	-0.001	-0.005**	-0.005**	-7.339***
	(-0.281)	(-2.143)	(-0.533)	(-2.104)	(-2.056)	(-4.333)
Governance			-0.068**	-0.063*	0.020**	0.020**
			(-2.357)	(-1.762)	(2.460)	(2.375)
Aid*Governance			-0.005**	-0.005*	-0.008***	-4.803***
			(-2.160)	(-1.962)	(-3.944)	(-3.894)
Log initial infant mortality	0.005	-0.020**	0.003	-0.015	-0.014	-0.022**
	(0.733)	(-2.055)	(0.416)	(-1.472)	(-1.408)	(-2.206)
Log population	-0.009***	-0.006**	-0.009***	-0.006*	-0.002	-0.006**
	(-4.208)	(-1.980)	(-3.993)	(-1.910)	(-0.520)	(-2.031)
Log GDP pc	0.002	-0.032***	0.004	-0.032***	-0.031***	-0.043***
	(0.641)	(-5.203)	(1.083)	(-4.655)	(-4.502)	(-6.097)
Log health expenditure		-0.070***		-0.073***	-0.068***	-0.072***
		(-5.513)		(-5.584)	(-5.250)	(-5.363)
Female literacy		0.005**		0.005**	0.006**	0.003
		(2.269)		(2.265)	(2.526)	(1.290)
Doctors		-0.016***		-0.013***	-0.014***	-0.017***
		(-4.197)		(-3.498)	(-3.810)	(-4.510)
Sanitation		0		0	0	0.000
		(-0.565)		(-0.508)	(-0.657)	(0.047)
Water		0.002***		0.002***	0.002***	0.002***
		(5.274)		(5.236)	(5.529)	(5.173)
Constant	-0.086	0.084	-0.107*	0.062	0.039	0.258***
	(-1.383)	(0.946)	(-1.685)	(0.685)	(0.434)	(2.718)
Observations	1,224	844	1,218	844	844	844
R-squared	0.191	0.289	0.199	0.291	0.298	0.308

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Columns (1)-(4) use the log of per capita health aid. Columns (5) and (6) use the log of the total value of health aid and aid as a share of GDP, respectively. All explanatory variables lagged five years. All regressions include time and region dummies. Robust *t*-statistics reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 3 reports the results of estimating Equation (2), where all variables are differenced over five years to eliminate country fixed effects. Health aid disbursed and its interaction are then lagged another five years to overcome reverse causality.[16] The format of the table is similar to Table 2. The sample size is reduced significantly in this model from a maximum of 844 to 274 observations. Aid and governance interactions are not statistically significant when aid is measured in per capita terms. However, the aid and governance

[16] To further address concerns regarding reverse causality, we also regressed the five-year differences in infant mortality on the five-year differences in aid (and aid interacted with governance), but these aid variables were lagged 10 years. These longer lags in aid are less likely to be affected by reverse causality. These results are consistent with the results presented in Table 3.

interaction is statistically significant when measured as a share of GDP or as the total value of aid.

Table 3
Health aid and infant mortality. Long-difference model. Dependent variable is the log of infant mortality differenced over 5 years.

	(1) Log aid pc	(2) Log aid pc	(3) Log aid pc	(4) Log aid pc	(5) Log total aid	(6) Aid/GDP
Aid	-0.006*	-0.004	-0.005*	-0.002	-0.002	-10.081***
	(-1.807)	(-0.897)	(-1.699)	(-0.519)	(-0.561)	(-3.016)
Governance			0.001	-0.002	-0.02	-0.003
			(-0.072)	(-0.066)	(-0.699)	(-0.121)
Aid*Governance			0.001	0.003	-0.014***	-7.251**
			(0.639)	(1.432)	(-3.005)	(-2.579)
Log initial infant mortality	0.017	-0.005	0.014	-0.008	-0.01	-0.019
	(1.636)	(-0.306)	(1.372)	(-0.572)	(-0.696)	(-1.303)
Log population	-0.068	-0.189	-0.086	-0.214	-0.2	-0.204
	(-0.746)	(-1.379)	(-0.908)	(-1.512)	(-1.447)	(-1.489)
Log GDP pc	0.008	-0.016*	0.008	-0.018**	-0.013	-0.023***
	(-1.573)	(-1.896)	(-1.521)	(-2.216)	(-1.527)	(-2.622)
Log health expenditure		-0.092***		-0.091***	-0.092***	-0.096***
		(-3.795)		(-3.638)	(-3.821)	(-3.865)
Female literacy		-0.024*		-0.024*	-0.027**	-0.019
		(-1.797)		(-1.781)	(-2.018)	(-1.474)
Doctors		-0.005		-0.002	-0.009	-0.008
		(-0.300)		(-0.134)	(-0.542)	(-0.475)
Sanitation		-0.001		-0.001	-0.001	-0.000
		(-0.423)		(-0.449)	(-0.333)	(-0.061)
Water		-0.008***		-0.008***	-0.008***	-0.009***
		(-2.771)		(-2.742)	(-2.886)	(-2.998)
Constant	-0.311***	0.015	-0.301***	0.048	0.004	0.110
	(-4.792)	-0.144	(-4.576)	-0.47	-0.04	(1.042)
Observations	521	274	516	274	274	274
R-squared	0.208	0.309	0.219	0.318	0.337	0.344

Notes: All columns report estimates of Equation (2): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 L_5 \Delta_5 Aid_{it} + \beta_2 L_5 \Delta_5 (Aid_{it} * Gov_{it}) + \delta \Delta_5 \mathbf{X}_{it} + \lambda_t + v_{it}$. All explanatory variables differenced over five years. Aid and aid interactions differenced and then lagged five years. Columns (1)-(4) use per capita health aid. Columns (5) and (6) use total health aid and aid as a share of GDP, respectively. All regressions include time and region dummies. Robust *t*-statistics reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

5.2 IV estimation

The identification strategy was discussed in section 4.1 above. In the first stage, the following two equations are estimated:

4(a) $Aid_{it-5} = \alpha + \beta_2 (Fitted\ Aid_{it-5}) + \delta \mathbf{X}_{it-5} + \beta_0 M_{it-5} + \lambda_t + \varepsilon_{it}$

4(b) $Aid_{it-5} \cdot Gov_{it-5} = \alpha + \beta_2 (Fitted\ Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \beta_0 M_{it-5} + \lambda_t + \varepsilon_{it}$, where *Fitted Aid* is our instrumental variable (IV) and its construction was discussed in Section 4.1. In the second stage, we estimate Equation (1). The first- and second-stage regression results are reported in Table 4, Columns (1) to (4), for health aid per capita disbursed. The reported *t*-statistics are robust to heteroscedasticity and autocorrelation. Fitted aid has the expected positive sign in the first stage regressions. The Kleibergen-Paap rk Wald F statistics are large confirming that our instrument is not weak.[17] The maximum bias in the IV estimators in these regressions is well below 5%. The Kleibergen-Paap rk LM statistic confirms that our model is not underidentified.

The IV results suggest a causal effect from health aid on infant mortality, conditional on good governance. These results confirm the baseline OLS results reported in Table 2. The results for aid on its own, are fragile, ranging from negative to positive effects on infant mortality, depending on the specification. However, aid reduces infant mortality when it interacts with government effectiveness. The size of the IV coefficient is larger than the corresponding OLS coefficient. IV results using total value of aid and aid as a share of GDP are presented in Table 5. The results are qualitatively similar.

[17] The first-stage regression results for the two instruments (fitted aid and fitted aid interacted with corruption or with governance) all have large *F*-statistics (greater than 69).

Table 4

IV regression: Health aid per capita disbursed (log) and infant mortality.

	(1) Log aid pc	(2) Log aid pc	(3)Log aid pc	(4) Log aid pc
Aid	0.004	0.004	-0.008	-0.016***
	(0.678)	(0.774)	(-1.342)	(-3.164)
Governance		-0.008	-0.620**	-0.369**
		(-0.927)	(-2.484)	(-2.380)
Aid * Governance			-0.046**	-0.027**
			(-2.443)	(-2.334)
Log initial infant mortality	0.009	0.006	0.011	0.007
	(0.846)	(0.496)	(0.878)	(0.434)
Log population	-0.008**	-0.008**	-0.007*	-0.012***
	(-2.239)	(-2.268)	(-1.821)	(-2.643)
Log GDP pc	0.008	0.010*	0.009	-0.035***
	(1.511)	(1.821)	(1.27)	(-3.358)
Log health expenditure				-0.082***
				(-4.493)
Female literacy				0.006*
				(1.787)
Doctors				-0.002
				(-0.339)
Sanitation				-0.001
				(-1.149)
Water				0.003***
				(5.45)
Constant	-0.105	-0.103	-0.310***	-0.111
	(-1.128)	(-1.110)	(-2.753)	(-0.808)
	First stage regressions			
Fitted aid	0.710***	0.714***	0.967***	0.955***
	(11.78)	(11.80)	(12.82)	(11.24)
Fitted aid interaction			0.221**	0.446***
			(2.31)	(4.05)
Kleinberg-Pap rk LM	130.588	130.056	10.497	14.531
	(0.000)	(0.000)	(0.001)	(0.000)
Kleinberg-Pap rk Wald F	138.719	139.279	5.364	9.048
Observations	1,068	1,065	1,065	744

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies. *t*-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk LM statistic tests for underidentification. Kleibergen-Paap rk Wald F statistic tests for weak identification. *** p<0.01, ** p<0.05, * p<0.1.

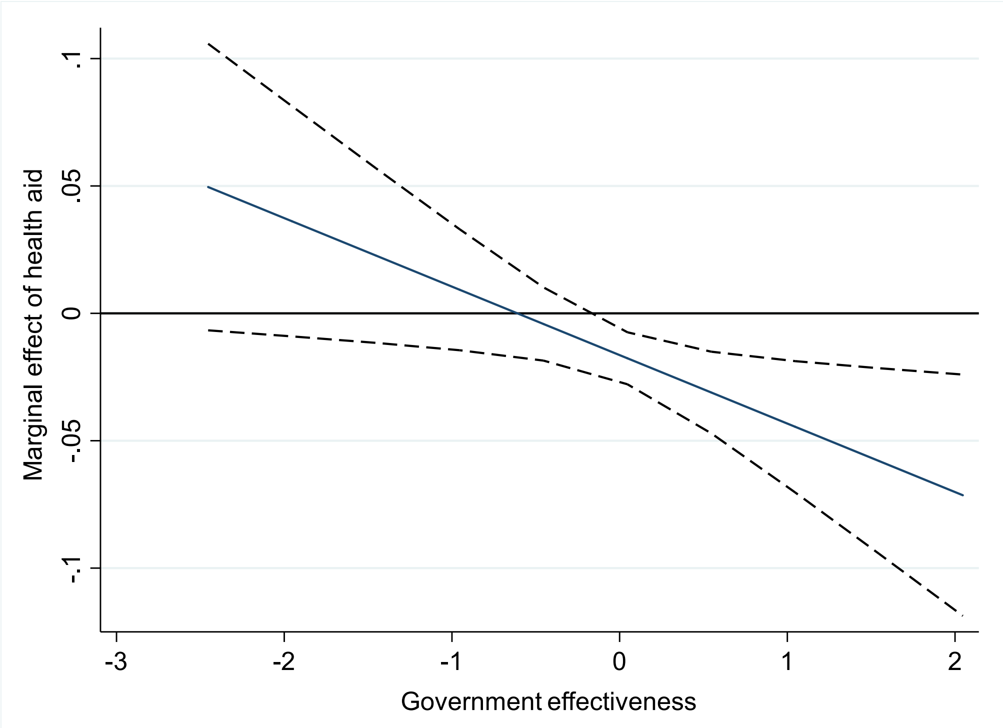
Table 5
IV regression: Total health aid and Aid/GDP and infant mortality

	(1) Log total aid	(2) Log total aid	(3) Aid/GDP	(4) Aid/GDP
Aid	-0.001	-0.017***	-5.947*	-10.629
	(-0.172)	(-3.196)	(-1.788)	(-1.579)
Governance	0.013	0.022	0.046**	0.033**
	(1.208)	(1.629)	(1.964)	(2.278)
Aid * Governance	-0.011***	-0.011***	-15.386**	-11.249***
	(-3.330)	(-2.656)	(-2.438)	(-4.250)
Log initial infant mortality	0.008	-0.003	0.015	-0.017
	(0.675)	(-0.204)	(1.005)	(-1.075)
Log population	-0.010***	0.002	-0.001	-0.009**
	(-2.739)	(0.437)	(-0.122)	(-2.040)
Log GDP pc	0.011**	-0.037***	0.029**	-0.038
	(2.151)	(-3.577)	(2.062)	(-1.483)
Constant	-0.137	-0.024	-0.434**	0.263
	(-1.532)	(-0.188)	(-2.244)	(1.077)
Other controls	NO	YES	NO	YES
Kleinberg-Pap rk LM	124.631	94.646	10.559	12.691
	(0.000)	(0.000)	(0.001)	(0.000)
Kleinberg-Pap rk Wald F	76.576	61.324	5.119	8.222
Observations	1,065	744	1,065	744

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies. Columns (2) and (4) include the full set of control variables. Full results reported in the Appendix, Table A3. t-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk LM statistic tests for underidentification. Kleibergen-Paap rk Wald F statistic tests for weak identification. *** p<0.01, ** p<0.05, * p<0.1.

The coefficient on aid is fragile in models without the interaction term; it is negative and statistically significant in some models but not others, depending on the model specification and the measurement of aid variable. However, the health aid and governance interaction term is always negative and statistically significant. The results suggest that aid is more effective in reducing infant mortality in recipient states that are better governed. Figure 3 illustrates the marginal effect of health aid on infant mortality as government effectiveness improves (dotted lines are 95% confidence intervals).

Figure 3. The marginal effect of health aid on infant mortality conditional on government effectiveness



The results suggest aid effects that are of practical significance. At sample means of government effectiveness, aid has no effect on infant mortality; the model predicts a -0.7% reduction in mortality, but this is not statistically significant (p-value = 0.252). Indeed, for nearly half the sample (recipient-year observations), we find that aid had no effect at all on infant mortality. However, a one standard deviation improvement in government effectiveness (0.809) from the sample mean would reduce infant mortality by nearly 3% (p-value = 0.000). The 10 worst governed countries (Somalia, South Sudan, Democratic People's Republic of Korea, Democratic Republic of the Congo, Comoros, Central African Republic, Equatorial Guinea, Myanmar, Togo, and Turkmenistan) had an average government effectiveness score of -1.674. For these nations, health aid had no impact on infant mortality.[18] Had these countries had the same government effectiveness score (+0.761) as the 10 better governed nations, then aid would have made significant contributions to reducing infant mortality in these countries; infant mortality would then have fallen by about 4% (p-value = 0.000). For our sample, we find that only 28% of the recipient-year observations had at least a 3% reduction in infant mortality arising from health aid.

In several instances, more health aid has been allocated to recipients experiencing deteriorating government effectiveness. For example, Zimbabwe's government effectiveness deteriorated from -0.90 in 2002 to -1.15 in 2015. Over the same period, health aid increased from $11.2 million to $137.2 million. While infant mortality fell from 62.7 to 46.6, our model predicts that none of this reduction can be attributed to health aid.

Turning to the other variables, we find that health expenditure matters. Domestic health expenditure reduces infant mortality, with an elasticity of around -0.08. Larger nations (as measured by population) experience greater reduction in infant mortality. Higher per capita income also reduces infant mortality, even after controlling for health expenditure and country size.

5.3 Robustness checks

Countries with a high probability of receiving health aid are regular aid recipients and they could differ from countries with a low probability of receiving aid (irregular recipients) in ways that are related to infant mortality. For example, countries receiving a greater amount of health aid may also receive a greater amount of other types of (non-health) aid from donors because of political and other strategic considerations, or simply because of their lower level of

[18] At sample means, the model predicts a 3% *increase* in infant mortality for these poorly governed nations, but this is not statistically significant (p-value = 0.151).

economic development. This non-health aid might have indirect effects on infant mortality through its effect on other dimensions of development in a recipient country. Our specification already controls for several development indicators: the initial level of GDP, the initial level of infant mortality, the number of doctors, water, sanitation and female literacy, which may be influenced by (non-health) development aid. Nevertheless, it is prudent to probe further. Given that non-health aid also varies over time and across countries, we additionally include in the regression non-health aid (which is constructed by subtracting health aid from total aid) interacted with time dummies to further check the robustness of our results. Nunn and Quin (2014) also follow a similar approach. These results are presented in Table 6 and confirm that the impact of aid on infant mortality is conditional on good governance.

Table 6
IV regression: Health aid disbursed (log) and infant mortality

	(1) Log aid per capita	(2) Log total aid	(3) Aid/GDP
Aid	-0.014**	-0.014**	-10.060*
	(-2.233)	(-2.16)	(-1.830)
Governance	-0.266**	0.019	0.044***
	(-2.205)	(1.25)	(2.706)
Aid*Governance	-0.019**	-0.010**	-15.490***
	(-2.159)	(-2.21)	(-3.543)
Non-health aid*time dummies	YES	YES	YES
Other controls	YES	YES	YES
Kleinberg-Pap LM	21.283	78.189	11.661
	(0.000)	(0.000)	(0.001)
Kleinberg-Pap r	19.271	45.002	6.422
Observations	707	707	724

Notes: Columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$, to which we add Non-health aid*time dummies. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies and the full set of control variables. Full results reported in the Appendix, Table A4. t-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk Wald F statistic tests for weak identification. Kleibergen-Paap rk LM statistic tests for underidentification. *** p<0.01, ** p<0.05, * p<0.1.

We also explored the robustness of the conditionality results by interacting aid with corruption instead of governance. These results are presented in Table 7 and are broadly consistent with those for government effectiveness, though the instrumentation strategy does not work as well in some instances.

Table 7
IV regression: Health aid interactions with corruption

	(1) Log aid pc	(2) Log aid pc	(3) Log aid pc	(4) Log total aid	(5) Log total aid	(6) Aid/GDP	(7) Aid/GDP
Aid	0	0.125**	0.062	0.024***	0.005	64.687	18.451
	(0.057)	(2.341)	(1.352)	(2.847)	(0.503)	(1.588)	(1.347)
Corruption	0.004	-0.488**	-0.29	0.015**	0.019***	0.016*	0.023***
	(0.824)	(-2.378)	(-1.631)	(2.557)	(2.99)	(1.915)	(2.908)
Aid*Corruption		-0.036**	-0.022*	-0.008***	-0.006**	-15.969**	-9.693***
		(-2.364)	(-1.665)	(-4.216)	(-2.247)	(-2.114)	(-3.315)
Log initial infant mortality	0.012	0.027*	0.019	0.011	-0.002	0.021	-0.022
	(1.02)	(1.789)	(0.92)	(0.933)	(-0.132)	(1.162)	(-1.387)
Log population	-0.011***	-0.013***	-0.012**	-0.010**	0.002	-0.000	-0.009**
	(-2.684)	(-2.812)	(-2.570)	(-2.368)	(0.427)	(-0.006)	(-2.053)
Log GDP pc	0.006	0.014*	-0.038***	0.006	-0.045***	0.095	-0.063*
	(0.999)	(1.823)	(-3.329)	(1.163)	(-4.299)	(1.073)	(-1.731)
Constant	-0.118	1.511**	0.904	-0.185*	-0.056	-1.047	0.295
	(-1.152)	(2.14)	(1.63)	(-1.878)	(-0.426)	(-1.120)	(0.990)
Other controls	NO	NO	YES	NO	YES	NO	YES
			First stage regressions				
Fitted aid	0.816***	0.241*	0.287	0.241*	0.287	-0.001	0.001**
	(11.88)	(1.73)	(1.44)	(1.73)	(1.44)	(-0.60)	(2.00)
Fitted aid interaction		1.066***	0.964***	2.118***	1.848***	0.002***	0.001***
		(3.82)	(2.67)	(8.97)	(6.03)	(5.06)	(3.00)
Kleinberg-Pap rk LM	124.503	7.086	5.766	121.107	88.900	2.196	7.570
	(0.000)	(0.008)	(0.016)	(0.000)	(0.000)	(0.138)	(0.0059)
Kleinberg-Pap rk Wald F	141.086	3.543	2.591	100.929	71.284	1.128	4.357
Observations	902	902	692	902	692	902	692

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies. Columns (3), (5), and (7) include the full set of control variables. Full results reported in the Appendix, Table A5. *t*-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk LM statistic tests for underidentification. Kleibergen-Paap rk Wald F statistic tests for weak identification. *** p<0.01, ** p<0.05, * p<0.1.

6. Summary

Health is a stated policy objective for many donors and recipients. We investigate whether the nearly $125 US billion allocated for health aid in the past two decades has been effective in improving a key health outcome, infant mortality. Our results show that on its own, aid does not, on average, have a robust effect in reducing infant mortality. This mirrors the varying findings reported in the literature. However, aid is effective in improving health conditional on the quality of governance; infant mortality declines as more aid is allocated to nations with higher government effectiveness.

One policy implication is that recipient nations need to further improve their governance. Of course, this is not a new insight. Nevertheless, our findings that good governance directly benefits the health of infants highlights the importance of institutions and their omnipresent impact. There clearly remains much room for improvements in the quality of governance. For example, the average government effectiveness score for recipient nations in our sample was -0.34 in 2015 compared to a maximum possible score of 2.5. The 10 worst governed recipients had an average government effectiveness score of -1.674. If poorly governed countries had the same government effectiveness score as the 10 better governed nations, then aid would have reduced infant mortality by about 4%. There is clearly much room for improving the effectiveness of health aid.

The results suggests that changes in infant mortality are driven by aid conditionality, country size, and income, and domestic health expenditure. Hence, another take home message from our study is that there is a strong case for allocating more domestic and international funds towards health. Health aid supplements domestic health expenditure, and probably also introduces new ideas and practices (Yamey *et al.*, 2016; Piva and Dodd, 2009). Our findings show that domestic health expenditure has played an important role in reducing infant mortality; a 10 percent increase in domestic health expenditure is associated with a 0.8 percent reduction in infant mortality.

Infant mortality is only one objective of aid. For example, donors also allocate aid to nations for strategic, military, or commercial reasons. Similarly, donors might allocate aid to poorly governed nations with the hope that this will improve governance. If these recipients are poorly governed, then mortality need not improve, and in some cases it may even worsen, even though other objectives might be satisfied. This points to contradictions among some of the donor objectives. Donors need to be cognizant of the various effects of aid. Indeed, since 2009, government effectiveness has deteriorated, on average, across recipient nations (recall Figure 2), at the same time as total health aid has accelerated (recall Figure 1).

Our study focused on infant mortality. This is only one of many critical health outcomes. Hence, in order to fully assess the total impact of aid, it is necessary to consider other health outcomes, such as cancer survival rates, disability support, and life expectancy, in recipient nations.

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Disclosure statement

No funding was received for the results reported in the paper.

None of the authors have any relevant or material financial or conflict of interests to declare.

APPENDIX

HEALTH AID, GOVERNANCE AND INFANT MORTALITY

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A1: List of recipient nations

Afghanistan	Albania	Algeria	Argentina	Armenia	Bangladesh
Bahrain	Belize	Benin	Bolivia	Botswana	Brazil
Burundi	Cambodia	Cameroon	Central African Republic	Chile	China (People's Republic of)
Colombia	Congo	Costa Rica	Côte d'Ivoire	Croatia	Cuba
Democratic Republic of the Congo	Dominican Republic	Ecuador	Egypt	El Salvador	Fiji
Gabon	Gambia	Ghana	Guatemala	Guyana	Haiti
Honduras	India	Indonesia	Iraq	Jamaica	Jordan
Kazakhstan	Kenya	Kyrgyzstan	Lao People's Democratic Republic	Lesotho	Liberia
Maldives	Malawi	Malaysia	Mali	Mauritania	Mauritius
Mexico	Moldova	Mongolia	Morocco	Mozambique	Myanmar
Namibia	Nepal	Nicaragua	Niger	Pakistan	Panama
Papua New Guinea	Paraguay	Peru	Philippines	Rwanda	Saudi Arabia
Senegal	Serbia	Sierra Leone	South Africa	Sri Lanka	Sudan
Swaziland	Togo	Thailand	Tajikistan	Tonga	Trinidad and Tobago
Tunisia	Turkey	Tanzania	Uganda	Ukraine	Uruguay
Venezuela	Viet Nam	Yemen	Zambia	Zimbabwe	

A2: Descriptive statistics

Variables	Source of data	Mean	Standard deviation
Infant mortality (per 1000 live births)	WDI	64.130	46.811
Total health aid disbursed (2014 USD, million)	OECD	46.767	83.180
Total aid (2014 USD, million)	OECD	463.373	872.425
Health expenditure (% of GDP)	WDI	5.815	2.595
Government effectiveness score	Kaufman *et al*. (2011)	-0.335	0.809
Corruption score	Transparency International	3.501	1.537
Population (million)	WDI	23.965	109.939
GDP per capita	WDI	5662.611	10579.61
Female literacy	WDI	76.423	24.148
Doctors	WDI	1.17231	1.28745
Sanitation	WDI	63.0766	30.6964
Water	WDI	80.6420	18.6525

Notes: WDI denotes World Development Indicators.

Table A3

IV regression: Total health aid and Aid/GDP and infant mortality, full results

	(1) Log total aid	(2) Log total aid	(3) Aid/GDP	(4) Aid/GDP
Aid	-0.001	-0.017***	-5.947*	-10.629
	(-0.172)	(-3.196)	(-1.788)	(-1.579)
Governance	0.013	0.022	0.046**	0.033**
	(1.208)	(1.629)	(1.964)	(2.278)
Aid * Governance	-0.011***	-0.011***	-15.386**	-11.249***
	(-3.330)	(-2.656)	(-2.438)	(-4.250)
Log initial infant mortality	0.008	-0.003	0.015	-0.017
	(0.675)	(-0.204)	(1.005)	(-1.075)
Log health expenditure		-0.068***		-0.091***
		(-3.902)		(-3.940)
Female literacy		0.006*		0.002
		(1.951)		(0.588)
Doctors		-0.010**		-0.011*
		(-2.011)		(-1.672)
Sanitation		-0.001		-0.000
		(-1.369)		(-0.594)
Water		0.003***		0.002***
		(5.469)		(4.545)
Log population	-0.010***	0.002	-0.001	-0.009**
	(-2.739)	(0.437)	(-0.122)	(-2.040)
Log GDP pc	0.011**	-0.037***	0.029**	-0.038
	(2.151)	(-3.577)	(2.062)	(-1.483)
Constant	-0.137	-0.024	-0.434**	0.263
	(-1.532)	(-0.188)	(-2.244)	(1.077)
	First stage regressions			
Fitted aid	0.967***	0.955***	0.002***	0.001*
	(12.82)	(11.24)	(4.14)	(1.65)
Fitted aid interaction	1.148*** (15.76)	1.122*** (15.30)	0.0001 (1.29)	0.002*** (5.56)
Kleinberg-Pap rk LM	124.631 (0.000)	94.646 (0.000)	10.559 (0.001)	12.691 (0.000)
Kleinberg-Pap rk Wald F	76.576	61.324	5.119	8.222
Observations	1,065	744	1,065	744

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies. *t*-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk LM statistic tests for underidentification. Kleibergen-Paap rk Wald F statistic tests for weak identification. *** p<0.01, ** p<0.05, * p<0.1.

Table A4

IV regression: Health aid disbursed and infant mortality, full results

	(1) Log aid per capita	(2) Log total aid	(3) Aid/GDP
Aid	-0.014**	-0.014**	-10.060*
	(-2.233)	(-2.16)	(-1.830)
Governance	-0.266**	0.019	0.044***
	(-2.205)	(1.25)	(2.706)
Aid*Governance	-0.019**	-0.010**	-15.490***
	(-2.159)	(-2.21)	(-3.543)
Log initial infant	-0.003	-0.006	-0.012
mortality	(-0.178)	(-0.37)	(-0.669)
Log health expenditure	-0.071***	-0.063***	-0.098***
	(-4.045)	(-3.56)	(-4.453)
Female literacy	0.006*	0.006*	0.001
	(1.884)	(1.91)	(0.301)
Doctors	-0.009	-0.013**	-0.008
	(-1.580)	(-2.50)	(-1.413)
Sanitation	-0.001	-0.001	-0.000
	(-1.219)	(-1.40)	(-0.898)
Water	0.003***	0.003***	0.003***
	(5.484)	(5.50)	(5.160)
Log population	-0.010**	-0.001	-0.013***
	(-2.294)	(-0.06)	(-3.029)
Log GDP pc	-0.035***	-0.035***	-0.048***
	(-3.418)	(-3.47)	(-2.622)
(Non-health aid)*time dummies	Yes	Yes	Yes
Constant	-0.061	0.009	0.401**
	(-0.339)	(0.050	(2.093)
Kleinberg-Pap LM	21.283	78.189	11.661
	(0.000)	(0.000)	(0.001)
Kleinberg-Pap r	19.271	45.002	6.422
Observations	707	707	724

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies. *t*-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk Wald F statistic tests for weak identification. Kleibergen-Paap rk LM statistic tests for underidentification. *** p<0.01, ** p<0.05, * p<0.1.

Table A5
IV regression: Health aid per capita disbursed, corruption and infant mortality, full results

	(1) Log aid pc	(2) Log aid pc	(3) Log aid pc	(4) Log total aid	(5) Log total aid	(6) Aid/GDP	(7) Aid/GDP
Aid	0	0.125**	0.062	0.024***	0.005	64.687	18.451
	(0.057)	(2.341)	(1.352)	(2.847)	(0.503)	(1.588)	(1.347)
Corruption	0.004	-0.488**	-0.29	0.015**	0.019***	0.016*	0.023***
	(0.824)	(-2.378)	(-1.631)	(2.557)	(2.99)	(1.915)	(2.908)
Aid*Corruption		-0.036**	-0.022*	-0.008***	-0.006**	-15.969**	-9.693***
		(-2.364)	(-1.665)	(-4.216)	(-2.247)	(-2.114)	(-3.315)
Log initial infant mortality	0.012	0.027*	0.019	0.011	-0.002	0.021	-0.022
	(1.02)	(1.789)	(0.92)	(0.933)	(-0.132)	(1.162)	(-1.387)
Log health expenditure			-0.079***		-0.067***		-0.063**
			(-3.992)		(-3.731)		(-1.987)
Female literacy			0.004		0.003		-0.002
			(1.219)		(1.064)		(-0.512)
Doctors			0		-0.010**		-0.012*
			(0.039)		(-2.081)		(-1.759)
Sanitation			0		0		0.000
			(-0.699)		(-0.446)		(0.157)
Water			0.003***		0.003***		0.003***
			(5.132)		(5.677)		(5.271)
Log Population	-0.011***	-0.013***	-0.012**	-0.010**	0.002	-0.000	-0.009**
	(-2.684)	(-2.812)	(-2.570)	(-2.368)	(0.427)	(-0.006)	(-2.053)
Log GDP pc	0.006	0.014*	-0.038***	0.006	-0.045***	0.095	-0.063*
	(0.999)	(1.823)	(-3.329)	(1.163)	(-4.299)	(1.073)	(-1.731)
Constant	-0.118	1.511**	0.904	-0.185*	-0.056	-1.047	0.295
	(-1.152)	(2.14)	(1.63)	(-1.878)	(-0.426)	(-1.120)	(0.990)
Other controls	NO	NO	YES	NO	YES	NO	YES
			First stage regressions				
Fitted aid	0.816***	0.241*	0.287	0.241*	0.287	-0.001	0.001**
	(11.88)	(1.73)	(1.44)	(1.73)	(1.44)	(-0.60)	(2.00)
Fitted aid interaction		1.066***	0.964***	2.118***	1.848***	0.002***	0.001***
		(3.82)	(2.67)	(8.97)	(6.03)	(5.06)	(3.00)
Kleinberg-Pap rk LM	124.503	7.086	5.766	121.107	88.900	2.196	7.570
	(0.000)	(0.008)	(0.016)	(0.000)	(0.000)	(0.138)	(0.0059)
Kleinberg-Pap rk Wald F	141.086	3.543	2.591	100.929	71.284	1.128	4.357
Observations	902	902	692	902	692	902	692

Notes: All columns report estimates of Equation (1): $\Delta_5 M_{it} = \alpha + \beta_0 M_{it-5} + \beta_1 Aid_{it-5} + \beta_2 (Aid_{it-5} * Gov_{it-5}) + \delta \mathbf{X}_{it-5} + \lambda_t + \varepsilon_{it}$. Aid instrumented using donor government fractionalization interacted with a recipient country's probability of receiving aid. All explanatory variables, including aid, lagged five years. All regressions include time and region dummies. *t*-statistics in parentheses are robust to heteroskedasticity and autocorrelation. Kleibergen-Paap rk LM statistic tests for underidentification. Kleibergen-Paap rk Wald F statistic tests for weak identification. *** p<0.01, ** p<0.05, * p<0.1.