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Public Health Expenditure and Child Mortality: Does Institutional Quality Matter?

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Abstract
The main objective of this paper is to test the impact of public health spending on infant health taking into account the role that institutional quality can play. We use a two-step system dynamic GMM method for 93 developed and developing countries over the1995–2015 period. Our main findings show that there is a clear positive and significant effect of health expenditure on infant mortality only for high-income countries, whereas for lower, lower-middle, and upper-middle-income ones, health spending does not have a significant impact on infant health status. Our findings show also that there is a certain threshold level that these groups must achieve to make government health spending (% GDP) positively affect infant mortality rates. This level is estimated at about 7%. Finally, estimations demonstrate also that institutional quality plays an important and significant role in mediating the relationship between health spending and IMR's.

Keywords Health expenditure · Infant mortality · Institutional quality

JEL Classification H51 · I12 · O43

Introduction

Infant mortality is an important indicator of a nation's health because it is associated with a variety of factors such as maternal health, quality and access to medical care, socioeconomic conditions, and public health practices. Today, the fight against this scourge is considered one of the key policy objectives. International organizations such as UNICEF whose goal is to reduce by two thirds the rate of infant mortality, from 93 of every 1000 children dying before the age of five in 1990 to 31 per 1000 in 2015, the

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World Bank and the World Health Organization (WHO) have incorporated the objective of infant mortality in most of their development assistance programs. WHO statistics show that more than 29,000 children under five die each day, mostly from causes that could have been avoided. These deaths occur mostly in developing countries. For example, an Ethiopian child is 30 times more likely to die before his fifth birthday than a child in Western Europe. Research and experience show that from nearly 11 million children who die each year, six million could be saved by simple measures (World Development Indicators 2017). For that reason, reducing the burden of mortality and morbidity that affect poor people is widely regarded as one of the foremost challenges. Indeed, health economics is crucial because of the attention paid by the international community to this great challenge.

Furthermore, researchers argue that infant mortality evolution is closely related to health and social conditions of the country. Besides, health in childhood is one of the most important factors in predicting health and productivity. That is why its level is an important indicator of socioeconomic development. This sparked a research interest among many researchers who have examined the underlying factors of the high mortality of children in the world such as residence environment, economic region, the level of parental education, and especially the priority given to health care expenditure policies because it has been shown that countries which experienced high rates of health care expenditures are those that have managed to reduce their mortality rates (see Fig. 1 below).

It is within this framework that our research is conducted. It goes beyond the traditional framework that seeks to test the direct effect of health spending on infant death only and attempts to test the role that institutional quality can play in mediating such a relationship. The analyses will be conducted by examining such linkage making a comparison between low, low-middle, upper-middle, and high-income countries. To do so, the paper utilizes aggregate annual panel data from the National Health Organization and World Development on health care expenditures and child mortality on a sample of 93 developed and developing countries from 1995 to 2015 in order to

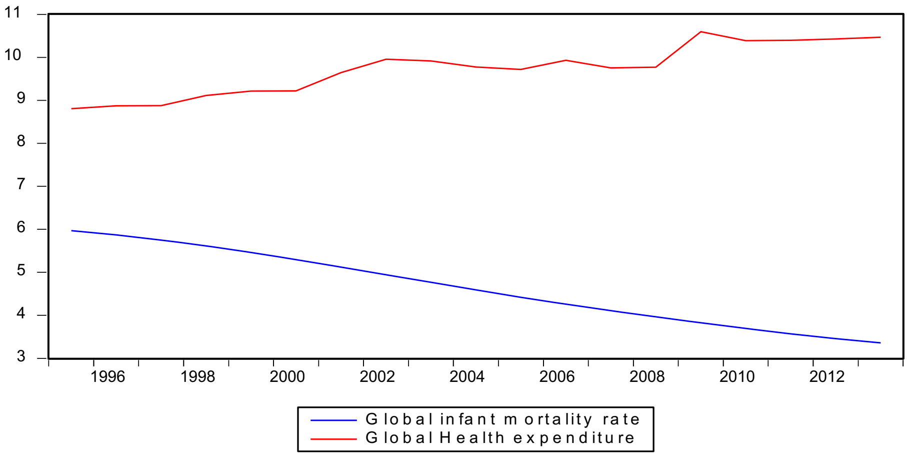

Fig. 1 Trends of global health care expenditure and global infant mortality rates. Source: figure made by the author based on the data provided by WHO.

estimate a model that captures the relationship between health spending and child mortality.

A substantial literature has tried in recent years to determine the relationship that can exist between health spending and infant mortality. Some studies have shown that health expenditure has no impact on production health care. For others, the impact is limited and a third category of studies showed that there is an impact only on specific interventions. Musgrove (1996) shows that health spending has no impact on infant mortality. Similarly, Filmer and Pritchett (1997), based on an empirical investigation, provided evidence to the fact that public spending on health is not a factor in the reduction of infant mortality. These authors believe that these variables such as income, income inequality, women education, and the degree of ethnolinguistic fragmentation explain almost all variations in child mortality in a country.

However, some studies have shown a positive relationship between health expenditure and production of health care (Gupta and Baghel 1999; Baldacci et al. 2004; Berger and Messer 2002). Others, conversely, proved the opposite (Filmer and Pritchett 1999; Thornton and DeSalle 2002). Others such as Baldacci (2003), found that the results depended on types of data and the used estimation methods. A final category showed that contribution of health spending on the population's health status as measured by infant mortality and maternal mortality is even less statistically significant (Filmer et al. 1998; Filmer and Pritchett 1997; Musgrove 1996). Berger and Messer (2002) found that the mortality rate depends simultaneously on health spending and the choice of a health insurance system. More particularly, an increase in the share of public funding devoted to health spending has led to a rise in mortality rates. Khaleghian and Gupta (2005) showed that public health expenditure plays a more important role for poor people in low-income countries than in high-income countries, stating that the yields of health expenditure were higher in high-income countries. As for Harttgen and Misselhorn (2006), they showed that access to health infrastructure reduces infant mortality significantly and that socioeconomic factors represent the main determinants of infant health status (Nolte and McKee 2004; Stleger 2001).

Despite the arguments discussed above, it is not quite clear that the relationship between health expenditure and child mortality is negative as one might expect. From an empirical perspective, the nature of such a relationship is ambiguous. Given this empirical ambiguity, it is important to investigate whether health expenditure, with the presence of a good quality of institutions, leads to lower child mortality rates. Our main contribution is to provide a unified empirical framework for studying the concept of thresholds in the process of expenditure on health and child mortality. We think that, if several attempts have been made to investigate the institutional effects in mediating the relationship between health spending and childhood mortality, no empirical study, to our knowledge, has addressed the issue of the threshold effect between health expenditure and infant mortality.

The rest of the paper is organized as follows. "Empirical Methodology" section is devoted to the empirical design; in this section, we expose the econometric methodology and the data. Empirical results are presented in the "Main Results and Discussion" section. Robustness analysis and results discussion are presented in the "Robustness Analysis" section, while the paper concludes and presents policy implications in the "Conclusion and Policy Implications" section.

Empirical Methodology

The purpose of this study is to analyze the interrelationship between health spending and infant mortality rates taking into account the role of institutional quality for 93 countries using annual data during the period 1995–2015. To do so, one needs to specify a model that allows capturing the direct and indirect effects of health expenditure. We think that a two-step system dynamic GMM model may be more appropriate insofar as it may test simultaneously the effects of health expenditure on child mortality directly via medical needs and indirectly via institutional quality (Judson and Owen 1999). The specification of the model is consistent with the literature and allows the identification of the channels through which total health expenditure and other variables affect children's health.

Based on theoretical health analysis and in order to assess the impact of the government's health spending on infant mortality, we adopted a standard model built on previous studies (Gwatkin et al. 2007; Berthelemy and Seban 2009; Baldacci et al. 2004; Berger and Messer 2002) that explains IMR's by health government spending and a set of control variables generally used in this type of work. The model is written as follows:

$$\mathrm{IMR}_{it} = \alpha_i + \beta^{'} X_{it} + \varepsilon_{it} \tag{1}$$

Where α_{i} is the country-specific effect which is distributed independently and is constant for all countries, 퐿 i denotes the country (i =1, 2, 93) and t denotes the time period (t = 1995, 2015); ε_{it} is the error term assumed to be distributed independently in all time periods of the country i, IMR_{it} is the infant mortality indicator where under − 5 (per 1000 live births) is used as a proxy and measures the proportion of deaths among infants and children less than 5 years old. X_{it} represents a vector of some macroeconomic hypothesized variables that affect children's health.

The generalized method of moments (GMM) for panel data analyses proposed by Arellano and Bond (1991) and then further developed by Blundell and Bond (1998) is utilized here to control endogeneity in our estimations. This method meets the need of the panel data study by providing solutions to the heterogeneity of individual behavior in the sample, i.e., the endogeneity (i.e., presence of endogenous lagged variables among the model) and simultaneity (bidirectional causality between variables). The empirical results suggest, however, that the past child death is suited in the explanation of the current level of infant mortality. Consequently, we estimate a dynamic model. The dynamic version of the model (1) can be written as follows:

$$\left(\mathrm{IMR}_{i,t} - \mathrm{IMR}_{i,t-1}\right) = \alpha_i + \alpha_0 \mathrm{IMR}_{i,t-1} + \beta^{'}_{i} X_{it} + \xi_{it} \tag{2}$$

The use of lagged variables in levels as instruments in the estimation of the model in first difference is proposed by Arellano and Bond (1991) proposes:

$$\left(\mathrm{IMR}_{i,t} - \mathrm{IMR}_{i,t-1}\right) - \left(\mathrm{IMR}_{i,t-1} - \mathrm{IMR}_{i,t-2}\right) = \beta_0 \left(\mathrm{IMR}_{i,t-1} - \mathrm{IMR}_{i,t-2}\right) + \beta^{'}_{i} (X_{it} - X_{it-1}) + (\xi_{it} - \xi_{it-1}) \tag{3}$$

Next, based on Arellano and Bond (1991), moment conditions are applied in determining the difference estimator as follows:

$$\begin{aligned} E\left[\mathrm{IMR}_{i,t-s}\left(\xi_{i,t}-\xi_{i,t-1}\right)\right] = 0 \ \ \text{For } s > 2 \ \ t = 3, T \\ E\left[X_{i,t-s}\left(\xi_{i,t}-\xi_{i,t-1}\right)\right] = 0 \quad \text{For } s > 2 \ \ t = 3, T \end{aligned} \tag{4}$$

This step is required in the estimation since lagged differences of the explanatory variables are used as instruments in levels equation with the presence of two important assumptions; namely, the error term is not correlated and correlation does not exist between difference in the explanatory variables and the error term despite association between the levels of the explanatory variables and the country-specific error term may occur.

As a result, the following stationarity properties are obtained:

$$E\left[\mathrm{IMR}_{i,t+p}\eta_i\right] = E\left[\mathrm{IMR}_{i,t+q}\eta_i\right] \quad \text{And} \quad E\left[X_{i,t+p}\eta_i\right] = E\left[X_{i,t+q}\eta_i\right] \tag{5}$$

for all p and q.

Following Arellano and Bover (1995), the additional moment conditions for the regression in levels are shown as follows:

$$\begin{aligned} E\left[\left(\mathrm{IMR}_{i,t-s}-\mathrm{IMR}_{i,t-s-1}\right)\left(\eta_{i,t} + \xi_{i,t-1}\right)\right] = 0 \quad \text{For } s = 1 \\ E\left[\left(X_{i,t-s}-X_{i,t-s-1}\right)\left(\eta_{i,t} + \xi_{i,t-1}\right)\right] = 0 \quad \text{For } s = 1 \end{aligned} \tag{6}$$

By utilizing the moment conditions in Eqs. (4, 5 ET 6), the GMM system estimator is derived. The validity of the instruments determines how consistent the GMM estimator would be. The Sargan test of over-identifying restrictions is used to examine the validity of the instruments.

Finally, to assess the health expenditure and institutional quality effect on IMR's, we specify our basic empirical model as follows:

$$\mathrm{IMR}_{it} = \alpha_i + \alpha_1 \mathrm{IMR}_{it-1} + \alpha_2 \mathrm{HEXP}_{i,t} + \alpha_3 \mathrm{INST} + \beta' X_{it} + \xi_{it} \tag{7}$$

Where IMR_{it} denotes the infant mortality rates measured by the proportion of deaths among infants and children less than 5 years old, HEXP_{it} is the health care expenditure variable measured by health public expenditure (% GDP); X_{it} is a vector of explanatory variables generally identified by health economics literature as key determinants of health expenditure which are GDP growth per capita, female literacy rate, the medical density (defined by physicians as doctors per thousand population), technological advancement measured by research and development expenditure (% of GDP), water access measured by the proportion of households that use water from the faucet, protected wells, and boreholes considered drinkable, financial development measured by the ratio of domestic credit to the private sector relative to GDP, trade openness measured by the sum of imports and exports to GDP, inflation measured by growth of consumer price index, urbanization measured by urban population as a proportion of total population, and CO2 emission which captures the cleanliness of the environment. Finally, β refers to a vector of parameters to be estimated and ε_{it} is the error term.

Then, in order to test how much the impact of health spending on IMR's is influenced by institutional quality, the interaction term between health expenditure and institutional quality needs to be included in Eq. (7) as follows:

$$\mathrm{IMR}_{it} = \alpha_i + \alpha_1 \mathrm{IMR}_{it-1} + \alpha_2 \mathrm{HEXP}_{i,t} + \alpha_3 \mathrm{INST}_{i,t} + \beta' X_{it} + \lambda\left(\mathrm{HEXP}_{it}{}^{*}\mathrm{INST}_{it}\right) + \xi_{it} \quad (8)$$

Where INST_{it} is the indicator of institutional quality which is constructed from the six governance indicators (government effectiveness, voice and accountability, political stability and absence of violence, rule of law, regulatory quality, and control of corruption.) using the principal component factor method (PCF). The choice of this institutional variable has been made in such a way that it must have a synthetic aspect, that is to say, contains a maximum of information about economic risk, political risk, and social risk. The interest of the decomposition of this variable is to take into account the other specific institutional aspects and it is more appropriate to the study of the population health. The construction of this variable explains the interest in institutional quality in the explanation of mortality. ($\mathrm{HEXP}_{\mathrm{it}}$*$\mathrm{INST}_{\mathrm{it}}$) is the interactive term between health expenditure and institutional quality, λ captures the role of institutions in mediating the impact of health expenditure on IMR's. As mentioned above, a better institutional quality is deemed to be more efficient to reduce the IMR's. If the estimated λ were negative and significant, it would indicate that a complementarity exists and an institution is important in mediating the health spending impact on children's health. We are particularly interested in the effect of the interaction term because we expect that government health spending may complement or substitute other conditions.

Finally, annual time series data, which cover the period 1995–2015 for a sample composed of 93 developed and developing countries are used in this study. The data are obtained from different sources, including various series of the World Health Organization (WHO), International Country Risk Guide (ICRG), and World Development Indicators (WDI). The sample size and the period of our study are limited by the availability of data about control variables.

Main Results and Discussion

We examine the impact of public health expenditure on infant mortality with the presence of the institutional quality variable for a panel of 93 developed and developing countries using GMM technique. The GMM estimator is used because it is a useful technique to estimate the effects of health care spending on infant health status in the sense that it helps solve the problem of endogeneity of these variables. The problem can be dealt with by taking the lagged values of the explanatory variables as instruments. Then, the Sargan test is applied to examine whether the instruments used in these models are valid. In so doing, we aim to examine the null hypothesis, i.e., that there is no correlation between the instruments used and the residuals. In all the equations, the Sargan statistic test shows that the null hypothesis, Ho: over-identifying restrictions are valid and cannot be rejected. In short, it is proven that the instrumental variables applied in the GMM estimation in this study are appropriate.

Table 1 reports the estimation results of the estimated model using the two-step system dynamic GMM method for the period 1995–2015. The dependent variable is IMR's and our variables of interest are government health expenditure and the composite indicator of institutional quality. The coefficients of these variables of interest have the correct signs and are statistically significant. We find that in all models (1 to 4), the initial level of IMR's has a positive sign and is statistically highly significant suggesting that the past IMR's is suited in the explanation of the current level of children's deaths.

Results show also that the coefficient of public health spending appears to be negatively significant at the 10% level suggesting that a 1% increase in health spending leads to a decrease in IMR's by 0.013 points. This confirms the hypothesis that health expenditure has a positive and statistically significant effect on infant deaths which can be viewed as a determinant factor of child health status. It means also that children's health status depends on the spending rate on health care which suggests that an increase in health expenditure implies a broader access to health care and services which help decrease mortality rates. This result confirms other studies that found a positive relationship between spending on health and infant mortality (Berger and Messer 2002).

As regards the explanatory variables, they have the expected sign and are statistically significant. The results show that GDP growth has a significant infant mortality-reducing effect where 1% increase in per capita income reduces child mortality by 2.4 points. A high rate of growth is expected to solve the problems of food insecurity, precariousness of buildings and equipment, lack of adequate social infrastructure, and shortfall budget needed to reduce infant and motherly mortality. In addition, higher incomes lead to improved public health infrastructure such as water and sanitation, better nutrition, better housing, and the ability to pay for health care (Pritchett and Summers 1996; Culter et al. 2006).

For the estimated coefficient of women's literacy, it appears to be significantly negative. A 1% increase in female education leads to a decrease in infant deaths by about 5% suggesting that women's education is an important determinant of infant health. This result coincides with the works of Baldacci (2003) and Schultz (1993) which showed that female literacy is an important determinant of infants' health status. Indeed, in developing countries, women play a more important role in family health and sanitation quite apart from the fact that female education is positively associated with the infants' health. The coefficient of technological progress, captured by research and development expenditure, appears to be negatively significant which indicates that research and development constitute a key determinant of children's health. This denotes that access to high technology has a great impact and helps increase health spending which may consequently reduce the IMR's. As regards the coefficient of the physicians' density variable, it appears to be statistically significant at the 1% level. Thus, a higher density of physicians indicates more easily accessible health care, and should, therefore, correlate with a lower mortality rate. For the estimated coefficient of urbanization, it shows that an increase of urban population by 1% decreases child death's rate by 3%. For the environment variable, the CO_2 emission rate appears to be

Table 1 Effects of public health expenditure and institutional quality on IMR's (full sample)

Variables	Dependent variables, IMR's (1)	(2)	(3)	(4)
IMRit-1	0.031**	0.033**	0.028**	0.037***
	(0.04)	(0.026)	(0.018)	(0.004)
HEXP		−0.012*	−0.014*	−0.013**
		(0.092)	(0.076)*	(0.055)
INST			−0.114**	−0.114**
			(0.039)	(0.027)
HEXP*INST				−1.246***
				(0.000)
GDPG	−2.431***	−2.415***	−2.393***	−2.442***
	(0.000)	(0.000)	(0.000)	(0.000)
WA	−2.863***	−2.211***	−2.765***	−2.369***
	(0.000)	(0.000)	(0.000)	(0.000)
URB	−3.192***	−3.132***	−3.191***	−3.178***
	(0.000)	(0.000)	(0.000)	(0.000)
TECH	−4.524**	−4.384**	−3.991***	−4.864***
	(0.028)	(0.035)	(0.000)	(0.000)
DENS	−1.965***	−2.023***	−2.103***	−2.281***
	(0.000)	(0.009)	(0.002)	(0.007)
TRADE	−4.076	−3.241**	−3.351***	−3.121***
	(0.163)	(0.02)	(0.000)	(0.000)
FD	2.265	2.542	2.198	1.965
	(0.462)	(0.516)	(0.287)	(0.356)
FEML	−5.435**	−4.923***	−4.689***	−4.742***
	(0.012)	(0.000)	(0.000)	(0.000)
INF	0.011	0.027	0.041	0.035
	(0.192)	(0.116)	(0.173)	(0.121)
CO2	1.231**	1.236***	1.222***	1.226***
	(0.038)	(0.002)	(0.004)	(0.001)
Const	10.548***	12.684***	11.356***	13.398***
	(0.000)	(0.000)	(0.000)	(0.000)
Diagnostic checking				
Sargan test	0.717	0.762	0.923	0.949
Obs.	1953	1953	1953	1953

IMR, infant mortality rate; *HEXP*, health expenditure; *CO2*, environmental degradation; *GDPG*, GDP growth; *FD*, financial development; *TRADE*, trade openness; *TECH*, technological advancement; *URB*, urbanization; *DENS*, density of physicians; *FEML*, female literacy; *WA*, water access; *INF*, inflation

*Significant at 10%

**Significant at 5%

***Significant at 1%

positively significant at the 5% level with a coefficient of 1.23 which means that a 1% increase in the emission rate of this gas causes 1.23% increase in IMRs. For the estimated coefficient of water access, it appears negatively significant suggesting that the drinking water sector provides infants food through technologies such as urban water, village water, and improved rural water Isley 1985. As regards the estimated coefficient of financial development, it shows that improving the financial system has no significant impact on children deaths. Finally, results show also that the coefficient of inflation appears to be statically none significant.

The estimated coefficient of institutional quality shows that there is a clear negative relationship between institutions and infant mortality suggesting that institution quality may be a main factor of health status. It is because good institutions may provide a favorable environment for cooperative solutions that bring about better economic performance. However, the interactive terms between institutional quality and health expenditure are negatively significant. This confirms the hypothesis that good institutions can significantly reduce IMR's by improving the allocations of health spending through their general impact on universal health policy issues such as universal access to high-quality services and universal health insurance and accessible programs. Good institutions may in addition, provide information and advices about hygiene, good health practices, and other knowledge useful for the population in general and the needy in particular.

Finally, and given the heterogeneity of our sample, the results may differ due to the structural characteristics of each economy. We think that it is not appropriate to conduct a study on this subject, considering a sample of countries consisting of the ones that do not have similar characteristics because it does not allow us to take account of the specific nature of each country, which may have erroneous results that cannot be generalized. Moreover, the process of separation of the sample might make it possible to give more accurate results that reflect the heterogeneous characteristics of the groups studied, which constitutes the subject matter of the following paragraph.

Robustness Analysis

Experiences demonstrate that IMR's is dependent on the level of health spending. Therefore, a higher health government spending is associated with lower child mortality rates. Conversely, a lower health government spending is associated with higher infant mortality rates. The robustness of the results is firstly tested by subdividing the full sample into four small ones. As a consequence, the results are sensitive to the sample choice. More specifically, we try to make a comparative study of four samples according to the standard income. Following the classification of the World Bank, we could build a database characterizing four samples around the world during the period 1995–2015: 20 low-income countries, 23 lower-middle-income countries, 25 upper-middle-income countries, and 25 high-income countries. Although the economic history of each country cannot be the same, we think that, in each group, the countries we have chosen are similar in their economic and health status as well as the political, regulatory, and social or cultural levels. The reason behind this attempt is to draw the political implications

Table 2 Effects of public health expenditure and institutional quality on IMR's (all groups of countries)

Variables	Dependent variables: IMR's			
	Low income	Lower middle	Upper middle	High
IMRit-1	2.033***	1.107***	0.923***	0.635***
	(0.000)	(0.000)	(0.000)	(0.000)
HEXP	0.561	0.395	− 0.475	− 0.471**
	(0.254)	(0.365)	(0.124)	(0.048)
INST	− 0.162**	− 0.156**	− 0.145**	− 0.214**
	(0.042)	(0.027)	(0.051)	(0.025)
HEXP*INST	− 2.234***	− 2.186***	− 2.166***	− 3.429***
	(0.000)	(0.000)	(0.000)	(0.000)
GDPG	− 4.524**	− 3.698***	− 2.658*	− 1.857*
	(0.028)	(0.006)	(0.075)	(0.072)
WA	− 0.469***	− 0.541***	− 0.354***	− 0.224***
	(0.000)	(0.000)	(0.004)	(0.007)
URB	− 5.657***	− 3.836*	− 2.547*	− 0.824
	(0.000)	(0.075)	(0.061)	(0.153)
TECH	− 4.259***	− 4.008**	− 2.367**	2.584**
	(0.000)	(0.036)	(0.042)	(0.028)
DENS	− 3.264***	− 2.854***	− 2.459***	− 2.345***
	(0.000)	(0.000)	(0.000)	(0.000)
TRADE	− 0.007***	− 0.005***	− 0.059***	− 0.081***
	(0.000)	(0.000)	(0.000)	(0.000)
FD	0.624	− 1.148	− 1.564**	− 1.564**
	(0.245)	(0.135)	(0.056)	(0.044)
FEML	− 6.952**	− 6.995***	−5.691***	− 4.891***
	(0.021)	(0.000)	(0.000)	(0.000)
INF	0.272*	0.308**	0.316	− 0.017
	(0.102)	(0.033)	(0.147)	(0.141)
CO2	2.0287***	2.254*	1.854**	2.274**
	(0.011)	(0.074)	(0.045)	(0.024)
Const	8.247***	7.684***	10.368**	9.247***
	(0.000)	(0.000)	(0.000)	(0.000)
Diagnostic checking				
Sargan test	0.823	0.739	0.903	0.877
Obs.	420	483	525	525

IMR, infant mortality rate; *HEXP*, health expenditure; *CO2*, environmental degradation; *GDPG*, GDP growth; *FD*, financial development; *TRADE*, trade openness; *TECH*, technological advancement; *URB*, urbanization; *DENS*, density of physicians; *FEML*, female literacy; *WA*, access to water; *INF*, inflation

*Significant at 10%

**Significant at 5%

***Significant at 1%

that will be adopted by each type of group of countries. To do so, we are going to keep the same empirical methodology, model and period. The results of the regression models for the four subgroups of countries are given in Table 2 below.

As regards the effects of health expenditure on infant mortality in which we are most interested in these estimations, they vary depending on the sample chosen. We note specifically that public health spending has a positive and significant effect on child health only for high-income countries, while their effects appear to be statistically non-significant for low, lower-middle, and upper-middle-income ones. This result is consistent with others studies that did not find a significant relationship between the two variables (Filmer and Pritchett 1999; Thornton and DeSalle 2002). This suggests, contrary to theoretical works which assumed that health care expenditure is favorable to the population's health in general, that health spending is not always a key determinant for health, especially for countries that are characterized by weak legal environments, the degradation of their macroeconomic environments (levels of inflation, high budget deficit, etc.) and low regulation of their financial systems (Dhrifi 2015). Another reason for this difference between less and more developed countries is the difference related to the access to healthcare, the inefficiency in health care spending, and the rising costs of medical technology.

However, for the second variable of interest in this second estimation which is the interactive variable of health expenditure and infant mortality, it appears to have the correct sign for all the groups of countries suggesting that a health spending with the presence of good institutions may affect IMR's positively. That is to say that a high level of institutional quality may solve the problem of the inefficiency of health care spending and reduce the rising costs of medical technology and services. This leads us to think that the institutional context seems as influential as the volume of health spending and constitutes a determining factor in the relationship between health expenditure and infant mortality. We believe that high-income countries that have managed to reduce their mortality rate, have necessarily adopted a policy based on meeting traditional prerequisites (limits on public deficits, health infrastructure, female literacy, etc.) but especially the conditions of institutions and good governance.

Therefore, we can conclude that these differences between developing and developed countries concerning the effects of health expenditure and institutional quality on IMR's may be due, not only to the good governance that has been implemented by developed countries but also and essentially to the differences in health spending rates. Figure 2 below shows and confirms clearly these differences which range from about 3% in less developed countries to about 13% in more developed ones. Moreover, according to WHO, health expenditures in high-income countries are over USD 3000 on average, while in poor countries, they do not exceed USD 30 per capita. That is to say, a higher health spending rate is associated with a lower child mortality rate. On the contrary, a lower health spending is associated with a higher infant mortality rate.

It seems that there is a certain "threshold" level of government health spending that an economy needs to attain before it can get the full indirect benefits. In other words, there is a certain threshold of health government spending from which the impact on IMR's changes sign which is determined by the calculation of the marginal impact of the institutional quality.

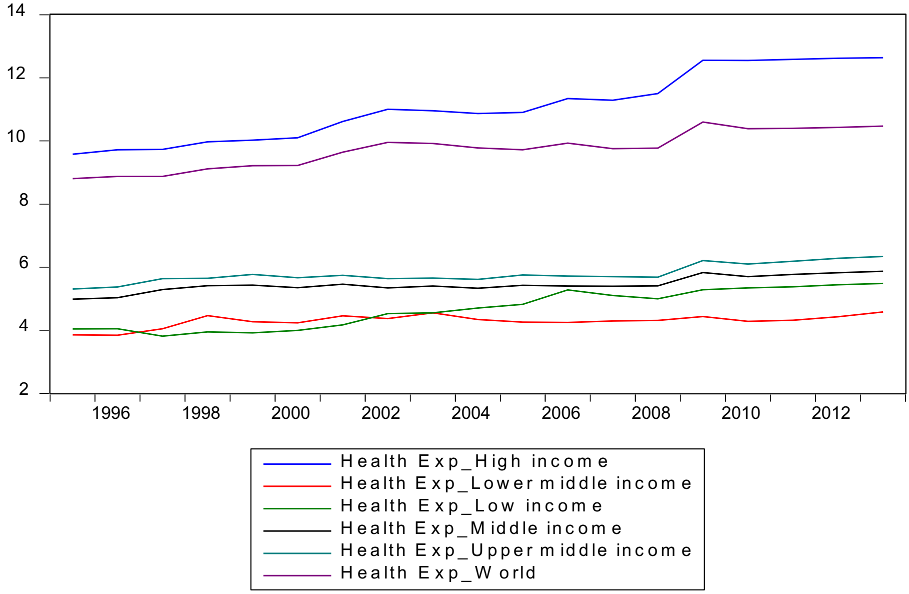

Fig. 2 Trends of health expenditure according to the income criterion. Source: figure made by the author based on the data provided by WHO

Calculating the Threshold Effect of HEXP on IMR's

The coefficients of interest in our study are α_2, α_3, and λ, which get the effect of the potential interaction between health expenditure and institutional quality. In this way, we allow the impact of one of both variables to depend on the level of the other one. α_2 and α_3, of Eq. (7) represent the marginal impacts of health expenditure and institutional quality respectively. On the contrary, α_3 in Eq. (8) represents the marginal impact of the institutional quality provided that the level of health expenditure is zero and the interpretation for α_3 is similar and holds. Finally, to obtain the threshold level of health expenditure, we calculate the mathematical derivative of IMR with respect to institutional quality:

$$\frac{\partial \mathrm{IMR}}{\partial \mathrm{INST}} = \alpha_3 + \lambda^{*}\ \mathrm{HEXP} = 0$$

Then, the threshold of health expenditure is equal to $\frac{\alpha_3}{\lambda}$.

Table 3 below shows the threshold levels of health expenditure that the different groups of countries must achieve so that their effects on infant mortality is positive. The thresholds are calculated from the results presented in Table 2. As mentioned above, the

Table 3 The threshold effects of health government spending

	Low income	Lower-middle income	Upper-middle income
Threshold levels	7.25	7.13	6.69

Source: Calculus of the author from the results of Table 2 threshold of health expenditure is equal to $\frac{\alpha_3}{\lambda}$; where α_3 is the estimated coefficient of the institutional quality and λ the coefficient of interactive terms between government health spending and institutional quality.

Our finding shows that, in the presence of a certain threshold of government health expenditure, less developed economies are more likely to reduce their IMR's once a certain threshold condition is satisfied. This threshold is estimated at a rate of government expenditure to GDP around 7.25% for lower-income countries, 7.13% for lower-middle-income countries, and 6.69% for upper-middle-income countries. From these levels, we may expect the advantages and benefits of government health spending on IMR's. This suggests also that government health expenditure % GDP is associated with the highest rate of infant mortality if countries lack good institutions. Institutional quality may catalyze government spending, improve governance, and impose discipline on macroeconomic policies.

Finally, and despite the fact that the question of the threshold effect in the relationship between health spending and infant mortality has not been, to our knowledge, the subject of any empirical work, a mere comparison of results makes us believe that most developed countries and a few emerging economies are above the estimated threshold levels of health spending, while a majority of developing countries are below them. Overall, we think that the threshold found in our study has merely a statistical significance. It may depend on the methodology, the decomposition of the sample in question, and on all the control variables used.

In sum, we can say that health spending and institution quality cannot be regarded as the only factors that may explain the high IMR's in less developed countries. The causes of children's deaths are especially linked to female literacy, malnutrition, insufficient access to care and infrastructure, and basic health care needs such as water and sanitation.

Conclusion and Policy Implications

This paper aims at studying the effects of health care expenditure on IMR's taking into account the role of institutional quality for 93 developed and developing countries over the period 1995–2015 using a two-step dynamic GMM system. We hypothesized that there would be a positive correlation between health care expenditure and infant deaths, indicating that an increase in spending would decrease mortality rates. However, we found that an increase in health spending is only positively significant in high-income countries which is not the case for low, lower-middle, and upper-middle-income ones. More precisely, results show that developed economies, which have higher rates of spending on health than developing countries, have benefited directly and indirectly from governments' health spending and their good governance. Thus, the lack of significance of health care spending in less developed countries may indicate, on the one hand, that in these economies, money is not allocated effectively towards health spending and that, on the other hand, these less developed countries must attain a certain threshold level of government health spending estimated to be around 7%. Findings also confirm the importance of institutional quality in explaining both health care expenditure and child mortality.

The results of the models developed in this paper provide several lessons about the role played by government health spending in declining infant mortality rates. To decrease child mortality rates, economies have to undertake a number of reforms. If government spending helps reduce infant mortality in the most economically developed countries, we believe that it remains insufficient and that governments must not limit their expenditure on healthcare spending. Private spending and external sources may also help satisfy medical needs. Political authorities must improve governance indicators such as political stability and fight corruption in order to increase children's survival significantly. The health system should be based on shared responsibility and accountability of the different actors.

In summary, child mortality can be reduced by strengthening national health systems, expanding immunization programs, enhancing growth monitoring of children, ensuring mothers' survival and health, supporting better nutrition for the child and mother, providing prenatal care of pregnant women, reducing delays of registration of pregnancy and identification of high risk pregnancies, immunizing pregnant women against tetanus, investing in improved reproductive health facilities, and boosting infrastructure investments.

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