The Effect of Private and Public Health Expenditure on Infant Mortality Rates: Does the Level of Development Matter?

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Abstract

Does health expenditure reduce infant mortality rates (IMRs)? To answer such important question we, first, disaggregate health expenditure into private and public health expenditures and, second, classify countries into two groups according to their level of development. Our results, based on different panel data techniques and relatively large sample countries, indicate that to assess the impact of health expenditure it is important to separate the individual effects of public and private health expenditures on IMRs. They also reveal that these individual effects depend on the level of the development of the country. Indeed, we find that at low stages of development public health expenditure is more effective in reducing IMRs; whilst at higher levels of development private health expenditure takes the lead in reducing IMRs. Our results also show that IMRs tend to be lower in countries with good governance, whereas they tend to be higher in countries located inside the tropics.

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Introduction:

Economic development is no longer confined to a process of persistent increase in per capita income. Other dimensions are now considered central aspects of this process; the most notable of them are improvements in health and education. Undoubtedly, the health of children and young people are among the most important health issues. In this regard, IMRs are widely used as credible measure of child health[1]. Available data on these rates shows dramatic decline over the last century in all developed countries. The same trend has been also noticed in the developing countries since the World War II, though the picture of the latter group of countries is less bright than that of the former one[2, 3].

Several socio-economic factors are considered responsible for the observed decline in IMRs. The most commonly sighted in the literature are per capita income, expenditure on health, the level of education mainly for females and the state (cleanliness) of the environment. Beenstock and Sturdy (1990) studied the determinants of infant and child mortality rates across several Indian states and found important role for female literacy. Caldwell (1986) demonstrated that declining IMRs depends on achieving several conditions almost all of them are about improving the health status and education level of the population. Female education and different health measures (e.g., vaccination coverage and number of nurses to total population) are shown by Hojman (1996) to be very important determinants of infant and child mortality in several Central American and Caribbean countries during the 1990s. Alves and Belluzzo (2004) estimated static and panel data models using census data from Brazil for the period 1970-2000 to investigate the determinants of IMRs. The findings of their paper confirm that poor child health (in terms of mortality rates) in Brazil can be explained by the levels of education, sanitation and poverty. Moreover, the paper shows that education is the most important variable as for every additional year of schooling, average mortality rates declines by more than 7%.

Concerning the health expenditure, available evidence suggests that at low levels of development public expenditure on health has stronger effect on mortality rates compared with private expenditure while at high development levels the opposite is true. Gupta *et. al.* (2001) provide evidence from 70 countries that public spending on health is more important for the health of the poor in low-income countries than in

[1] There are several other indicators that are used to predict child health such as under-5 mortality rates, nutrition level, and baby weight at birth.

[2] Between the mid 1960s and late 1970s the decline in mortality rates in developing countries was slower than its trend, for more details see Hill and Pebley (1989).

[3] It is well established in the demographic literature that declining mortality rates is an important aspect of the process of demographic transition. Moreover, this aspect is widely viewed as an essential prerequisite for the decline in fertility rates and the key to the whole transition process (Kirk (1996) and Mason (1997)).

the high-income ones suggesting higher returns on health spending in the former countries compared with the latter group. The cross-country study of 22 developing countries by Anand and Ravallion (1993) documents that public spending on health significantly matters for life expectancy at birth. Hanmer *et. al.* (2003) test the robustness of the determinants of infant and child mortality for a set of developing countries. Their results show that in addition to the level of per capita income, health and education variables are robust determinants as well.

In this paper, we attempt to complement the existing literature on the determinants of infant mortality rates. The hypotheses to be examined in this study are (i) in empirical studies total expenditure on health is not the precise proxy to reflect the effects of health on IMRs (ii) at low levels of development "i.e. in developing countries" reducing IMRs would relatively be more effective by increasing public health expenditure (iii) at high levels of development "i.e. in developed countries" reducing IMRs would relatively be more effective by increasing private health expenditure .To achieve this, we first disaggregate health expenditure into its private and public components. Secondly, we attempt to investigate whether the effects of these components of total health expenditure are conditional on the level of the development of the countries in our sample. Using data from 160 countries over the 1990-2000 period and various panel data techniques the paper finds, overall, that the effect of private and public health expenditures on reducing infant mortality depends on the development level of the country.

The rest of the paper is structured as follows. In Section 2 we discuss the model specification and the methodology used for the estimation purpose. In Section 3 we present and discuss the estimation results. Section 4 concludes.

2. Model and Methodology

2.1 The model

In order to investigate the impact of private and public health expenditure on IMRs we specify the following baseline model:

$$y_{it} = \beta_{0i} + \beta_{1iPRIHEXit} + \beta_{2iPUBHEXit} + \gamma_p x_{pit} + e_{it} \quad (1)$$

where y_{it} represents the indicator of infant mortality, with the subscript *i* for countries (i=1, . . ., n) and *t* for years (t = 1990, . . ., 2000), $PRIHEX_{it}$ and $PUBHEX_{it}$ correspond to private and public expenditure on health, respectively, x_{pit} represents the set of *p* explanatory variables, and γ_p their associated slope coefficients.

The data used in this paper covers the period 1990-2000. The full sample consists of 160 countries. The dependent variable, as aforementioned, is infant mortality (per 1000 lives birth). The measures of our health expenditures are, respectively, private health expenditure and public health expenditure both expressed as a percentage of GDP. Given that we want to highlight the importance of the disaggregation of health expenditure, we also present results using data on total health expenditure. The

controlled variables are real income per capita, Female secondary enrolment, CO2 emissions (which captures the cleanliness of the environment), Female labour force, Good governance (proxied by the Freedomhouse Civil Liberties index)[4], the fraction of land area in geographic tropics (tropical). In order to capture proportional effects the natural log of the variables was used. Table 1 in Appendix A provides summary statistics of the raw data, whilst Table 2 definitions and sources of the variables used in this paper.

2.2 Methodology

We consider three different estimation methods to ensure robustness of our results across different estimation techniques. The first estimation consists of using ordinary least squares (OLS) with the pooled data. The drawback of the pooled OLS estimator is that it is likely to generate highly biased coefficients by ignoring both country specific effects and possible endogeneity of the right hand side variables. The second and third estimation method consist of, respectively, applying fixed effects (FE) and (GMM-SYS) estimations techniques to model (1). These two techniques can handle systematic tendency of individual specific components to be higher for some units than for others (individual effects) and possible higher in some time periods than others (time effects). Another advantage of these two techniques is that they adjust for heteroskedasticity. However, it is important to note that even though the FE estimator appears to be preferable to the pooled OLS estimator, it still requires some assumptions to be satisfied, such as the so-called *strict exogeneity* assumption. To cope with the potential endogeneity problem we use the instrumental variable approach based on the general moment method (GMM) estimator first proposed by Arellano and Bond (1991). Our preferred GMM technique is the system-GMM (SYS-GMM) which is superior to the standard GMM (see Blundell et al. 2000; Bond et al. 2001; and Hoeffler 2002). The validity of the instruments used in the estimation process can be tested using standard Hansen/Sargan tests of overidentifying restrictions. This test is asymptotically distributed as C^2 and tests the null hypothesis of validity of the (overidentifying) instruments. In addition to the Sargan test, it is also important to check for the absence of serial correlation in the error term, as consistency of the estimates depends on it. First-order, AR(1), and second-order, AR(2), serial correlation tests are used for this purpose. While first order serial correlation is expected by construction, failure to reject the null hypothesis of "absence of second order serial correlation" leads to the conclusion that the original error term is serially uncorrelated. The test statistics are asymptotically distributed as standard normal variables. It is also worth pointing out that for the OLS and FE estimation techniques we do not adopt a dynamic specification for various reasons. Firstly, the OLS estimates will generate inconsistent results in the presence of serial correlation in dynamic panels (Maddala

[4] The index ranges from 1 (good governance) to 7 (poor governance). However, for our purpose we constructed the index in the way that higher values imply good governance.

1997). Secondly, the FE model tends to generate biased estimates when applied to a dynamic panel, particularly in shorter time series.[5]

3. The results

The results are summarised in Table 1 through Table 6 in Appendix B. For the purpose of keeping the discussion tractable and more consistent, the analysis of the empirical results would proceed first by discussing the results for the aggregate health expenditure variable then move to the disaggregated model. In each case the results from the whole sample, low income group and high income group would be considered. We will also discuss the effect of the other variables, in our model, on IMRs.

3.1 Results with Total Health Expenditure

Table 1 presents the results of the whole sample. Columns (1), (4) and (7) represent the baseline model using OLS, FE, and GMM-SYS, respectively. These results show that the effect of total health expenditure on infant mortality rate is only significant (with a negative sign) in the OLS regressions. In Columns (2), (5) and (8) we augment our basic model with our first group of control variables: Female secondary enrolment, CO2 emissions and Female labour force. Our results remain the same i.e. the effect of total health expenditure is only significant (with a negative sign) in the OLS regressions. In Columns (3), (6) and (9) we include some additional control variables (Good governance, geographical location in relation to the tropics). Again, our results do not change. In other words, the results in Table 1 suggest that, on balance, the impact of total health expenditure on IMRs is statistically insignificant.

In Table 2, we replicate the same regressions but this time for low income countries. Results related to the baseline model (see Columns (1), (4) and (6)) it can be seen that total health expenditure reduces IMRs in the OLS regression but not in the FE and GMM-SYS estimations. In Columns (2), (5), and (7) we added our first group of control variables; however, the results do not change. In the final specification (see Columns (3), (6) and (9)) it is also clear that the impact of total health expenditure is only significant in the OLS regression. Again, this seems to suggest that overall there is no strong evidence that total health expenditure reduces IMRs, in the context of low income countries.

[5] Monte Carlo studies based on mean square error criteria generally show that the fixed effect model is better suited as $T \rightarrow 30$ but that GMM estimators are preferable for T between 5 and 30 (see Judson and Owen 1999).

Table 3 summarises the results related to the high income country group. The finding that total health expenditure bears no significant effect on IMRs is even stronger in the case of the high income group. Starting with the baseline regressions, Columns (1), (4) and (6), it can be seen that only in the FE regression that the estimated coefficient of total health expenditure statistically significant, albeit at the 10 percent level. When we add our first group of control variable the estimated coefficient is statistically significant in the OLS regressions, albeit at the 10 percent level (Column 2) but not the FE (Column 5) and GMM-SYS (Column 7) regressions. In the final set of regressions where Good governance and Tropical are added as control variables, although the OLS results show a negative and significant effect of total health expenditure on IMRs, in the high income group, the FE and GMM-SYS results show this effect to be statistically insignificant.

In short, the above results appear to indicate that increases in total health expenditure do not necessarily translate into a reduction in IMRs. However, as we argued earlier, this finding might be misleading. Indeed, we argue that to disentangle the effect of health expenditure on IMRs it is important to look at private and public health expenditure separately. We went further to hypothesis that in low income countries we expect increases in public health expenditure to be associated with a decline in IMRs and in high income countries this role is taken up by private health expenditure. This is what the next sub-section is devoted to.

3.2 Results with Public and Private Health Expenditure

As before, we will start our analysis with the whole sample, followed by the low income group results and then the high income group results. Table 4 presents the results for the whole sample. The baseline results, Columns (1), (4), and (7), show that the estimated coefficient of public health expenditure is negative and statistically significant in all three (OLS, FE and GMM-SYS) regressions. With regard to private health expenditure its estimated coefficient is negative and significant in the FE and GMM-SYS regression results. In Columns (2), (5), and (8) we augment the basic specification with our first group of control variables (i.e. Female secondary enrolment, CO2 emissions and Female labour force). The results show that public expenditure on health is negatively correlated to IMRs. Indeed, the estimated coefficient is highly significant in statistical terms in all three regressions. Turning to private health expenditure, it is clear from the results that this variable is only significant throughout the FE results. After adding Good Governance and Tropical as additional control variables, our finding that increases in public health expenditure are associated with reductions in IMRs remain robust. However, as for private health expenditure, the results seem to suggest that it has not significant effect on IMRs, when the full sample is considered.

In Table 5 we present results of the sample constituted by the low income group. Starting with the baseline specification (see Columns (1), (4), and (7), it can be seen from Table 5 that public health expenditure has a negative and significant effect on IMRs in the context of low income countries. The estimated coefficient is highly significant irrespective of the estimation technique used. These results, however, show that private health expenditure does not exert a significant effect on IMRs in the context of low income countries. Even after adding our first group of control variables (see Columns (2), (5), and (8)) and second group of control variables (see Columns (3), (6), and (9)) the negative significant effect of public health expenditure on IMRs remain robust. However, private health expenditure appears to have no significant effect on IMRs, as far as the low income group is concerned.

Finally in Table 6 we report results of high income group. The results, based on the baseline line specification, suggest that in the case of high income countries private health expenditure has a negative significant effect on IMRs. Public health expenditure, however, appears to exert no significant impact on IMRs. The finding that private health expenditure plays an important role in reducing IMRs in high income countries and that public health expenditure has no significant effect on them is found to be consistent across all the specifications i.e. even after we added our first group of control variables (see Columns (2), (5), and (8)) and second group of control variables (see Columns (3), (6), and (9)).

3.3 results of the other variables

Although the main focus of the paper was to investigate the differential effects of public and private health expenditure on IMRs, it is also useful to discuss how the impact of the other variables in the model. Starting with real income per capita, we find that it is a robust determinant of IMRs. Indeed, the estimated coefficient of real income per capita is found to be significant in most of our regressions. This finding is consistent with most studies in this literature. Turning to female education, measured by Female secondary enrolment, the results suggest that, overall, this variable is negatively correlated to IMRs. Precisely, this variable is significant and negatively correlated with IMRs in the low income group; however, it has a positive impact in the group of high income countries. The variable CO_2, which captures the cleanliness of the environment, appears to bear a positive effect on IMRs, although this finding is not robust and is very sensitive to the choice of specification. Our results indicate that the variable Female labour force has a negative significant effect on IMRs, although in the context of the high income group this effect appears to be insignificant. The results in this paper also reveal two very interesting findings. Firstly, they reveal that IMRs tend to be lower in countries with good governance. Secondly, they suggest that IMRs are higher in countries inside the tropics.

4. Conclusion

This paper has attempted to examine the impact of health expenditure on IMRs. Using data for a relatively large sample of low income as well high income countries over the period 1990-2000 and a variety of panel data technique the findings in this paper challenges the results of a World Bank work (see Filmer and Pritchett, 1997) that argued that health spending has not significant effect on IMRs.

In short, our findings suggest that the extent to which public or private health expenditure affect IMRs dependent on the development level of the country. For the low income countries our findings has clearly important policy implications. Indeed, with the emphasis on meeting the Millennium Development Goals our findings suggest that scaling up aid, especially in the health sector, would help boost public spending on health and thus speed up the process to achieve health related targets set up by the international community.

Our results also revealed some interesting findings with respect to the other variables in our specifications. Consistent with most studies in the literature, our paper find strong negative relationship between per capita income and IMRs. Female education measured by secondary level enrolment ratios is significant and negatively correlated with IMRs in the low income group. However, and unexpectedly, it has positive impact on IMRs in the group of high income countries. We found no strong evidence that CO_2 emissions have an effect on IMRs. With respect to female labour force is significant in most of the regressions with the expected negative sign in the whole sample and the group of low income countries, but with a positive sign in the group of high income countries. Also, we found that good governance is important in reducing IMRs, whilst countries located in the tropical areas tend to have higher IMRs.

This study, Based on these results, recommends governments in the developing countries to (i) channel more financial resources of their budgets to health expenditure if they want to reduce IMRs, (ii) enhance female education especially at the secondary level as it is proven that female education is conductive to better infant and child health and lower IMRs, (iii) improve the efficiency of governance as better governance is influential in improving overall health levels this may be because better governance speeds and strengthens the implementation of government health policies.

APPENDICES

Appendix A

Table 1 Summary Statistics of the Raw Data

Variable	Mean	Std. Dev.	Min	Max
Infant Mortality rates	43.77699	38.41982	3.566667	192.6
Real GDP per capita	8185.207	8408.712	436.1662	44766.92
Total health Expenditure	5.409942	2.227264	1.124	13.032
Public Health expenditure	3.181737	1.93352	.33	9.494
Private Health expenditure	2.25	1.39821	.28	8.35
Female School Enrolment	60.60982	29.74484	3.574844	142.4252
CO2 emissions	5.248886	9.999212	-.765399	115.3082
Female Labour Force	37.40454	9.352392	9.7	50.9
Good Governance[a]	.8328263	.3105754	.5138984	1.442695
Tropical	.4542178	.4702743	0	1

[a]: higher values mean good governance.

Table 2 Variables Definition and Sources

Variable	Definition	Source
Imfant Mortality Rates	Number of infants dying before reaching one year of age, per 1,000 live births in a given year.	WDI 2003 & WDI 2007 (online version)
Real GDP Per Capita	Real GDP Per Capita	Penn World Tables
Total Health Expenditure	Covers the provision of health services (preventive and curative), family planning activities, nutrition activities, and emergency aid designated for health	WDI 2003 & WDI 2007 (online version)
Public Health Expenditure	Recurrent and capital spending from government (central and local) budgets, external borrowings and grants (including donations from international agencies and nongovernmental organizations), and social (or compulsory) health insurance funds.	WDI 2003 & WDI 2007 (online version)
Private Health Expenditure	Direct household (out-of-pocket) spending, private insurance, charitable donations, and direct service payments by private corporations.	WDI 2003 & WDI 2007 (online version)
Female Secondary Enrolment	Ratio of total enrollment, regardless of age, to the population of the age group that officially corresponds to secondary education	WDI 2003 & WDI 2007 (online version)
CO2 Emissions	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement	WDI 2003 & WDI 2007 (online version)
Female Labour Force	Female labor force as a percentage of the total labour	WDI 2003 & WDI 2007 (online version)
Good Governance	Freedonhouse civil liberties index.	Author's calculation using Freedomhouse civil liberty index (higher values mean good governance)
Tropical	Fraction of land area in geographic tropics	Gallup et al. 1999

Appendix B

Table 1 Results for the Whole Sample (using Total Health Expenditure)

	OLS			FE			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged Infant mortality							0.797***	0.740***	0.821***
							(0.034)	(0.053)	(0.054)
Real GDP per capita	-0.829***	-0.821***	-0.611***	-0.120***	-0.138***	-0.086*	-0.177***	-0.206***	-0.130***
	(0.014)	(0.022)	(0.049)	(0.024)	(0.036)	(0.044)	(0.035)	(0.059)	(0.047)
Total health expenditure	-0.298***	-0.261***	-0.345***	0.000613	-0.00395	-0.011	-0.0212	-0.0778	-0.0412
	(0.039)	(0.060)	(0.089)	(0.022)	(0.035)	(0.037)	(0.048)	(0.065)	(0.060)
Female secondary enrolment		-0.151***	-0.178***		-0.00398	0.043		-0.0229	0.0155
		(0.035)	(0.045)		(0.015)	(0.028)		(0.051)	(0.034)
CO2 emissions		0.0248*	0.0348*		-0.0146**	0.0001		0.00812	0.0250
		(0.013)	(0.018)		(0.0057)	(0.036)		(0.020)	(0.018)
Female labour force			-0.391***			-0.660***			-0.187*
			(0.12)			(0.18)			(0.100)
Good governance			-0.489***			0.014			-0.0574
			(0.100)			(0.029)			(0.076)
Tropical			0.152*						
			(0.080)						
Constant	10.47***	10.94***	11.32***	4.180***	4.354***	6.272***	2.102***	2.704***	2.344***
	(0.088)	(0.18)	(0.71)	(0.20)	(0.31)	(0.82)	(0.39)	(0.66)	(0.72)
Observations	*1127*	*508*	*181*	*1127*	*508*	*181*	*1126*	*508*	*194*
R-squared	*0.84*	*0.84*	*0.84*	*0.61*	*0.65*				
AR(1) p-value							*0.000*	*0.000*	*0.002*
AR(2) p-value							*0.864*	*0.279*	*0.530*
Hansen/Sargan test p-value							*0.442*	*0.299*	*0.660*

Notes: Robust standard errors in parentheses; ***, ** , * represent statistical significance at the 1, 5, and 10 percent, respectively.

Table 2 Results for the Low Income Countries Sample (using Total Health Expenditure)

	OLS			FE			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged Infant mortality							0.896***	0.731***	0.841***
							(0.027)	(0.060)	(0.0073)
Real GDP per capita	-0.765***	-0.779***	-0.535***	-0.159***	-0.135***	-0.158**	-0.0833***	-0.198***	-0.107***
	(0.017)	(0.023)	(0.045)	(0.026)	(0.039)	(0.066)	(0.025)	(0.053)	(0.0060)
Total health expenditure	-0.255***	-0.228***	-0.258***	-0.0224	-0.00848	-0.0546	0.0411	0.0101	-0.00903
	(0.039)	(0.055)	(0.071)	(0.020)	(0.038)	(0.071)	(0.031)	(0.080)	(0.012)
Female secondary enrolment		-0.202***	-0.136***		-0.0175	-0.0952***		-0.0776	0.0116***
		(0.036)	(0.044)		(0.015)	(0.029)		(0.055)	(0.0018)
CO2 emissions		0.0349***	0.0188		-0.0147**	-0.0191		0.0235	0.0151***
		(0.013)	(0.017)		(0.0069)	(0.016)		(0.022)	(0.0024)
Female labour force			-0.158			-1.813***			-0.143***
			(0.13)			(0.36)			(0.018)
Good governance			-0.674***			0.0950			-0.110***
			(0.096)			(0.063)			(0.0089)
Tropical			0.220***			0			
			(0.060)			(0)			
Constant	9.958***	10.79***	9.763***	4.926***	4.723***	11.66***	0.933***	2.760***	1.948***
	(0.12)	(0.20)	(0.77)	(0.20)	(0.31)	(1.06)	(0.28)	(0.71)	(0.082)
Observations	*828*	*389*	*144*	*828*	*389*	*144*	*827*	*389*	*154*
R-squared	*0.71*	*0.78*	*0.86*	*0.55*	*0.58*	*0.54*			
AR(1) p-value							*0.000*	*0.002*	*0.007*
AR(2) p-value							*0.737*	*0.578*	*0.824*
Hansen/Sargan test p-value							0.422	0.531	0.437

Notes: Robust standard errors in parentheses; ***, ** , * represent statistical significance at the 1, 5, and 10 percent, respectively.

Table 3 Results for the High Income Countries Sample (using Total Health Expenditure)

	OLS			FE			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged Infant mortality							0.850***	0.826***	0.959***
							(0.050)	(0.046)	(0.031)
Real GDP per capita	-0.638***	-0.700***	-0.379*	-0.592***	-0.259***	-0.430***	-0.0943*	-0.158*	-0.0265
	(0.14)	(0.10)	(0.18)	(0.19)	(0.095)	(0.13)	(0.050)	(0.088)	(0.028)
Total health expenditure									
	-0.421	-0.301*	-0.569***	-0.202*	-0.0373	0.0134	-0.0867	-0.131	-0.0769
	(0.27)	(0.17)	(0.18)	(0.11)	(0.054)	(0.063)	(0.052)	(0.099)	(0.060)
Female secondary		0.0615	-0.196		0.0203	0.137		0.0343	0.0868***
enrolment									
		(0.11)	(0.14)		(0.026)	(0.092)		(0.041)	(0.027)
CO2 emissions		-0.0117	0.119**		-0.00395	-0.0266		-0.00239	-
									0.0180***
		(0.039)	(0.054)		(0.0091)	(0.034)		(0.015)	(0.0057)
Female labour force			2.627*			-5.272			-0.0316
			(1.38)			(5.46)			(0.053)
Good governance			-0.486			-			0.0588
						0.301**			
			(0.30)			(0.11)			(0.037)
Tropical			-0.214						
			(0.26)						
Constant	8.818***	8.944***	-1.433	7.970***	4.660***	26.36	1.307**	1.904**	0.127
	(1.00)	(0.97)	(5.91)	(1.85)	(0.94)	(21.7)	(0.55)	(0.87)	(0.48)
Observations	*299*	*119*	*37*	*299*	*119*	*37*	*299*	*119*	*40*
R-squared	*0.58*	*0.55*	*0.87*	*0.14*	*0.90*	*0.93*			
AR(1) p-value							*0.000*	*0.002*	*0.077*
AR(2) p-value							*0.964*	*0.100*	*0.138*
Hansen/Sargan test p-value							*0.306*	*0.302*	*0.215*

Notes: Robust standard errors in parentheses; ***, ** , * represent statistical significance at the 1, 5, and 10 percent, respectively.

Table 4 Results for the Whole Sample

	OLS			FE			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	9)
Lagged Infant mortality							0.388***	0.637***	0.592***
							(0.054)	(0.080)	(0.069)
Real GDP per capita	-0.783***	-0.803***	-0.578***	-0.280***	-0.321***	-0.101**	-0.243***	-0.283***	-0.260***
	(0.015)	(0.023)	(0.049)	(0.033)	(0.048)	(0.049)	(0.081)	(0.093)	(0.053)
Private health expenditure				-0.187***		-0.170***			
	0.0140	0.0331	-0.122*		-0.188***		-0.267**	-0.0261	-0.0524
	(0.022)	(0.036)	(0.067)	(0.024)	(0.034)	(0.049)	(0.12)	(0.082)	(0.046)
Public health expenditure	-0.281***	-0.230***	-0.213***	-0.114***	-0.140***	-0.205***	-0.269**	-0.292***	-0.102*
	(0.027)	(0.036)	(0.054)	(0.033)	(0.042)	(0.071)	(0.13)	(0.086)	(0.051)
Female secondary enrolment		-0.104***	-0.143***		-0.0734***	-0.0220		-0.00985	-0.0833***
		(0.034)	(0.047)		(0.022)	(0.031)		(0.061)	(0.031)
CO2 emissions		0.0212*	0.0468**		-0.00227	-0.0141		0.0131	0.0301**
		(0.013)	(0.019)		(0.0088)	(0.014)		(0.023)	(0.015)
Female labour force			-0.396***			-2.362***			-0.186*
			(0.13)			(0.41)			(0.10)
Good governance			-0.475***			-0.131***			-0.212***
			(0.095)			(0.037)			(0.057)
Tropical			0.245***						
			(0.077)						
Constant	9.901***	10.40***	10.60***	5.835***	6.482***	12.97***		3.791***	4.755***
	(0.11)	(0.20)	(0.82)	(0.27)	(0.38)	(1.24)		(0.96)	(0.93)
Observations	*1317*	*582*	*218*	*1317*	*582*	*233*	*1170*	*582*	*227*
R-squared	*0.83*	*0.84*	*0.84*	*0.18*	*0.23*	*0.51*			
AR(1) p-value							*0.000*	*0.001*	*0.008*
AR(2) p-value							*0.408*	*0.407*	*0.569*
Hansen/Sargan test p-value							*0.694*	*0.523*	*0.100*

Notes: Robust standard errors in parentheses; ***, ** , * represent statistical significance at the 1, 5, and 10 percent, respectively.

Table 5 Results for Low Income Countries

	OLS			FE			GMM-SYS		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged dependent variable							0.363***	0.716***	0.659***
							(0.063)	(0.071)	(0.048)
Real GDP per capita	-0.710***	-0.726***	-0.517***	-0.101***	-0.110***	-0.0504*	-0.144**	-0.168***	-0.215***
	(0.016)	(0.022)	(0.042)	(0.020)	(0.030)	(0.027)	(0.067)	(0.060)	(0.036)
Private health expenditure	0.0103	0.0263	-0.101	-0.0343*	0.0138	-0.0292	-0.265*	0.000970	-0.0532
	(0.027)	(0.038)	(0.067)	(0.018)	(0.031)	(0.046)	(0.14)	(0.055)	(0.033)
Public health expenditure	-0.249***	-0.284***	-0.112**	-0.0457***	-0.0215	-0.0489**	-0.278**	-0.200***	-0.0752**
	(0.028)	(0.035)	(0.043)	(0.017)	(0.031)	(0.025)	(0.11)	(0.057)	(0.030)
Female secondary enrolment		-0.183***	-0.102**		-0.0130	0.0174		-0.0379	-0.0629**
		(0.032)	(0.042)		(0.015)	(0.023)		(0.039)	(0.024)
CO2 emissions		0.0459***	0.0164		-0.0130**	-0.00790		0.0220	0.00855
		(0.011)	(0.017)		(0.0059)	(0.0074)		(0.016)	(0.011)
Female labour force			-0.0442			-1.090**			-0.0348
			(0.12)			(0.50)			(0.063)
Good governance			-0.762***			0.0447			-0.185***
			(0.092)			(0.036)			(0.041)
Tropical			0.241***						
			(0.053)						
Constant	9.363***	10.18***	9.000***	4.549***	4.497***	7.944***		2.621***	3.523***
	(0.12)	(0.19)	(0.74)	(0.15)	(0.25)	(1.62)		(0.74)	(0.54)
Observations	*990*	*449*	*171*	*990*	*449*	*182*	*881*	*449*	*176*
R-squared	*0.70*	*0.79*	*0.89*	*0.53*	*0.60*	*0.87*			
AR(1) p-value							*0.000*	*0.000*	*0.009*
AR(2) p-value							*0.898*	*0.563*	*0.774*
Hansen/Sargan test p-value							*0.999*	*0.584*	*0.500*

Notes: Robust standard errors in parentheses; ***, ** , * represent statistical significance at the 1, 5, and 10 percent, respectively

Table 6 Results for High Income Countries

	OLS				FE			GMM-SYS	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lagged dependent variable							0.657***	0.506***	0.474***
							(0.082)	(0.072)	(0.14)
Real GDP per capita	-0.658***	-0.751***	-0.375	-0.573***	-0.766***	0.0280	-0.172	-0.168	0.113
	(0.044)	(0.070)	(0.22)	(0.10)	(0.15)	(0.17)	(0.10)	(0.13)	(0.17)
Private health expenditure	-0.0656*	-0.0235	-0.307*	-0.284***	-0.478***	-0.235**	-0.203**	-0.187**	-0.187**
	(0.038)	(0.073)	(0.16)	(0.040)	(0.094)	(0.099)	(0.077)	(0.074)	(0.088)
Public health expenditure	-0.301***	-0.0244	-0.162	-0.119	0.0310	-0.285	-0.143	-0.188	-0.271
	(0.044)	(0.072)	(0.24)	(0.22)	(0.24)	(0.25)	(0.085)	(0.16)	(0.23)
Female secondary enrolment		0.134	-0.196		-0.00183	0.450***		0.0629	0.517***
		(0.083)	(0.13)		(0.070)	(0.14)		(0.058)	(0.16)
CO2 emissions		-0.0407	0.107*		-0.0305	-0.0657*		-0.00962	0.0509
		(0.029)	(0.061)		(0.026)	(0.035)		(0.018)	(0.050)
Female labour force			2.621**			-1.713			0.753
			(1.14)			(1.19)			(1.35)
Good governance			-0.511*			0.151			1.362
			(0.26)			(0.32)			(1.13)
Tropical			-0.133						
			(0.24)						
Constant	8.682***	8.596***	-2.053	7.737***	9.460***	7.380	2.602**		
	(0.38)	(0.61)	(5.27)	(1.05)	(1.56)	(4.49)	(1.13)		
Observations	*327*	*133*	*47*	*327*	*133*	*51*	*327*	*90*	*33*
R-squared	*0.60*	*0.59*	*0.84*	*0.25*	*0.38*	*0.44*			
AR(1) p-value							*0.001*	*0.004*	*0.089*
AR(2) p-value							*0.199*	*0.719*	*0.250*
Hansen/Sargan test p-value							*0.931*	*0.100*	*0.376*

Notes: Robust standard errors in parentheses; ***, ** , * represent statistical significance at the 1, 5, and 10 percent, respectively.

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