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Examining the Impact of Health Care Expenditures on Health Outcomes in the Middle East and North Africa (MENA) Region

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ABSTRACT

Objective: To examine the impact of health care expenditures on selected health outcomes for 19 countries in the Middle East and North Africa (MENA) region.

Methods: We used panel data collected by the WHO and the World Bank for 1990-2010 to estimate the impact of both government and private health care expenditures on infant, under-five, and maternal mortality rates. Pooled ordinary least regression, random effects, and Hausman-Taylor instrumental variable models were used to examine the relationship between health care expenditures and selected health outcomes.

Results: The results show that after controlling for confounding factors, both government and private spending on health care significantly improve infant, under-five, and maternal mortality in the MENA region. The relationships are causal in nature. Specifically, a percentage increase in per capita government expenditures reduces the infant mortality rate by 8.6-9.5 deaths per 1000 live births ($p<0.01$), the under-five mortality by 10.3-12.1 under-five deaths per 1000 live births ($p<0.01$), and maternal mortality by 26.0-26.3 deaths per 100000 live births ($p<0.01$). Similarly, a percentage increase in the log per capita private expenditures reduces the infant mortality rate by 7.2-8.1 deaths per 1000 live births ($p<0.01$), under-five mortality rate by 9.5-9.8 deaths per 1000 live births ($p<0.01$), and the maternal mortality rate by 25.8-25.9 deaths per 100000 live births ($p<0.01$).

Conclusion: Overall, we observe a notable improvement of the selected health outcomes in the MENA region from 1990 to 2010 mostly due to government and private health spending on health care. Consistent with existing literature, improvements in access to safe drinking water, increasing share of births attended by the health personnel, and adult literacy rate also reduce infant, under-five, and maternal mortality rates.

Introduction

There is no doubt that health outcomes have been improving in developed countries amid increasing health expenditures. For example, the average life expectancy at birth in the OECD area has increased over the last fifty years by about ten years, while infant mortality rate has fallen more than tenfold. Over the same period, share of health expenditures in gross domestic product rose from a little over 3 percent to almost 10 percent (OECD, 2012).

Infant, under-five, and maternal mortality rates are most widely used indicators of health status. Infant mortality rate is the number of deaths of infants under one year of age per 1000 live births in a given year. Worldwide, approximately 11 million infants die each year, of which more than 90% occur in the developing world (UNICEF, 2011). Infant mortality rate consists of two components. One is the neonatal mortality rate, which takes into account deaths occurring in the first four weeks of life. Leading causes of neonatal mortality are problems arising during pregnancy (congenital abnormalities, low birth weight), delivery (birth injuries, asphyxia), after delivery (tetanus, other infections) (UNICEF, 2011). The second component is post neonatal mortality rate, which is calculated from deaths occurring in the remainder of the first year. Whereas neonatal mortality rate is related to maternal and obstetric factors, the most important

cause of the post neonatal mortality is a variety of environmental factors, including poverty, inadequate health care, congenital problems, infectious diseases and injuries (UNICEF, 2011).

The under-five mortality rate is the probability of dying between birth and exactly five years of age per 1000 live births. Although it has been declining over time, at the end of last decade, the number of deaths worldwide among children under 5 stood at about 7 million (UNICEF, 2012). Diarrhea, pneumonia and malaria, as well as tetanus and other infections are among the most frequent causes of under-five mortality globally. According to the same source, the frequency of such illnesses is often influenced by poverty, poor nutrition and civil conflict, with under-five deaths being increasingly concentrated in sub-Saharan Africa and South Asia. While the global under-five mortality rate was 51 deaths per 1000 live births in 2011, in sub-Saharan Africa one in every nine children dies before reaching the age of 5 (UNICEF, 2011).

Several researchers have examined the relationship between health care expenditures and infant, under-five, and maternal mortality rates. Anyanwu and Erhijakpar (2007) used data from 47 African countries between 1999 and 2004 and provided econometric evidence that health expenditures have a statistically significant effect on infant mortality and under-five mortality. Gupta, Verhoeven, and Tiongson (1999) used 1994 data for 50 developing and transition and found that health expenditure reduces childhood mortality rates. Gottret and Scieber (2006) conducted a study of 81 low and middle income countries and found that a 10 percent increase in government health expenditure has a larger impact in reducing under-five mortality and maternal mortality than a 10 percent increase in education, roads and sanitation. Bokhari, Gai, and Gottret (2007) provided additional econometric evidence linking a country's per capita income to two health outcomes: under-five mortality and maternal mortality.

The World Health Organization defines maternal mortality rate as the number of female deaths per 100000 live births from any cause related to or aggravated by pregnancy or its management in a given year. More than half a million women die each year from pregnancy-related causes, with the overwhelming majority of these deaths occurring in developing countries (WHO, 2004). The leading causes of maternal mortality in these countries are lack of adequate health care and family planning as well as minimal access to skilled labor and emergency care.

Existing research falls short of providing evidence on causal link between health care expenditures and health outcomes. Most studies show the relationship between health care expenditures and health outcomes while controlling for a number of additional explanatory variables characterizing different aspects of socio-economic development. Moreover, majority of these studies focus on developed countries leaving out developing countries possibly because of the lack of available data.

In this study, we extend the current state of knowledge on this topic by examining this relationship further by testing and modeling a causal link between health care expenditures and selected health outcomes for 19 countries in the Middle East and North Africa (MENA) over the 1990-2010 period using infant, child, and maternal mortality as our key dependent variables. We use mortality rates, rather than life expectancy, as our health outcome measures for a number of reasons. First, compared to life expectancy, mortality is more strongly associated to changes in economic conditions in the developing world. Second, in developing countries, declines in mortality rates explain a large portion of improvements in life expectancy (Cutler et al., 2006). Finally, existing literature shows that in developing countries, mortality depends on access to medicines and health facilities, water and sanitation, fertility patterns, maternal health, maternal and infant nutrition, maternal and infant disease exposure, and female literacy in addition to per capita GDP and economic inequality. Therefore, we employ three different

mortality variables as our health outcome measures using secondary data for a sample of 19 MENA countries.

We find that an increase of per capita government health expenditures significantly reduces infant, under-five, and maternal mortality rates. In particular, a unit increase in the log per capita government expenditures reduces the infant mortality rate by 8.6-9.5 deaths per 1000 live births, the under-five mortality rate by 10.3-12.1 under-five deaths per 1000 live births, and the maternal mortality rate by 26.0-26.3 deaths per 100000 live births. The results also suggest that, unlike public expenditures, private health spending has a greater positive impact on reducing infant, child, and maternal mortality in the MENA region.

The remainder of this paper is organized as follows: section II reviews and summarizes the existing literature on this topic; section III describes the methods used to perform our empirical analysis of the relationship. The empirical results are presented in section IV, followed by a discussion and conclusion section.

Literature Review

In this section we provide key findings from the existing literature that examined the relationship between health expenditures and health outcomes. In terms of dependent variables, most studies utilize age-specific or infant mortality rates and life expectancy at birth. As the main independent variable, studies include some form of health expenditures with health expenditures as a share of GDP and per capita health expenditure being most commonly used. To control for various socio-economic and life-style factors, studies include a wide range of explanatory variables, among which are health care input variables (e.g., number of physicians, nurses, beds), alcohol and tobacco use, demographics information (e.g., age, population density). The principal result found in these studies is that health expenditures represent a statistically significant determinant for health outcomes.

Cochrane et al. (1978) estimate mortality rates for 18 developed countries over the period of 1969-1971. Besides having a variable for public health expenditures, authors include a number of other control variables. Among them are commonly used health care input variables, such as GNP spent on health, beds, physicians, nurses as wells as alcohol, tobacco and sugar consumption. Authors find that higher public health expenditures are associated with lower mortality rates. Also, while GNP per capita has a negative effect on mortality rates, number of physicians, alcohol, sugar and tobacco consumption were found to be positively associated with mortality rates.

To estimate infant mortality rates, Grubaugh and Rexford (1994) perform panel data analysis for 12 OECD countries (excluding US) for the 1960-1987 period. Various health care input variables, time trend (for technology effect) as well as health care system dummy are captured in the model. While physicians and time trend have statistically significant negative relationships with infant mortality, alcohol and tobacco consumption are found to be positively associated with this health outcome.

Babazono and Hillman (1994), using data for 21 OECD countries for 1988, relate health care expenditure to life expectancy and infant mortality. Two types of health care expenditure used in their study are per capita health care spending and public per capita health care spending. Additional explanatory factors include number of beds, physicians and other inputs. Authors find that public health care expenditures have a significant positive effect on female life expectancy at birth (elasticity of 0.38). Beds and non-health care spending have statistically significant negative relationships with infant mortality (-0.55 and -0.35, respectively).

Elola et al. (1995) use 1990 (1991) data for 17 Western European countries (excluding Portugal) to estimate various health outcomes, including infant mortality rates, potential years of life lost (PYLL) by gender, and life expectancies by gender. The key independent variable is health care expenditures per capita. Authors find that health care expenditures explain a third of variability in PYLL, 45 percent in infant mortality, and 37 percent of life expectancy for females.

Berger and Messer (2002) estimate mortality rate using panel data for 20 OECD countries over the period of 1960-1992. Their key explanatory variable is per capita health expenditures in 1990 US dollars. Authors also include GDP and population statistics as well as information on alcohol and tobacco consumption. They find that per capita health expenditures have a statistically significant negative effect on mortality rate (coefficient of -0.13).

Miller and Frech (2002) estimate numerous health outcomes for 18 OECD countries using various cross-sectional data over the period of 1994-1999. Explanatory variables used in their models include pharmaceutical expenditure per capita, GDP per capita, alcohol and tobacco use, and body mass index. Authors find that while pharmaceutical expenditure and obesity are statistically significant in explaining health outcomes, income is not significant.

Using data for Canadian provinces over the period of 1975-1998, Cremieux et al. (2005) build a model relating infant mortality and life expectancy to non-drug health care spending and other factors. Non-drug health care spending is found to have a statistically significant negative relationship with male infant mortality (elasticity of -0.51) and be positively related with male life expectancy at birth (0.017). In earlier paper by Cremieux et al. (1999), which also used data for Canadian provinces over the period of 1978-1992, authors find a statistically significant relationship between health expenditures and various health outcomes.

Gani (2009) relates mortality rate to per capita public health expenditures using data from Pacific Island countries for selected years between 1990 and 2002. Controlling for such variables as per capita income, immunization, urbanization and calorie intake, the author finds a statistically significant negative relationship between per capita health expenditure and mortality rate. In particular, a 10 percent increase in per capita health expenditures is found to be associated with an approximate 6.6 percent reduction in infant mortality.

Farag (2010), using data for Eastern Mediterranean region over the 1995-2006 period, estimates the effect of health care expenditures on infant mortality. Other explanatory variables are GDP per capita, government effectiveness (World Bank indicator), and gender parity in secondary school education. The model employed by the author is random effects model with year fixed effects, which control for country and year-specific unobserved factors. The results suggest that a 1 percent increase in health care expenditures is associated with 0.11 percent reduction in infant mortality.

Recently, Muldoon et al. (2011) examine the link between mortality rates and 13 explanatory variables, including government and out-of-pocket expenditures on health, using a sample of 136 UN member countries for 2008. Performing mixed effects linear regression analysis, authors find that out-of-pocket expenditures on health is significantly related to mortality rates. Other variables that are found to be important in explaining variability in mortality rates are health care system, access to water and sanitation and corruption index.

To our knowledge, our study is among the first that explores the complex relationship between health care expenditures and health outcomes in the context of MENA countries. Using an

empirical strategy discussed below, we attempt to provide empirical evidence regarding the impact of health expenditures on infant, under-five, and maternal mortality in the MENA region. Most importantly, having information on health expenditures from 19 MENA countries with different levels of government and private health care financing, we are able to extend the above studies by exploring the mediating effect of differences in health care financing across MENA countries on the relationship between health expenditures and health outcomes.

The main objective of this study is to evaluate the relationship between health care spending at the country level and selected health outcome indicators in the MENA region. Specifically, we assess whether infant, under-five, and maternal mortality rates are affected by per capita government expenditure on health, government expenditures on health as a percentage of total expenditures on health, per capita private expenditures on health, and out-of-pocket expenditures as a percent of private expenditures on health. Given the findings summarized from the existing literature, the following hypotheses are formulated:

Hypothesis 1. An increase of government expenditures on health reduces infant, under-five, and maternal mortality rates.
Hypothesis 2. An increase of private expenditures on health reduces infant, under-five, and maternal mortality rates.
Hypothesis 3. An increase of out-of-pocket expend as a percentage of private expenditures on health increases infant, under-five, and maternal mortality rates.

Data and Methodology
We use secondary data collected by the World Health Organization and the World Bank for 1990-2010 years and publicly available data on the respective websites. The analysis is performed using STATA statistical software package. The choice of the time framework has been prompted by the availability of the data. Prior to 1990 the data sources provide very scarce information on health care spending in the region as well as on health outcomes. The analysis incorporates 19 countries that are categorized by the World Bank as the MENA region namely Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunis, United Arab Emirates (UAE) and Yemen as well as Turkey that is formally classified by the World Bank as European country.

We follow Muldoon et al (2011) to select our key study and control variables in the regression framework. In particular, the dataset includes the following variables:

Dependent variables
- Infant mortality (death between birth and age 1 per 1000 live births)
- Under-five mortality (probability of death by age 5 per 1000 live births)
- Maternal mortality ratio (per 100000 live births)

Independent and control variables
- Per capita government expenditures on health (PPP int. $)
- Government expenditures on health as a percentage of total expenditures on health
- Per capita private expenditures on health (PPP int. $)
- Out-of-pocket expenditures as a percent of private expenditures on health
- Physicians density (per 10000 population)
- Hospital beds (per 10000 population)
- Population with an access to safe drinking-water (%)
- Birth attended by skilled health personnel (%)
- Adult literacy rate (%)

Having selected 19 countries for 20 years, we have ended up with a balanced panel dataset with very few missing observations. The methodology of the study draws on regression analysis. In fact, most of the recent literature on the topic (e.g. Or, 2000; Farahani et al, 2010; and Muldoon et al, 2011) has been extensively relying on regression analysis. Prior to reporting findings from the regression analysis, we provide summary descriptive statistics.

Muldoon et al (2011) and several other existing studies estimate an effect of health spending on health outcomes using the following empirical framework:

$$\ln \mathbf{IM_{it}} = \beta_0 + \beta_1 \ln \mathbf{GE_{it}} + \beta_2 \mathbf{GEPT_{it}} + \beta_3 \mathbf{DCTR_{it}} + \beta_4 \mathbf{HB_{it}} + \beta_5 WTR_{it} + \beta_6 \mathbf{BHP_{it}} + \beta_7 \mathbf{LIT_{it}} + \sum_i \gamma \mathbf{T} + \varepsilon_{it}$$

where i identifies a country and t – time period. $\mathrm{IM_{it}}$is infant mortality rate in the country i at time t. Independent and control variables are defined in line with the above mentioned set of variables in the dataset.

$\ln \mathrm{GE_{it}}$: natural log of the per capita government expenditure on health
GEPT : government expenditures on health as a percentage of total expenditures on health
DCTR: Physicians density (per 10000 population)
$\mathrm{HB_{it}}$: Hospital beds (per 10000 population)
$\mathrm{WTR_{it}}$: Population with an access to safe drinking-water (%)
$\mathrm{BHP_{it}}$: Birth attended by skilled health personnel (%)
$\mathrm{LIT_{it}}$: Adult literacy rate (%)
$\mathrm{T_{it}}$: Dummy variable that identifies time period

Conventionally, the most of the existing studies estimate equation (1) using OLS or other linear estimation techniques. Therefore, we also first run a pooled OLS regression with cluster-adjusted robust standards errors. Using OLS model though is quite restrictive since it fails to take into account unobserved heterogeneity in determination of health outcomes and endogeneity of the health spending.

Next, a longitudinal nature of our data provides an opportunity to estimate a more sophisticated panel models. A major advantage of panel data is a possibility of consistent estimation of the regression model allowing for an unobserved heterogeneity. Time-varying unobserved heterogeneity may stem from omitted common variables that may be correlated with dependent variable. More importantly, these unobserved or immeasurable factors may lead to inconsistent and biased regression coefficient estimates if they are correlated with the explanatory variables included into regression. Pooled OLS models generally fail to account for an unobserved heterogeneity hence equation (1) is next estimated using random effects model. Estimation of panel data also increases the precision of estimation because pooling several time periods of data provides more information about the country. In this regard, the study adds a significant value to the body of the existing knowledge.

Prior to running the random effect model, we conduct Hausman test on fixed effects. The test results suggest that difference in coefficients of fixed effect and random effects models are not systematic. Under such setting random effects model is more efficient, plus we are able to estimate parameter estimates for time-invariant variables such as sector dummy variables.

Our third estimation framework is Hausman–Taylor panel IV model. The rationale behind using this model is as following. Although random effects panel models take into account the problem of unobserved heterogeneity they fall short of a potential problem of endogeneity of key explanatory variable which health spending in our case. The endogeneity of health spending has been discussed recently by Bokhari et al (2007) and Martin et al (2008). We test for endogeneity using the test proposed by Durbin (1954). The results show that government and private care spending as well as the level of out-of-pocket expenditures are endogeneous in nature. That has serious implications effecting bias and consistency of parameter estimates in equation (1).

Endogeneity problem in the estimation is usually tackled by application of the instrumental variable (IV) technique to solve this problem. IV technique involves identification of an exogenous variable that is correlated with endogenous variable of interest and uncorrelated with the error term in the main regression. Such procedure aims to introduce exogenous variation that leads to improved estimation. We estimate Hausman–Taylor panel IV model. Given that our data have panel settings we can utilize information about the level or government spending in previous and future periods to calculate the instrument for the value of the variable in the current period. Specifically, we replicate procedures proposed by Hausman and Taylor (1981). Below, we follow Hausman and Taylor's notation to describe our estimation framework. The procedure assumes that α_i are unobservable individual effects that are time invariant and correlated with the health spending. The Hausman –Taylor panel IV model is estimated as following:

$$Y_{it} = \beta_1 X_{1it} + \beta_2 X_{2it} + \gamma_1 Z_{1i} + \gamma_2 Z_{2i} + \alpha_i + \eta_{it} \qquad (2)$$

where X_{1it} - variables that are time-varying and uncorrelated with α_i

X_{2it} - variables that are time-varying and correlated with α_i

Z_{1i} - variables that are time-invariant and uncorrelated with α_i

Z_{2i} - variables that are time-invariant and correlated with α_i

η_{it} - error term that is uncorrelated to regressors

Estimating regular panel estimators such as random and fixed effects models the presence of endogenous X_{2it} and Z_{2i} generates a bias in parameter estimates. Hausman and Taylor suggest using panel features of the dataset in calculation of instrumental variables. Unproblematic X_{1it} and Z_{1i} remain in the model as well. Time-varying endogenous variables X_{2it} is instrumented by $(X_{2it} - \overline{X}_{2i})$, time-invariant endogenous Z_{2i} is instrumented by $\overline{X}_{1i}$. Exogenous X_{1it} and Z_{1i} are instrumented by their own values. The Hausman–Taylor IV procedure produces consistent and efficient estimators. Health spending is endogenous in nature as discussed above; it is also time-

varying. In the equation 2, the GEit would be similar to X_{2it} in nature and therefore be instrumented by $(GE_{it} - \overline{GE_i})$. We assume that the remaining regressor variables are not endogenous, similar in nature with X_{1it} and Z_{1i} equation 2.

While estimating the effect of health spending on under-five and maternal mortality rates, we follow a similar approach. In other words, we estimate the following models using (i) pooled OLS with cluster robust standard errors, (ii) random effects model, (iii) Hausman-Taylor panel IV model.

$$\ln \mathbf{CM_{it}} = \beta_0 + \beta_1 \ln \mathbf{GE_{it}} + \beta_2 \mathbf{GEPT_{it}} + \beta_3 \mathbf{DCTR_{it}} + \beta_4 \mathbf{HB_{it}} + \beta_5 WTR_{it} + \beta_6 \mathbf{BHP_{it}} + \beta_7 \mathbf{LIT_{it}} + \sum_i \gamma \mathbf{T} + \varepsilon_{it} \quad (3)$$

where $\mathrm{CM_{it}}$ is under-five mortality rate at country i at time t.

$$\ln \mathbf{MM_{it}} = \beta_0 + \beta_1 \ln \mathbf{GE_{it}} + \beta_2 \mathbf{GEPT_{it}} + \beta_3 \mathbf{DCTR_{it}} + \beta_4 \mathbf{HB_{it}} + \beta_5 WTR_{it} + \beta_6 \mathbf{BHP_{it}} + \beta_7 \mathbf{LIT_{it}} + \sum_i \gamma \mathbf{T} + \varepsilon_{it} \quad (4)$$

where $\mathrm{MM_{it}}$ is maternal mortality rate at country i at time t.

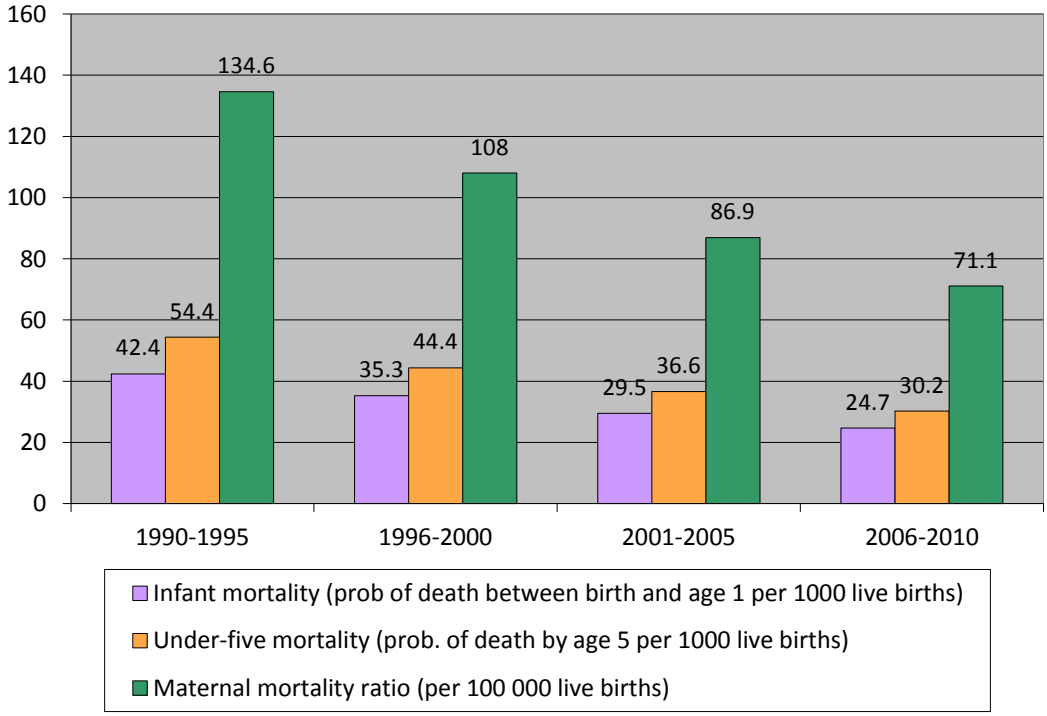
Finally, to explore an effect of private expenditures and out-of-pocket expenditures, we estimate another set of regressions where instead of controlling for $\mathrm{GE_{it}}$ and $\mathrm{GEPT_{it}}$ in the equations (1), (2) and (3) we introduce per capita private expenditure on health and out-of-pocket expenditures as a percent of private expenditures on health.

Results

Descriptive statistics

Over the study period, we observe a notable improvement of the selected health outcomes in the MENA region. As shown in the Figure 1, the average infant mortality rate declined from 42.4 deaths per 1000 live births in 1990-1995 to 24.7 in 2006-2010. Quite similar progress is registered in terms of the under-five mortality rate in the region. It has been reduced from 54.4 deaths per 1000 live births in 1990-1995 to 30.2 in 2006-2010. Within the same time period, the average mortality rate in the region has declined from 134.6 deaths per 100 000 births down to 71.1. Although we observe a significant degree of variation within the sample, improvements in health outcomes were registered across the board. Such findings support empirical evidence in the existing literature. Boutayeb and Serghini (2006) offer a detailed discussion of the topic suggesting that the Arab countries have made substantial social progress; infant and maternity mortality rates sharply declined across the region. Prior to Boutayeb and Serghini study by Mohana (2005) provides similar evidence on the improved health outcomes in the region.

Figure 1. Selected health outcome indicators in the MENA region, 1990-2010 (country averages)



Government health care expenditures have been on a rise. As shown in the Table 1, average annual per capita government expenditures have increased from 254.2 USD in 1990-1995 to 448.3 USD in 2006-2010. In many of the listed countries such a significant growth in public spending was achieved with an intention of meeting criteria of the Millennium Development Goals widely promoted by the United Nations and World Bank. Although the aggregate pattern of the spending is quite positive, there is a considerable variation at the country level dynamics. Turkey has the most notable growth rate as the government's spending on health care increased more than fourfold while Qatar maintained the leadership with an average annual per capita spending of 1616.2 USD in 2006-2010. Governments in Bahrain, Kuwait and UAE spent 916.8, 896.8 and 862.8 per capita, respectively. At the bottom of the list are Iraq, Morocco, Syria and Yemen with annual per capita public spending below 100 USD in 2006-2010.

Table 1. Annual per capita government expenditures on health (PPP* int. $)

	1990-1995	1996-2000	2001-2005	2006-2010
Qatar	944.1	1001.6	1803.6	1616.2
Bahrain	553.9	584.6	655.8	916.8
Kuwait	811.4	725.0	679.2	896.8
UAE	721.9	689.0	616.8	862.8
Saudi Arabia	245.7	370.6	531.8	662.8
Turkey	123.9	211.6	355.6	623.0
Oman	405.9	433.6	556.6	550.0
Lebanon	212.0	235.2	300.8	465.8
Libya	108.1	146.0	287.2	365.2
Jordan	141.1	148.4	178.4	284.8
Algeria	142.3	142.4	176.0	257.8
Tunis	113.3	130.8	180.4	263.2
Iran	90.3	116.0	179.2	262.0
Djibouti	40.4	52.2	67.0	113.6
Egypt	49.3	63.4	89.6	110.8
Iraq	10.0	13.2	48.2	91.8
Morocco	26.4	28.6	44.6	80.0
Syria	65.3	62.4	79.0	54.0
Yemen	23.6	40.6	48.8	40.6
Average in the region	254.2	273.4	362.0	448.3

* Purchasing power parity

Average annual per capita private expenditures in the MENA region have increased as well though the growth rate was less remarkable than that of the public spending. Once again, the largest increase was observed in Turkey where per capita expenditures grew from 54.0 USD per year in 1990-1995 to 239.0 USD in 2006-2010. Lebanon remained on the top of the table

largely due to well-developed financial services industry that includes a large network of health insurance firms. Gulf states followed with annual expenditures of 406.2 USD in Qatar, 403.4 USD in Bahrain, and 394.8 USD in UAE. At the bottom of the list are Iraq and Djibouti with less than 50 USD of annual private spending per year.

Table 2. Annual per capita private expenditures on health (PPP* int. $)

	1990-1995	1996-2000	2001-2005	2006-2010
Lebanon	530.6	567.8	485.0	506.8
Qatar	547.6	479	493.0	406.2
Bahrain	242.1	262.8	307.5	403.4
UAE	191.3	195.8	230.2	394.8
Iran	109.7	139.2	216.5	361.6
Saudi Arabia	223.1	217.4	206.0	298.6
Turkey	54.0	107.6	155.8	239
Tunis	104.7	116.4	158.0	229.6
Kuwait	184.3	201.6	184.3	211.2
Libya	110.4	138.4	162.7	186.8
Jordan	87.4	121.4	167.8	175.4
Egypt	58.1	94.4	128.8	153.4
Morocco	56.9	69.2	108.3	149.6
Oman	77.0	93	117.2	146.4
Yemen	47.3	44.4	57.8	97
Syria	101.6	103.8	89.0	85.4
Algeria	46.0	49.2	53.8	66.4
Iraq	53.0	23.2	26.8	37.8
Djibouti	27.0	28	31.5	36.2
Average in the region	150.1	160.7	177.9	220.3

* Purchasing power parity

Finally, Table 3 displays out-of-pocket (OOP) expenditures as a percentage of private health spending. Countries with least developed health insurance sectors and lower private expenditures tend to have the highest share of OOP expenditures. In Iraq, Lybia and Syria all the private spending on health care are paid in cash by patients due to a lack of private health care insurance schemes. In contrast, in the MENA countries with more developed financial services industries and higher private expenditures OOP expenses constitute significantly lower share of private spending. Saudi Arabia, Oman, Bahrain, Turkey, UAE and Qatar have the lowest share of OOP expenses.

Table 3. Out-of-pocket expenditures as a percentage of private expenditures on health

	1990-1995	1996-2000	2001-2005	2006-2010
Iraq	100	100	100	100
Libya	100	100	100	100
Syria	100	100	100	100
Djibouti	98,3	98,4	98,6	98,6
Egypt	89,6	95,7	98,3	97,9
Yemen	95,6	94,6	96,2	97,3
Iran	97	96,6	95,4	96,6
Algeria	97	96,8	95,2	94,7
Kuwait	93,8	93,8	92,5	91,6
Tunis	78,4	83,9	81,8	86,7
Morocco	77,8	76,9	80,9	86,3
Jordan	64,3	70,4	80,2	85
Lebanon	77,2	80,6	76,2	77,8
Qatar	92,7	88,7	84,8	77
UAE	71	69,5	68,3	66,5
Turkey	100	89,7	68,5	66,3
Bahrain	71,2	71,3	68,8	61,7

Oman	63,2	64	61,6	61,7
Saudi Arabia	72,9	70,5	64,8	54,5
Average in the region	86,3	86,4	84,9	84,2

Regression estimates

Infant Mortality

We first present results for the infant mortality in Table 4. Columns under (1)–(3) focus on the impact of the government spending on health on infant mortality while columns (4)-(6) present parameter estimates of the empirical relationship between private expenditures on health, OOP and infant mortality rates. Column (1) and (4) employ the pooled OLS techniques, columns (2) and (5) show the estimates of the random effect model while columns (3) and (6) display results of the Hausman-Taylor IV estimation technique.

As shown in columns (1) – (3) increase of per capita government health expenditures significantly reduces infant mortality rate. In particular, a percentage increase in per capita government expenditures reduces the infant mortality rate by 8.6-9.5 deaths per 1000 live births. The effect is statistically significant and robust to model selection and specifications. The estimated effect is causal in nature since in Hausman-Taylor IV model, the parameter estimate remains statistically significant at 0.01 significance level.

We also report that controlling for government expenditures on health an increase of government's share in health spending increases infant mortality. A percentage increase of government's share in health spending increases infant mortality rate by 0.25-0.40 deaths per 1000 live births.

As expected, improvement of the access to safe drinking water, increasing share of birth rates attended by the health personnel and adult literacy rate reduce infant mortality rate. More specifically, from the Hausman-Taylor IV model a percentage increase in the access to safe water saves 0.71 infant lives per 1000 live births; a percentage increase in the share of births attended by the health personnel reduces infant mortality rate by 0.53 lives per 100 live births; a percentage increase in adult literacy rate reduces mortality rate by 0.33 lives per 1000 live births. Effect of physician's density and hospital beds availability are not statistically significant. In the OLS model, R-square is 0.83 confirming a good fit of the suggested equations.

Consider models (4)-(6) that examine the effect of the private and OOP expenditures on infant mortality rate. A percentage increase in per capita private expenditures reduces the infant mortality rate by 7.2-8.1 deaths per 1000 live births. Once again, the effect is statistically significant and robust to model selection and specifications. The estimated effect is causal as well in nature since in Hausman-Taylor IV model, the parameter estimate remains statistically significant at 0.01 significance level. While increased private expenditures reduce infant mortality rate, OOPs'share in private health spending has a slight negative effect. A percentage

increase of OOP's share in private health spending increases infant mortality rate by 0.24-0.26 deaths per 1000 live births.

The estimated effects of other control variables are consistent with parameter estimates from the models (1)-(3). Improved water access, birth settings and literacy reduce infant mortality rate while the effects of number of physicians and hospital beds are not statistically significant at conventional levels of confidence. The models have a good fit with 0.84 R-square in the OLS model.

Table 4. Effect of government, private and out-of-pocket expenditures on infant mortality

	Effect of government expenditures on infant mortality			Effect of private expenditures on infant mortality		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Pooled OLS	Panel Random Effects	Panel Hausman-Taylor IV	Pooled OLS	Panel Random Effects	Panel Hausman-Taylor IV
Log of per capita government expenditure on health (PPP int. $)	-8.650***	-9.517***	-9.178***			
	[2.945]	[0.848]	[0.831]			
Govern expend on health as a percentage of total expend on health	0.398**	0.280***	0.252***			
	[0.174]	[0.040]	[0.039]			
Log of per capita private expenditure on health (PPP int. $)				-8.113***	-7.511***	-7.155***
				[2.817]	[0.806]	[0.796]
Out-of-pocket expend as a percent of private expend on health				0.096	0.241***	0.256***
				[0.113]	[0.039]	[0.039]

Population with an access to safe drinking-water (%)	0.149	-0.619***	-0.708***	0.192	-0.586***	-0.658***
	[0.169]	[0.081]	[0.081]	[0.186]	[0.081]	[0.081]
Birth attended by skilled health personnel (%)	-0.192	-0.497***	-0.531***	-0.189	-0.548***	-0.576***
	[0.142]	[0.038]	[0.038]	[0.138]	[0.039]	[0.039]
Adult literacy rate (%)	-0.933***	-0.354***	-0.325***	-0.928***	-0.410***	-0.393***
	[0.213]	[0.054]	[0.052]	[0.222]	[0.051]	[0.050]
Physicians density (per 10 000 population)	0.158	0.684**	0.230	0.091	0.665**	0.691
	[0.264]	[0.334]	[1.108]	[0.273]	[0.333]	[0.599]
Hospital beds (per 10 000 population)	0.304	-0.438	-0.163	0.348	-0.332	-0.359
	[0.342]	[0.358]	[1.239]	[0.355]	[0.357]	[0.648]
Observations	399	399	399	399	399	399
R-squared	0.834			0.835		
Number of id		19	19		19	19

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Under-five mortality rate

The analysis of the under-five mortality rate produces quite similar results. In Table 5 columns under (1)–(3) focus on the impact of the government spending on health on under-five mortality while columns (4)-(6) present parameter estimates of the empirical relationship between private expenditures on health, OOP, and under-five mortality rates. As shown in columns (1) – (3) increase of per capita government health expenditures significantly reduces under-five mortality rate. In particular, a percentage increase in per capita government expenditures reduces the under-five mortality rate by 10.3-12.1 under-five deaths per 1000 live births. The effect is statistically significant and robust to model selection and specifications. The estimated effect is

causal in nature since in Hausman-Taylor IV model, the parameter estimate remains significant amplifying policy implications of the result.

Increase in government's share in health spending is associated with greater under-five mortality. A percentage increase of government's share in health spending increases under-five mortality rate by 0.33-0.51 deaths per 1000 live births. The finding may suggest that compared to public expenditures, private health spending have a greater effect on reduction of under-five mortality.

Availability of safe drinking water sources, higher share of birth rates attended by the health personnel as well as adult literacy rate are associated with reduced under-five mortality rate. From the Hausman-Taylor IV model, a percentage increase in the access to safe water reduces under-five mortality by 0.86 lives per 1000 live births; a percentage increase in the share of births attended by the health personnel reduces under-five mortality rate by 0.76 lives per 100 live births; a percentage increase in adult literacy rate reduces under-five mortality rate by 0.51 lives per 1000 live births. Similar to the case of infant mortality effect of physician's density and hospital beds availability are not statistically significant factors of under-five mortality rate. In the OLS model, R-square remains high 0.83.

Columns (4)-(6) examine the effect of the private and OOP expenditures on under-five mortality rate. A percentage increase in per capita private expenditures reduces under-five mortality rate by 9.5-9.8 deaths per 1000 live births. This finding remains statistically significant and robust across all three models thus pointing out a causal relationship. Meanwhile an increase of the OOP expenditures increases under-five mortality rate by 0.23-0.24 live births.

Table 5. Effect of government, private and out-of-pocket expenditures on under-five mortality

	Effect of government expenditures on under-five mortality			Effect of private expenditures on under-five mortality		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Pooled OLS	Panel Random Effects	Panel Hausman-Taylor IV	Pooled OLS	Panel Random Effects	Panel Hausman-Taylor IV
Log of per capita government expenditure on health (PPP int. $)	-10.338**	-12.077***	-11.789***			
	[3.909]	[1.169]	[1.160]			
Govern expend on health as a percentage of total	0.506**	0.358***	0.332***			

expend on health						
	[0.239]	[0.055]	[0.054]			
Log of per capita private expenditure on health (PPP int. $)				-9.770**	-9.804***	-9.547***
				[3.771]	[1.130]	[1.131]
Out-of-pocket expend as a percent of private expend on health				0.120	0.228***	0.240***
				[0.154]	[0.055]	[0.055]
Population with an access to safe drinking-water (%)	0.073	-0.772***	-0.853***	0.128	-0.746***	-0.799***
	[0.223]	[0.112]	[0.112]	[0.239]	[0.114]	[0.114]
Birth attended by skilled health personnel (%)	-0.324	-0.729***	-0.764***	-0.307	-0.776***	-0.798***
	[0.210]	[0.053]	[0.053]	[0.207]	[0.054]	[0.054]
Adult literacy rate (%)	-1.179***	-0.533***	-0.507***	-1.164***	-0.618***	-0.605***
	[0.299]	[0.074]	[0.073]	[0.316]	[0.071]	[0.071]
Physicians density (per 10 000 population)	0.285	0.955**	0.951	0.199	0.931**	0.978
	[0.348]	[0.469]	[0.864]	[0.348]	[0.467]	[0.625]
Hospital beds (per 10 000 population)	0.249	-0.524	-0.538	0.294	-0.406	-0.443
	[0.450]	[0.503]	[0.937]	[0.462]	[0.501]	[0.673]
Observations	399	399	399	399	399	399
R-squared	0.825			0.825		

Number of id	19	19	19	19

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

The estimated effects of other control variables are consistent with parameter estimates from the models (1)-(3). Improved water access, birth settings and literacy reduce under-five mortality rate while the effects of number of physicians and hospital beds are not statistically significant at conventional levels of confidence.

Maternal mortality

An increase of government expenditures reduces maternal mortality rates (Table 6). A percentage increase in per capita government expenditures reduces maternal mortality rate by 26.0-26.3 deaths per 100000 live births. Once again, the estimated effect is causal in nature since in Hausman-Taylor IV model.

An increase in government's share in health spending is associated with higher probability of maternal mortality. In particular, a percentage increase of government's share in health spending increases maternal mortality rate by 0.98-1.02 deaths per 100000 live births. Similar to findings related to infant and under-five mortality, availability of safe drinking water sources, higher share of birth rates attended by the health personnel as well as adult literacy rate are associated with reduced maternal mortality rate while an effect of physician's density and hospital beds availability are not statistically significant factors of under-five mortality rate. In the OLS model, R-square remains high 0.83.

Columns (4)-(6) in Table 6 report the estimated the effect of the private and OOP expenditures on maternal mortality rate. A percentage increase in per capita private expenditures reduces the maternal mortality rate by 25.8-25.9 deaths per 100000 live births. The estimated effect is causal as well in nature since in the Hausman-Taylor IV model the parameter estimate remains statistically significant. While increased private expenditures reduce infant mortality rate OOPs' growth have a slight negative effect. A percentage increase of government's share in health spending increases infant mortality rate by 0.77-0.84 deaths per 100,000 live births.

Table 6. Effect of government, private and out-of-pocket expenditures on maternal mortality

	Effect of government expenditures on maternal mortality			Effect of private expenditures on maternal mortality		
	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Pooled OLS	Panel Random Effects	Panel Hausman-Taylor IV	Pooled OLS	Panel Random Effects	Panel Hausman-Taylor IV

Log of per capita government expenditure on health (PPP int. $)	-21.252	-26.009***	-26.337***			
	[15.434]	[5.399]	[5.475]			
Govern expend on health as a percentage of total expend on health	1.246	1.022***	0.981***			
	[0.838]	[0.253]	[0.257]			
Log of per capita private expenditure on health (PPP int. $)				-20.200	-25.823***	-25.868***
				[15.396]	[5.122]	[5.189]
Out-of-pocket expend as a percent of private expend on health				0.274	-0.768***	-0.836***
				[0.650]	[0.251]	[0.252]
Population with an access to safe drinking-water (%)	-0.943	2.206***	2.584***	-0.812	1.959***	2.305***
	[0.853]	[0.513]	[0.534]	[0.924]	[0.513]	[0.529]
Birth attended by skilled health personnel (%)	-1.392	-2.797***	-2.938***	-1.273	-2.647***	-2.739***
	[0.921]	[0.243]	[0.250]	[0.885]	[0.246]	[0.252]
Adult literacy rate (%)	-3.745***	-2.675***	-2.563***	-3.659***	-2.934***	-2.891***
	[1.058]	[0.344]	[0.346]	[1.100]	[0.324]	[0.324]
Physicians density (per 10 000 population)	1.402	-1.535	3.389	1.182	-1.524	-1.111
	[1.531]	[1.809]	[8.068]	[1.534]	[1.796]	[4.652]

Hospital beds (per 10 000 population)	-1.545	0.642	-2.566	-1.533	0.492	0.230
	[1.586]	[1.935]	[9.117]	[1.624]	[1.923]	[5.065]
Observations	399	399	399	399	399	399
R-squared	0.808			0.806		
Number of id		19	19		19	19

Robust standard errors in brackets

*** p<0.01, ** p<0.05, * p<0.1

Discussion and Conclusion

In this paper, we attempt to evaluate causal relationships between health care expenditures at the country level from public and private sources in the MENA region and three health outcomes namely infant, under-five, and maternal mortality rates. The study focuses on countries in the MENA region limiting external validity of the results in terms of applicability to other geographical locales. Having said that we emphasize importance of results to policy-makers in the MENA region where health care spending were on a rise and welcome similar research attempts for other regions. We did not perform cross-country comparisons because data on public health expenditure and mortality are unlikely to be comparable across countries.

All three health outcome measures are included in the Millennium Development Goals (MDGs) approved by the United Nations in 2000. All 189 United Nations member states including the MENA countries and at least 23 international organizations agreed to achieve these goals by the year 2015. Therefore, both government and private sector in the region have been tackling these issues by investing in hospitals, clinics and personnel in urban and rural areas. Largely due to these efforts, we have witnessed significant improvement in infant, child, and maternal mortality in the region.

The average infant mortality rate declined from 42.4 deaths per 1000 live births in 1990-1995 to 24.7 in 2006-2010. Child mortality rate in the region has been reduced from 54.4 deaths per 1000 live births in 1990-1995 to 30.2 in 2006-2010 while within the same time period, the average maternal mortality rate declined from 134.6 deaths per 100000 births down to 71.1. Although overall regional dynamics have been quite positive, the panel data shows a significant variation within the region. While Gulf Coast countries and Turkey advanced significantly across all three dimensions, the progress in Iraq, Morocco, Syria, and Yemen remains to be seen. For example, health reforms associated with the Health Transformation Program of Turkey and improvements in the scale and functioning of the healthcare system in recent years appear to play an important role in improvement of key health outcomes in Turkey (Akinci et al, 2012; OECD, 2008). Future research studies should examine the underlying factors associated with variations in health outcomes in the MENA region.

Using Pooled OLS, random effects, and Hausman-Taylor IV model, we find that both government and private spending on health care improve infant, child and maternal mortality in the MENA region. In particular, a percentage increase in per capita government expenditures reduces the infant mortality rate by 8.6-9.5 deaths per 1000 live births ($p<0.01$), the under-five mortality by 10.3-12.1 under-five deaths per 1000 live births ($p<0.01$), and maternal mortality by 26.0-26.3 deaths per 100000 live births ($p<0.01$). Similarly, a percentage increase in the log per capita private expenditures reduces the infant mortality rate by 7.2-8.1 deaths per 1000 live births ($p<0.01$), under-five mortality rate by 9.5-9.8 deaths per 1000 live births ($p<0.01$), and the maternal mortality rate by 25.8-25.9 deaths per 100000 live births ($p<0.01$). All the estimated effects are causal in nature as opposed to associative relationship that has been reporting in the existing literature.

The study also suggests that while increased private expenditures reduce infant mortality, under-five and maternal mortality rates, an increase in the OOP has a slight negative effect. This finding highlights the need for developing health policies to address the high financial burden placed on low-income citizens in some of the MENA countries such as Iraq, Lybia, and Syria. In line with existing literature on the topic, we also report that improvements in access to safe drinking water, increasing share of birth rates attended by the health personnel and adult literacy rate reduce infant, under-five and maternal mortality rates.

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