Health Aid and Child Mortality in Developing Countries: Accounting for Transmission Mechanisms

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List of abbreviations and acronyms

CRS	Credit Reporting System
IHME	Institute for Health Metrics and Evaluation
HDI	Human Development Index
MDGs	Millennium Development Goals
ODA	Overseas Development Assistance
OECD	Organisation for Economic Co-operation and Development
SSA	Sub-Saharan Africa

Abstract

Using a sample of 94 developing countries over the period 1990-2011, this paper examines both the direct and indirect effect of health aid on child mortality. We test for this relationship using a dynamic panel data model. The results reveal that health aid decreases infant mortality in developing countries. More specifically, a 1% increase in health aid per capita leads to a 0.047% decrease in child mortality over five years. This effect operates mainly through the improvement of primary education completion rate of female and governance. However, the magnitude of the effects is too small if developing countries would like to achieve Millenium Development Goals (MDGs through) additional health aid. The policy implications of the paper are further discussed.

Key words: Health aid, Child mortality, Instrumental variable, Developing countries

JEL Classification: C23, F35, I10

1. Introduction

Despite an impressive amount of studies devoted to the effectiveness of foreign aid, there is no general consensus. This is particularly striking in the health sector, where very few studies exist due to the fact that health is one of the largest and most complex sectors of foreign aid. The results of the few existing studies on health aid effectiveness are very inconclusive. Two contrasting views have, however, emerged over the last few years. According to Williamson (2008), foreign aid is ineffective at increasing overall health. Conversely, Mishra and Newhouse (2009) find that health aid has a beneficial and statistically significant effect on infant mortality. This study takes advantage of this literature and assesses the effect of health aid on child mortality in developing countries over the period 1990-2012.

Studies undertaken on health care in developing countries have evoked several arguments. First of all, the health status of the populations is a major preoccupation as it determines the level of productivity of the labour force and contributes to growth as well as to poverty reduction (Bloom et al., 2004; Carstensen and Gundlach, 2006; Weil, 2007). The key role of health, as input for development, has been reaffirmed at the international level, as proved by the Millennium Development Goals (MDGs). Indeed, three out of the eight objectives of the MDGs are centred directly on health (child mortality reduction, improvement of maternal health, and the fight against HIV/AIDS, malaria and other diseases). Secondly, the paradox that developing countries face relies on the size of their needs in the access to health-care services in a context of severe financial constraints. Foreign aid remains one of the main sources of external financing for health-care services in developing countries in general, and in Africa in particular (Ebeke & Drabo, 2011). This could be explained by the widely shared belief that foreign aid improves health outcomes in developing countries by relaxing resource constraints and directly improving health service delivery.

It is well known that developing countries are a major recipient of health aid (Gomanee et al, 2005a; Williamson, 2008), yet these countries exhibited poor health performance. A variety of factors have contributed to poor health indicators in developing countries, including a lack of political will to put in place major reforms (e.g., improving governance and tackling corruption) and a lack of resources for financing the health sector.

Despite the recent global economic and financial crisis, gross Official Development Assistance (ODA) aid disbursement for health has increased in most developing countries. This is especially the case for sub-Saharan Africa (SSA), where it has increased from one billion in 2000 to four billion in 2009 (World Bank, 2011). SSA is also making progress in the health sector. Maternal mortality rates decreased from 777 deaths per 100,000 births in the 1990s to 588 deaths per 100,000 births in 2008.

Similarly, the under-five mortality rate also dropped from 147 in 2000 to 118 in 2009. Life expectancy improved and increased from 52 in 1990 to 55 in 2009 (World Bank, 2011). In spite of these improvements, SSA still has a long way to go. Both maternal and under-five mortality rates should decrease by half in order to meet the fourth and fifth objectives of MDGs by 2015.[1] SSA has the highest HIV prevalence rate of 5%, followed by the Caribbean (1.1%), Eastern Europe and Central Asia (0.8%) (Youde, 2010).

Despite the empirical literature considering the effect of foreign aid on growth, there is little disaggregated evidence on how overall foreign aid affects health, or on how health aid affects health outcomes. Moreover, within the available literature (Chauvet et al., 2008; Williamson, 2008; Ebeke and Drabo, 2011; Mishra and Newhouse, 2009; Masud & Yontcheva, 2005), there is no agreement or strong evidence on the effect of health aid on health outcomes. In fact, while Ebeke and Drabo (2011) and Mishra and Newhouse (2009) find a strong positive effect of health aid, Williamson (2008) and Wilson et al. (2009) do not observe any significant effect. One of the major concerns in this literature is about the wide variety of health indicators used, ranging from life expectancy and child mortality (Williamson, 2008; Wilson et al., 2009; Mishra & Newhouse, 2009) to access to health-care services (Ebeke & Drabo, 2011).This makes the comparison across studies difficult. Furthermore, most of the studies make use of a full sample of developing countries. Besides, in the literature, both direct and indirect effects of foreign aid on the health indicators are not considered. This calls for more investigation on the effect of health aid on health, mostly in developing countries, where the standards of living are very low.

The main objective of this study is to examine the effect of health aid on child mortality in developing countries. Specifically, we investigate the direct and indirect effects of health aid on child mortality, testing for several transmission mechanisms, including governance and education. The main reason behind the choice of this health outcome indicator is that it relies upon the fact that developing countries are the most affected by child mortality. Adding to this, the fourth MDG is to reduce by two-thirds, between 1990 and 2015, the mortality rate of children under five, and the under-five mortality rate is widely recognized as an important indicator of the level of child health and overall development in countries. Finally, child mortality encompasses most of the reasons why donors give aid to the health sector. Moreover, previous analyses have not found strong relationship between under-five mortality and aid while there are too many problems associated to the use of indicators such as disease prevalence (Malaria, Tuberculosis, HIV), access to health-care services, and life expectancy.

The contribution of this paper is twofold. First, the effectiveness of health aid is assessed while accounting for both direct and indirect impacts on child mortality. To the best of our knowledge, little is known about the key channels through which health aid affects child mortality in developing countries. Unlike the existing literature on official development assistance, we take into account the endogeneity of the mediators using, alternatively, a Seemingly Unrelated Regression (SUR) framework and a two steps GMM estimator. Second, we take a close look at the data and provide a case study on two African countries, namely Niger and Mali, which exhibit poor health indicators.

This research is relevant for at least three reasons: Firstly, the relationship between

health aid and child mortality is controversial in the empirical literature. Secondly, there is little evidence on the channels through which health aid affects child mortality. Finally, as health indicator, the reduction of child mortality contributes to the improvement of the economic performance and poverty reduction.

The rest of the paper is organized as follows. Section two provides a literature review. Section three outlines the empirical model and describes the data. Section four and five present the results and test some mediators. Section six concludes.

2. Literature review

This section provides a review of the available literature on the relationship between foreign aid and health. The question of foreign aid impact on health outcomes is highly controversial and excites polarized opinions. There are two competing hypotheses on how foreign aid affects health outcomes in recipient countries. The first hypothesis is optimistic about aid impact on health. According to this view, foreign aid can have a positive effect on developing countries' health indicators by improving them (Ebeke and Drabo, 2011; Mishra and Newhouse, 2009; Chauvet et al., 2008). The second hypothesis is pessimistic. According to this view, aid is not only unable to promote health in recipient nations, but often has the opposite effect (Wilson et al*.,* 2009; Williamson, 2008).

In the first view, foreign aid is needed to enhance the quality of health indicators. In this regard, Chauvet et al. (2008) analysed the respective impact of aid and remittances on human development as measured through infant and child mortality rates with a panel data on a sample of 109 developing countries, and cross-country quintile-level data on a sample of 47 developing countries. Their results suggest that health aid significantly improves child health outcomes. The impact of health aid is non-linear, though, suggesting that aid to the health sector is more effective in the poorest countries. Recent work by Ebeke and Drabo (2011) finds that remittances, health aid and public spending are important determinants of access to health services in recipient countries. In the same vein, Mishra and Newhouse (2009) examine the relationship between health aid and infant mortality, using data from 118 countries between 1973 and 2004. They 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% reduction in infant mortality rates, which is small in light of the desired goals of the MDGs. In contrast, they fail to find concrete 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 estimated effect of health aid on infant mortality should be mitigated because the health aid data are likely to suffer from underreporting. Bhutta et al. (2010) reviewed progress between 1990 and 2010 in coverage of 26 key interventions in 68 countdown priority countries accounting for more than 90% of maternal and child deaths worldwide. A total of 19 countries studied were on track to meet MDG 4, while in 47 countries they noted acceleration in the yearly rate of reduction in mortality of children younger than five years, and in 12 countries some progress had decelerated since 2000. According to the authors, the financing of health indicators (maternal, newborn, and child health) included an assessment of ODA in addition to patterns of national spending. The indicators that they present include an analysis of the maternal, newborn,

and child health components of ODA on the basis of data reported by the Organisation for Economic Co-operation and Development (OECD). The global mortality rate in children younger than five years fell by 28%, from an estimated 90 deaths per 1,000 livebirths in 1990, to 65 deaths per 1,000 livebirths in 2008. On the basis of these estimates, the absolute number of child deaths decreased to an estimated 8.8 million in 2008, from 12.5 million in 1990, which was the baseline year for the MDGs. Masud and Yontcheva (2005) assessed the effectiveness of foreign aid in reducing poverty through its impact on human development indicators. Their results show that NGOs aid reduces infant mortality and does so more effectively than official bilateral aid.

The opposite view is that foreign aid is ineffective and unable to improve health indicators in recipient countries. In this line, Wilson et al. (2009) find that the extensive funds going to the health sector aid basically have no impact on the level of mortality across countries. In short, health aid is not able to meet health needs, and health sector aid has had little visible effect on improvements in mortality. Likewise, Williamson (2008) finds a negligible impact of health sector aid on a variety of health outcomes, including infant mortality, life expectancy and death rate. Kosack and Tobin (2006) find no impact of development assistance on infant mortality or life expectancy. Negative findings are not universal; Goomanee et al. (2005b) find that total aid flows (as a percentage of GDP) do lead to higher levels of aggregate welfare (as measured by the Human Development Index (HDI), though the effects are weaker for infant mortality. Kosack (2003) argues that development aid has a positive effect on HDI when the country is a democracy, but a negative effect in an autocracy.

Very little is known, however, about health aid effectiveness at the sub-aggregate level, such as the effect of projects targeted at particular health problems or at particular communities. White (2003) looks at specific health interventions in Bangladesh and finds that health outcomes are not related to health aid, but are related to aid in other sectors. From a 15-year, carefully controlled study in rural Gambia, Hill (2000) reports that villages with assistance in providing primary care and those without assistance experience a decline in child health. Some works show the effectiveness of some types of targeted aid. Du Lou et al. (1995), for example, evaluate a vaccination programme in Senegal and find, unsurprisingly, a negative relationship between vaccination rates and child mortality.

Despite the empirical literature considering the effect of foreign aid on health, systematic evidence that aid improves HIV prevalence rates is surprisingly scarce. To the best of our knowledge, the paper by Youde (2010) is the first empirical study to examine the effect of health aid on adult HIV prevalence rates. He finds that there exists a negative statistically significant relationship between adult HIV prevalence rates and the amount of foreign aid.

In a nutshell, most of the previous studies on the effect of foreign aid on health have mainly focused on the direct effect on a large sample of developing countries. To the best of our knowledge, few papers have attempted to identify the channels through which health aid affect health outcomes. In this way, we identify female education as the most significant transmission mechanism, and also consider effects through governance and the number of physicians. In fact, primary female education is crucial to empower women with skills necessary to increase their entire household

productivity, to raise healthier children and to make better economic decisions (Cutler et al., 2006). Empirically, it is demonstrated that a woman with basic education is a significant determinant of infant and child mortality. For example, Schultz (1993) finds that at the sample mean, a one-year increase in women's education is associated with a 5% decline in child mortality. Related literature finds that mothers' schooling is considered to be an important determinant of the decline in infant and child mortality, presumably because they better manage child care by more effectively administering food and medical care.

This study is a contribution to the clarification of the debate on the effects of foreign aid on health indicators.

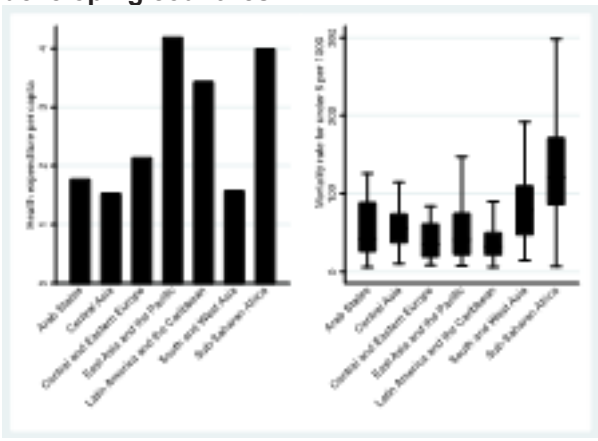
3. Testing the relationship between health aid and child mortality in developing countries

This section articulates around three steps. First, we study the cross-country correlation between health aid and child mortality. This is useful to explore the pattern of the relationship across regions, which is not easily feasible with rigorous techniques due to lack of data. Secondly, we use a dynamic panel data specification to assess the direct effect of health aid on child mortality. Finally, we use the mediation analysis to test different channels through which health aid may affect child mortality in developing countries.

Graphical evidence

Figure 1 shows the respective distributions of health aid and child mortality across developing regions.[2]

Figure 1: Distribution of health aid and prevalence of child mortality in developing countries



Sources: Author's computation based on World Bank (2011) and OECD, Credit Reporting System (CRS)

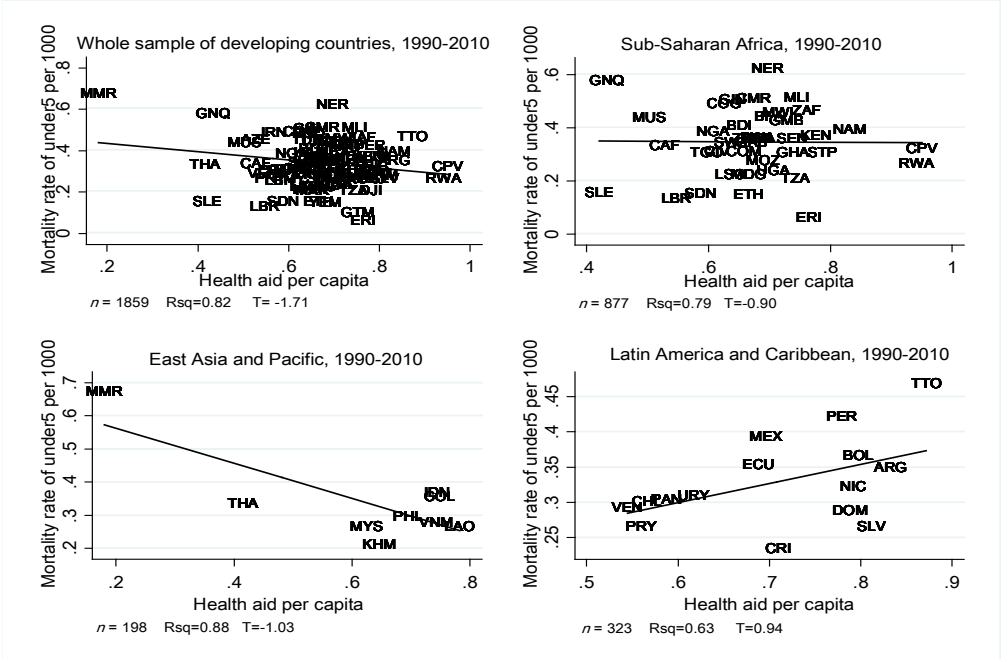
Looking at the first chart (left hand side), one notices that three regions receive significantly more health aid than the other regions. These are East Asia and the Pacific,

Latin America and Caribbean, and sub-Saharan Africa. Concerning child mortality (mortality rate for the under five years old), SSA countries exhibit the highest number of deaths, followed by the South and West Asia. Figure 2 portrays the correlation between health aid and child mortality in developing countries over the period 1990-2010.

The first chart of Figure 2 displays the correlation between health aid and child mortality for the whole sample of developing countries. This chart suggests a negative, but barely significant, relationship between health aid and child mortality. Further analysis looks at the pattern of this relationship in various developing regions.

Although the pattern of the relationship clearly differs across regions, there is no evidence of the significant negative effect of health aid on child mortality. Besides, while the correlation is negative in the case of SSA and that of East Asia and Pacific, one observes a steady positive correlation in the case of Latin America and the Caribbean. The latter is rather surprising, but may be explained by the fact that countries that report low levels of child mortality receive less aid.

Figure 2: Relationship between health aid and child mortality in developing regions (1990-2010)



Source: Author's computation based on World Bank (2011) and OECD, Credit Reporting System (CRS). The health aid and child mortality are residuals derived from pooled regressions using annual data of these variables regressed on the same set of control variables (log of real GDP per capita, fertility rate, governance, primary female education completion, Hiv prevalence, total population). This gives adjusted measures of the prevalence of the health aid and child mortality that are purged from any collinearity with the determinants of the child mortality.

We further examine the relationship between health aid and child mortality by estimating a dynamic panel data specification.

Estimation strategy and data

Empirical studies on the effects of health aid on health outcomes rely mainly on instrumental variable regression with external instruments. Although these studies attempt to address the issue of endogeneity, they are unable to identify the dynamics of the relationship and tackle both the issue of endogenous controls and omitted variable bias. In fact, Ordinary Least Squares (OLS) estimates are biased if aid is correlated with the unobserved component of child mortality. For example, if countries receive more health aid as child mortality increases, the beneficial effect of aid will be underestimated (Mishra and Newhouse, 2009; Ebeke and Drabo, 2011). In this line, Lee and Lim (2014) show that, when health status in the recipient country deteriorates, the total value of health aid to the country increases. Another potential source of bias is measurement error. Since the health aid data are reported by donors, any measurement error is likely to be correlated with the characteristics of the recipient country, which would imply that any beneficial effect of aid would be further underestimated (Mishra and Newhouse, 2009). Another issue is the potential endogeneity of health spending and GDP per capita. In fact, there is more likely to be higher health expenditure in countries with poor health performance. In addition, health outcomes may exhibit inertia in the sense that the current value may be determined by the past value of the variable since the policies implemented take time to give results. For this latter reason, we adopt a dynamic specification, following Mishra and Newhouse, (2009) and Williamson (2008).

Estimation strategy

Our baseline dynamic panel data model takes the following form:

$$Child_{it} = \alpha Child_{it-1} + X'_{it}\beta + \delta Haid_{it} + \mu_i + \tau_t + \varepsilon_{it} \quad (1)$$

Where, $Child_{it-1}$, X are, respectively, the lagged variable of child mortality, the matrix of control variables including the GDP per capita, health spending, the total population, the number of physician per 1,000, the fertility rate, the level of women education captured by the primary completion rate for women, and governance measured, respectively, by the governance effectiveness and the control of corruption. $Haid$ishealth aid per capita, μ_i is the country fixed effect, $\tau_t$is the time effect, and ε_{it} is the error term. We expect δ to be significantly negative in order to confirm the hypothesis according to which health aid helps to reduce child mortality in developing countries.

Data

Our final sample contains 94 countries over the period 1990-2011. Data are averaged over five-year periods to reduce annual fluctuation and measurement errors. Except for

fertility, governance and female primary education completion rate, all the variables are in logarithm.

The dependent variable is the child mortality which is the probability per 1,000 that a newborn baby will die before reaching age five, if subject to current age-specific mortality rates. The data are drawn from the World Bank's World Development Indicator (WDI, 2011).

The interest variable is the health aid per capita. This is the aggregate total for general health and basic health. It includes health policy and administrative management; medical education/training; medical research and medical services. Data are taken from the Institute for Health Metrics and Evaluation (IHME). IHME compute data from the Credit Reporting System (CRS) of the OECD database.

Control variables: Except for the variables that capture the level of good governance, all the control variables are from the World Bank's WDI, 2011. Corruption is captured by the variable "control of corruption" available on the World Wide Governance Indicator of the World Bank. It captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests (Kaufman et al, 2010). This variable ranges between -2.5 for the high level of corruption to 2.5 for the low level one. The effectiveness of governance captures the perception of 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. Table 1 provides the descriptive statistics of the variables used in regressions.

Table 1: Descriptive statistics

Variable	Observations	Mean	Std. Dev.	Min	Max
Child mortality	230	75.67	54.44	6.5	278.16
Primary education completion (female)	230	71.32	28.62	10.08	119.34
Health aid per capita	230	4.32	6.73	0.017	50.68
Health expenditure per capita	230	198.35	216.69	13.51	1115.9
GDP per capita	225	3,907.67	3389.69	484.32	17561.1
Total population	230	3.26e+07	1.04e+08	8,4872.25	1.17e+09
Number of Physician per 1000	230	0.91	1.15	0.008	6.39
Fertility rate	230	3.67	1.46	1.46	7.5
Control of Corruption	230	-0.48	0.57	-1.60	1.40
Voice and accountability	230	-0.52	0.72	-2.19	1.11
Governance effectiveness	230	-0.47	0.55	-1.71	1.19

Source: Authors based on the World Bank (2011)

Table 1 shows that, on average, 76 children out of 1,000 are likely to die before the age of five. Likewise, on average, each citizen in developing countries received more than USD4 in terms of health aid over five years. This is less than USD1 per year. This amount is very small and should be increased if one wants to substantially

reduce child mortality in developing countries. Besides, Table 1 shows that, on average, developing countries exhibit poor governance while they have a high fertility rate and larger populations.

The estimates of the dynamic model presented above with OLS estimator are inconsistent, since the lagged dependent variable is introduced alongside country fixed effects. This bias is of great concern because of the short temporal dimension of the dataset used. The Generalised Method of Moments (GMM) estimator must therefore be implemented. The equations in levels and the equations in first differences are combined in a system and estimated with an extended system, GMM estimator, which allows for the use of lagged differences and lagged levels of the explanatory variables as instruments (Blundell and Bond, 1998).[3]We use two and three period lagged variables in level to instrument health aid and the other predetermined variables in the difference equation, whereas we use one to three lagged difference in the level equation.[4]

4. Estimation results

The estimation of the dynamic panel data model provides an evidence of the negative effect of health aid on child mortality in developing countries. Table 2 presents the results. We use several specifications in order to assess the robustness of the results to the introduction of different controls. The first column (1) presents the estimates of the baseline model with several controls including health spending and governance effectiveness. According to this specification, a 1% increase in foreign aid per capita leads to a reduction of 0.028% of deaths of the under-five newborn babies per 1,000. The second and the third columns add, respectively, corruption and GDP per capita as controls. The results remain very stable with regard to the baseline specification. However, we notice that the magnitude of the effect of health aid almost doubles when the GDP is added as control. A possible explanation of this result is that aid, to be more effective, requires some basic infrastructure that are available in most developed countries in the developing world. In column (4), we control for both the level of GDP per capita and governance effectiveness. The negative effect of health aid on child mortality remains strong. In addition, the null hypothesis of the no two-period serial correlation in the residuals cannot be rejected in all the specifications. In addition, the Hansen's test of over-identifying restriction passes in all cases. However, in specifications (1) and (3) there is a strong suspicion of non-stationarity in the dependent variable. Therefore, our conclusions rely more on the specifications (2) and (3). Overall, the GMM results suggest that increasing health aid by 1% decreases child mortality in the next five years by a magnitude of 4.7%. This effect is more than twice the one found by Mishra and Newhouse (2009). Although we use the GMM technique as they did, our studies differ on two main points. First, they use health aid data over the period 1973-2004, while our study focuses on the period 1990-2011. This difference might explain the higher magnitude of the health aid's effect since more efforts have been made in the health sector since 2000. Second, they use infant mortality rather than child mortality.

Table 2: Health aid and child mortality, two steps GMM dynamic panel data estimator

Dependent Variable: Log(Child mortality)	(1)	(2)	(3)	(4)
Log of Child mortality, t-1	0.951***	-0.101	0.936***	0.009
	(0.172)	(0.075)	(0.176)	(0.083)
Log of health aid per capita	-0.028**	-0.047*	-0.027*	-0.047**
	(0.012)	(0.027)	(0.014)	(0.023)
Log of health expenditure per capita	-0.052		-0.020	

	(0.096)		(0.119)	
Log of GDP per capita		-1.223***		-0.790***
		(0.300)		(0.262)
Primary completion rate (female)	0.002	-0.002	0.002	0.001
	(0.003)	(0.005)	(0.003)	(0.005)
Log of total population	-0.007	-0.072	0.000	-0.046
	(0.018)	(0.059)	(0.025)	(0.057)
Log of physician per 1,000	0.028	0.085	0.031	0.084
	(0.036)	(0.131)	(0.049)	(0.093)
Log of physician per 1,000 squared	-0.007	-0.053*	-0.010	-0.031
	(0.008)	(0.029)	(0.012)	(0.020)
Fertility rate	0.126	0.128	0.172	0.283***
	(0.078)	(0.093)	(0.122)	(0.103)
Control of Corruption		-0.057	0.010	
		(0.230)	(0.086)	
Governanceeffectiveness	0.052			-0.082
	(0.120)			(0.205)
Time fixed effect	No	Yes	No	Yes
Constant	-0.041	15.159***	-0.439	10.055***
	(0.981)	(3.238)	(1.175)	(2.854)
Arellano-Bond test for AR(2) P-value	0.780	0.261	0.914	0.980
Hansen OID test P-value	0.498	0.888	0.699	0.257
Observations	230	225	230	225
Number of countries	96	94	96	94
Number of instruments	28	27	28	28
F-test of the stability of coefficients		63.21		58.73

Note:Standard errors in parentheses. * p< 0.1, ** p< 0.05, *** p< 0.01

Since child mortality refers to the death of child of less than five years of age, our measure is less restrictive. Besides, our results contrast with those of Williamson (2008), who does not find any significant effect of health aid. In fact, they used a different sample and a different period of estimation. They used a sample of 208 countries including those with zero value of aid, over the period 1973-2004. Moreover, they use an instrumental variable approach with two and third period lagged health aid as instrument. However, controls such as the GDP per capita are not instrumented. In the same line, using several health aid measures including child mortality, Wilson (2011) does not find any effect of health aid. One of the key features of this paper is the use of various methods leading to drastically different results. Moreover, the study covers the period 1975-2005. Overall, the difference between our results and the ones found in the literature is due mainly to the difference in the sample size and in the methodologies used.

Based on the fact that much funds have been spent in the health sector after MDGs declaration in 2000, we run a regression on the sub-period 2000-2011. The results are reported in Table 3.

Table 3: Health aid and child mortality, two steps GMM dynamic panel data estimator, 2000-2010

Dependent Variable: Log(Child mortality)	(1)	(2)	(3)	(4)
Log of Child mortality, t-1	0.012	0.032	0.039	0.040
	(0.043)	(0.034)	(0.040)	(0.039)
Log of health aid per capita	-0.013**	-0.010*	-0.007**	-0.010**
	(0.006)	(0.005)	(0.003)	(0.004)
Log of health expenditure per capita	-0.001		-0.019	
	(0.025)		(0.022)	
Log of GDP per capita		0.042		0.042
		(0.062)		(0.052)
Primary completion rate (female)	-0.002*	-0.000	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Log of total population	-0.013***	-0.017***	-0.020**	-0.010
	(0.005)	(0.006)	(0.008)	(0.006)
Log of physician per 1,000	-0.009	-0.022	-0.022	-0.010
	(0.012)	(0.018)	(0.016)	(0.015)
Log of physician per 1,000 squared	-0.007**	-0.005	-0.006*	-0.005
	(0.003)	(0.004)	(0.003)	(0.004)
Fertility rate	0.061**	0.026	0.010	0.054**
	(0.028)	(0.026)	(0.046)	(0.023)
Control of Corruption		-0.056	-0.063	
		(0.043)	(0.043)	
Governance effectiveness	-0.007			0.008
	(0.054)			(0.044)
Intercept	-0.231	-0.293	0.172	-0.517
	(0.222)	(0.446)	(0.352)	(0.437)
Time fixed effect	Yes	Yes	Yes	Yes
Arellano-Bond test for AR(2) P-value	0.463	0.332	0.360	0.359
Hansen OID test P-value	0.658	0.469	0.212	0.396
Observations	180	175	180	175
Number of countries	94	92	94	92
Number of instruments	25	26	27	27

Note: Standard errors in parentheses. * $p< 0.1$, ** $p< 0.05$, *** $p< 0.01$.

Whatever the specification, the results suggest a negative and significant effect of health aid on child mortality. On average, a 1% increase in health aid leads to 1% decrease of child mortality. However, this effect remains too small to meet the MDGs.

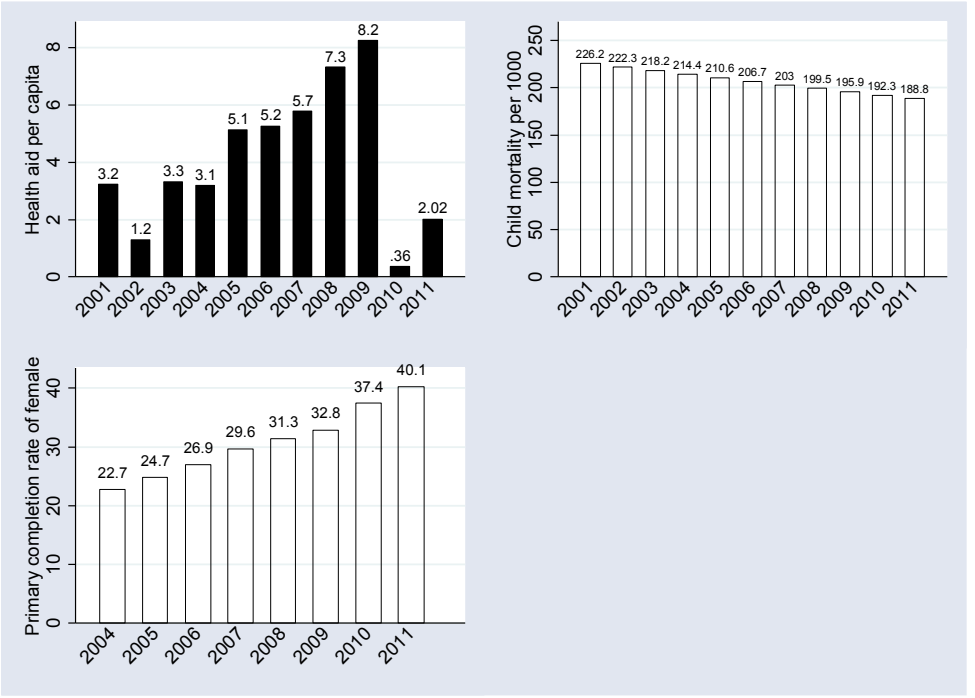
In order to have a better understanding of what is behind this global picture of developing countries, we took a closer look at the data of two countries, Mali and Niger, which are among the poorest countries around the world. These countries exhibit poor health indicators, including high level of child mortality, and are to some extend comparable with respect to the amount of aid received as a percentage of GDP, the size of the population and land area. Over the period of the study, Mali has a child mortality rate of 184 per 10,000 whereas the reported rate of child mortality in Niger is 194 per 10,000. In both cases, this rate is more than twice the average of the developing countries.

In terms of health aid, Mali receives 0.33% of the GDP while Niger receives 0.27% of the GDP. However, in per capita terms, Mali receives 0.42 USD against 0.80 USD for Mali. It is worth mentioning that this difference is in part due to the difference in terms of the size of the population (15 million in Mali and 17 million in Niger).

Figures 3 and 4 present the respective trends of health aid per capita, child mortality and female education over the period 2001-2011. Figure 3 presents these statistics for Mali while Figure 4 reports the statistics for Niger. Each figure has three panels. The first reports the evolution of health aid. The second is about child mortality, whereas the third displays the change in female education over time.

Panel1 of Figure 3 shows a steady increase in health aid allocated to Mali over the period 2001-2009, followed by a drop in 2010 and 2011, mainly due to the financial crisis which has affected developed countries starting from the third quarter of 2007. Panel 2 shows a sharp but continuous decrease in child mortality over the same period. Specifically, health aid increased, on average, by 19.53% per year while child mortality decreased, on average, by 1.67%. This corresponds to three less deaths per 10,000 per year. This result suggests that much money has been spent for few results. The third panel of Figure 3 shows that the primary completion rate (female) has almost doubled in ten years.[5]

Figure 3: Health aid, child mortality and female education in Mali, 2001-2011



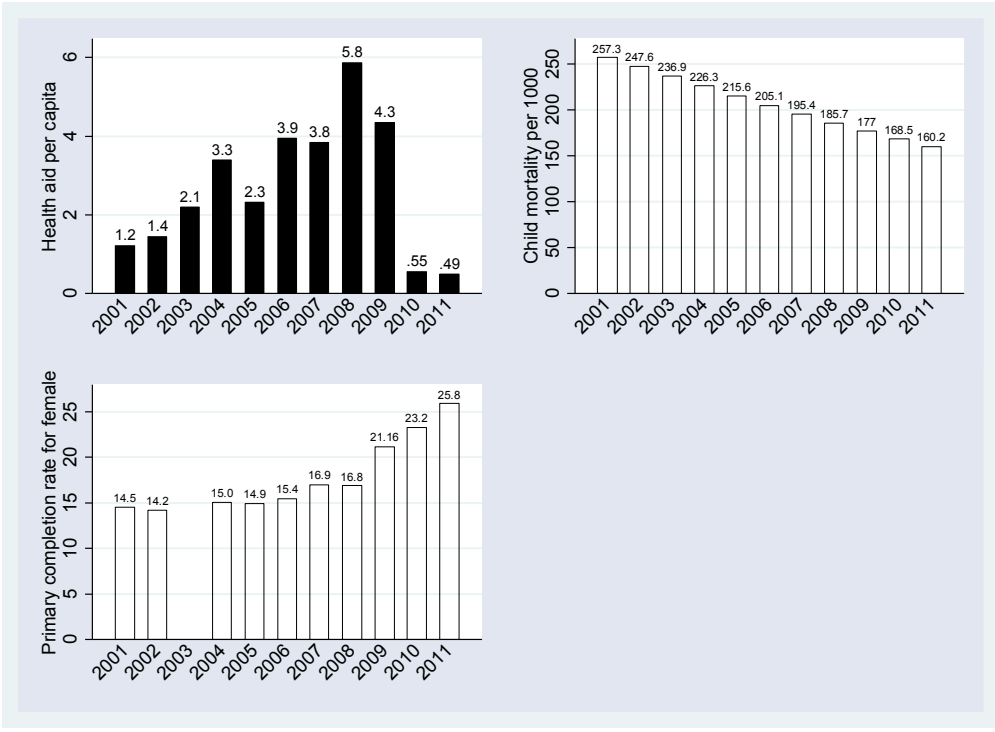
Source: Author's calculations

Panel 1 of Figure 4 shows a positive trend of health aid as from 2001 to 2008 despite some drop, respectively, in 2005 and 2007. Likewise, panel 2 reports a continuous decline of child mortality in Niger. In raw terms, health aid increased by 42.59% per year while child mortality decreased by 3.09%. This corresponds to five less deaths per year. Female education follows the same pattern in Niger as in Mali with a steady increase over time.

Bringing together the figures of Mali and Niger, we notice that the first one received more aid both per capita and in percentage of GDP, but performs less in reducing child mortality compared to the latter. Likewise, the amount of health aid seems to matter less than the change over time. For example, Niger received less in value, but witnessed the strongest annual variation over the time under study. Thus, the growth rate of health aid

over the period under study represents more than two times the one observed in Mali.

Figure 4: Health aid, child mortality and female education in Niger, 2001-2011



Source: Author's calculations

5. Health aid and child mortality: Exploring possible channels of causality

This section explores some possible mediators of the relationship between health aid and child mortality in developing countries. Although there are some studies assessing the transmission mechanism of the overall official development assistance, we are not aware of papers addressing this issue in the specific case of health aid. Then we build on the literature of development assistance, especially we follow Gomanee et al (2005), Levine et al (2004), Schmidt (2009) and test five potential channels: female education measured by the primary completion rate for female, health spending, governance, respectively, measured by the control of corruption, governance effectiveness and governance accountability. We expect that the increase of health aid may be used to fund women-specific education programmes, notably for pregnant women. This can help women adopt appropriate attitudes to manage the newborn baby in such a manner as to lower the risk of death before five years of age. In the same vein, health aid may lead to the increase of health spending which in turn is used to fund health infrastructure and programmes. Finally, health aid may also be used to finance government programmes devoted to improve governance in hospitals and medical centres.

In order to test the channels highlighted above, we resort to causal mediation analysis following Hicks and Tingley (2011). This approach uses an SUR framework in order to obtain a causal inference. This framework encompasses the standard mediation analysis based on a single mediator with strong exogenous assumptions. The following model is estimated:

$$M_{it} = \alpha_0 + \beta_0 Haid_{it} + X'_{it}\delta_0 + \varepsilon_{0it} \quad (2)$$

$$Child_{it} = \alpha_1 + \beta_1 Haid_{it} + \gamma M_{it} + X'_{it}\delta_1 + \varepsilon_{1it} \quad (3)$$

Where *M* represents the variable that mediates the effect of health aid on child mortality.

In this model, standard errors are corrected using the bootstrap procedure. The results are presented in Table 4.

Table 4: Indirect effect of health aid on child mortality

	(1)	(2)	(3)	(4)	(5)
Transmission channel	Primary completion rate (female)	Health spending	Governance effectiveness	Control of corruption	Voice and accountability
Total effect	-0.00936	0.0596**	-0.00672	-0.00672	-0.00229
	(0.0207)	(0.0258)	(0.0221)	(0.0227)	(0.0215)
Direct effect	-0.000998	0.0492**	0.00646	-0.000998	0.0172
	(0.0196)	(0.0236)	(0.0210)	(0.0225)	(0.0225)
Indirect effect	-0.00836*	0.0105	-0.0132**	-0.00572	-0.0195***
	(0.00472)	(0.00815)	(0.00611)	(0.00476)	(0.00701)
Number of bootstrap replications	250	250	250	250	250
Observations	274	278	278	278	278

Source : Author's

Table 4 suggests that only three channels among the five tested are valid in the sense of mediation analysis. These are primary completion rate (female), governance effectiveness as well as voice and accountability.

According to Hicks and Tingley (2011), under the assumption of sequential ignorability, and if the linearity assumption holds, the mediation effect can be interpreted as causal. However, in some cases, this assumption may not hold. In order to test the robustness of the results obtained within the SUR framework, for each channel, we run a GMM estimate of the effect of the treatment variable (health aid) on the mediator and further an estimate of the effect of the mediator on the outcome. The results are reported in Table 5. The first three columns show the effect of the treatment variable on the mediator, while columns (4) and (5) present the estimates of the effect of the mediator on the outcome. The first three columns show that there is a positive and significant effect of health aid on each of the mediators. The two remaining columns report a negative and significant effect of governance and female education on child mortality. However, there is no significant effect of health expenditures. Overall, the results confirm the previous findings obtained using the SUR framework.

Table 5: Indirect effect of health aid on child mortality, two steps GMM estimates

	First stepequations			Main equation	
	pcrfem	GE_EST	lhepc2005	lchildmort	lchildmort
Log of Child mortality, t-1				0.141**	0.933***
				(0.060)	(0.141)
Primary completion rate, female, t-1	0.175**				
	(0.080)				
Governance effectiveness, t-1		0.988***			

		(0.243)			
Primary completion rate (female)		-0.009	-0.007	-0.006*	0.001
		(0.007)	(0.007)	(0.004)	(0.003)
Log of health expenditure per capita					-0.066
					(0.112)
Governance effectiveness	-7.371		-0.311*	-0.431***	0.030
	(9.675)		(0.182)	(0.152)	(0.088)
Log of health aid per capita	1.887*	0.036*	0.063***		
	(0.962)	**(0.020)**	**(0.022)**		
Log of GDP per capita	10.640	0.512	1.631***	-0.369***	
	(7.846)	(0.366)	(0.342)	(0.140)	
Log of total population	0.174	0.034	0.041	0.001	-0.001
	(1.210)	(0.030)	(0.047)	(0.038)	(0.016)
Log of physician per 1,000	0.678	0.010	-0.150	0.070	0.033
	(3.432)	(0.075)	(0.211)	(0.053)	(0.033)
Log of physician per 1,000 squared	0.743	0.039	0.053		
	(0.793)	(0.024)	(0.043)		
Fertility rate	-14.552***	0.003	-0.292***	0.167*	0.087*
	(4.273)	(0.073)	(0.106)	(0.087)	(0.052)
Intercept	21.174	-4.088	-7.607**	6.049***	0.151
	(86.761)	(2.786)	(2.954)	(1.504)	(1.066)
Observations	229	220	225	274	230
Number of countries	86	93	94	94	96
number of instruments	24	19	26	19	22
Arellano-Bond test for AR(2) P-value	0.692	0.736	0.784	0.705	0.499
Hansen OID test P-value	0.220	0.392	0.662	0.544	0.270

Note: Standard errors in parentheses. * $p< 0.1$, ** $p< 0.05$, *** $p< 0.01$. **pcrfem**: primary completion rate for female; **GE_EST**: governance effectiveness; lhepc2005: log of health spending; **lchildmort**: log of child mortality.

6. Conclusion

Despite the long-standing debate on the effectiveness of foreign aid, there has been little evidence on the long-term effect of health aid. This paper adds to the existing literature by investigating the relationship between health aid and child mortality using a sample of 94 developing countries over the period 1990-2011.

The evidence suggests that, on average, countries that witness an increase in the amount of health aid experience a more rapid decrease of child mortality. More specifically, a 1% increase in health aid per capita leads to a 0.04% decrease in child mortality over five years. In other words, every five years, a 1% additional increase in health aid saves the lives of four children. Furthermore, the current study has been able to identify valid channels through which health aid affects child mortality. These are female education and governance. Given the fact that health aid reduces child mortality in developing countries, one policy recommendation could be to encourage external funding from donor agencies and international organizations, and the policymakers receiving these aids must manage them accordingly and be held accountable. Furthermore, health aid should be oriented towards sub-sectors that are relevant to achieve MDGs.

To sum up, this paper has demonstrated that health aid matters in developing countries. However, as suggested by the graphical evidence, the pattern of the relationship between health aid and child mortality may vary with regions. Unfortunately, we were not able to run separate regression for each region. In this regard, a potential avenue of future research may be to check the robustness of the results when some major regions are excluded from the sample or when additional controls are included in the model.

Notes

1. The fourth goal is to reduce child mortality by two-thirds over its 1990 level; the fifth goal is to reduce maternal mortality by two-thirds over its 1990 level.
2. The description of the dataset used in this section will be presented later in the section devoted to the estimation strategy.
3. This paper uses the two-step system-GMM estimator.
4. Note that governance is instrumented using one lag in both cases.
5. This figure is an illustration of the trend over time of one of the channels through which health aid may affect child mortality. We come back to this issue later in the paper.

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