DOI: 10.52950/ES.2022.11.2.010

HEALTH EXPENDITURE, LIFE EXPECTANCY, FERTILITY RATE, CO2 EMISSIONS AND ECONOMIC GROWTH DO PUBLIC, PRIVATE AND EXTERNAL HEALTH EXPENDITURE MATTER

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Abstract:

This article aims to detect empirically, the nexus dynamic interrelationships between health expenditure, totally and disaggregated, economic growth, fertility rate, life expectancy and CO2 emissions in six middle-income MENA countries, namely, (Algeria, Egypt, Jordan, Lebanon, Morocco, and Tunisia), during 2000 to 2019. We employ an advanced econometric technique, Dynamic Panel Data system analysis, which allows estimating time rarely variant variables. Article results show a significant and robust positive association between health expenditure and economic growth, in one hand, and negative associations between economic growth and all which of, fertility rate, life expectancy and CO2 emissions, on the other hand. Moreover, a negative nexus between fertility rate and life expectancy has been detected. Public, private and external health expenditure affect economic growth positively and significantly, meanwhile affect fertility rate negatively, except health public expenditure, which seems to encourage fertility rate. This indicates that disaggregated health expenditure matters for examination. Furthermore, negative impact of CO2 emissions on growth and life expectancy can crowd out health expenditure positive impacts on both growth and life expectancy. A series of recommendations have been introduced such as increasing health share in public spending, and for more effective government health expenditure and control pollution and CO2 emissions. Furthermore, health spending, policies and system has to function as well to mitigate impacts of high fertility, in marginalized, rural and fungible population and areas. This article shines a light on the notable issues in the area, whereas high fertility rate, limited government health expenditure, high employment and low awareness for pollution and environment degradation.

Keywords:

Health Expenditure, Economic Growth, Fertility Rate, Life Expectancy, CO2 emissions, GMM DPD system and Arab Region

JEL Classification: C23, H51, I15

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Citation:

MAHMOUD SABRA (2022). Health expenditure, life expectancy, fertility rate, CO2 emissions and economic growth Do public, private and external health expenditure matter. International Journal of

Economic Sciences, Vol. XI(2), pp. 179-191., 10.52950/ES.2022.11.2.010

1. Introduction

The nexus relationship between health expenditure and economic growth has been attracted a great attention in economic literature, recently. Higher economic growth and output enhances more health expenditure, which is highly and positively associated with output. In fact, health expenditure plays an essential role in improving economic development. It improves people's wellness, participation in production, acquisition of more education and life expectancy, that in turn increases production under high level of labor participation. Better health reduces production losses because workers illness, and allows to transfer financial resources to various alternatives instead of treating diseases, WB, (1993), that would increase/reduce both profits/costs and tax revenue/ burdens at micro and macro levels, respectively. Life expectancy in the selected countries range from minimum value equals 57.5 to maximum value equals 79, and have increased in range for each country from 15 to 19 year in average during period from 1980 to 2020 that reflects the essential and influential impact of health expenditure, knowledge, progress and infrastructure. Moreover, higher level of life expectancy enlarges elderly category in society that have to led to more expenditure on chronic diseases, such diabetes and cancer, which increase burden on public expenditure. Therefore, several much-related matters have been in focus of literature such as life expectancy, fertility rate and CO_2 emissions have to be included in such work. Furthermore, whether public, private or external health expenditure matters or not. This is raising a question concerning the health expenditure adequacy, whereas whether the total types of expenditure are similar in efficiency or not? Health is wealth and expanding the health expenditure is highly desired in developing countries, meanwhile thoughts in developing countries that spending on environment is not as much as likely or important for growth and development. Pollution impacts on environment and health may cause a crowding out the benefits of health expenditure, at least partially, that impose measuring the impact of CO_2 emissions on economic growth.

A very limited work discusses such issues in the Arab region. A middle-income level country from Arab region have been selected as long as income level either high, middle or low is highly matters in these relationships.

In the next section we review the theoretical and empirical literature, then we derive the models, then we introduce methodology and data, and finally we present the results, conclusions, recommendations and policy implication.

2. Literature review

Very rare studies have been discussed the variety of interrelationships between health expenditure, disaggregated to government, private and external health expenditure, life expectancy, fertility rate, CO_2 emissions and economic growth. Furthermore, the nexuses relationships between health expenditure, economic growth, fertility rate and life expectancy. Moreover, very limited work exists in the MENA countries. Studies that have discussed the health care impact on economic growth have a wider range, and present a conflicting results positive, negative and inconclusive impacts. Several studies have found positive relationship between health expenditure and economic growth such as Parkin, et al. (1987), Hansen, & King, (1996). In addition, Rivera & Currais (1999), used data for OECD countries to examine relationship between health status and productivity and found positive effect of health on economic growth. Blázquez et al. (2015), examined the growth effects of early life health for 17 Spanish regions during the period 1980–2007, and found that higher infant mortality has a direct negative impact on per capita income growth as a result of greater risk of early-life death that cause losses of capital and human accumulations that in turn reduces growth. Khan, &

Khattak, (2022), examined the nexus between public health expenditure and economic growth using panel data from 1995 to 2018 for seven South Asian countries. It found that long-term economic growth is positively affected by public health expenditure, HDI, labor force, life expectancy, and infant mortality. In addition, public health expenditure is positively and significantly impact on economic growth. In fact, a well known important, significant and positive impact of human capital, expressed and influenced by expenditure on health and education, meanwhile, such impact depends on the healthier labor force participation in total factor productivity (TFP). On the other side, more expenditure on health accompanied with high rate of unemployment especially in youth unemployment, may cause no or negative impact on economic growth through higher burdens on public and private budgets, and higher expenses on elderly peoples. Rengin, (2012), found a long-term causality relationship between health expenditures, economic growth and life expectancy for the Turkish economy, meanwhile, there is not a short-term relationship although there is a long-term relationship between health expenditures and economic growth. Erçelik, (2018), examined relationship between health spending both private and public and GDP in Turkey from 1980 and 2015 by using investment and found that there is a significant relationship in the long-run. Behera, & Dash, (2018), examined the dynamic relationships between public health expenditure and macroeconomic factors (economic growth, domestic revenue, domestic debt, fiscal balance, and central government transfer) of 15 major states of India; results show that non-tax revenue and direct tax show no impact on public health expenditure in the short run, while it shows a positive impact in the long run, and concluded that economic growth and fiscal balance lead to a favorable impact on public health expenditure in the long run.

On the other hand, Eggoh, et al. (2015), provides an evidence that public expenditures on education and health have a negative impact on economic growth, whereas human capital stock indicators have a slight positive effect, using panel of 49 African countries from 1996 to 2010. Furthermore, Frimpong and Adu (2014), found no significant impact of healthie population on economic performance using panel data for 30 sub-Saharan Africa. In addition, Afonso and Sarabanda, (2016), found no impact of healthy labor as a share in skilled population on economic growth. Yazdi and Khanalizadeh (2017), examined the impacts of economic growth and environmental quality on heath expenditure in MENA countries during 1995–2014, found long-run elasticities show that income and CO2 and PM10[1] emissions have significant positive effects on health expenditure, and that health expenditure is not more sensitive to income and the adjustment to changes in income in MENA countries. Ghorashi, & Rad, (2017), examined the causal relationship between CO2 emissions, health expenditures, and economic growth, using dynamic simultaneous equation models in Iran for 1972–2012, and found results show that there is a bidirectional relationship of causality between CO2 emissions and economic growth, and also a unidirectional relationship of causality from health expenditures to economic growth. Wang, et al. (2019), examined linkages among CO2 emissions, health expenditures, and economic growth in the presence of gross fixed capital formation and per capita trade by ARDL model for Pakistan during 1995–2017. Its results show that there is significant long run as well as short-term causal relationship between health expenditure, CO2 emissions, and economic growth, and Bidirectional relationship of Granger causality is found between health expenditures and CO2 emissions, and further between health expenditures and economic growth. Short-run unidirectional causality is running from carbon emissions to health-related expenditures. The bidirectional causal relationship is also investigated between carbon emissions and growth as well as gross fixed capital formation and growth.

[1] Any particulate matter in the air with a diameter of 10 micrometers or less, including smoke, dust, soot, salts, acids, and metals.

The previous literature shows the dialectical and conflicted results in the field, and in addition, limited studies, which examine extensively the interrelationships among health expenditure, current, governmental, private and external; economic growth, fertility rate, life expectancy and CO2 emissions, especially in the Arab region.

3. Empirical Investigations

3.1 Models specifications

In this part we present our models specifications to detect the various interrelationships. Models equations examine, the dual relationships between health expenditure and economic growth, whereas the health expenditure examined totally as current health expenditure and expressed by disaggregated health expenditure by, public, private and external health expenditure. One of the main purposes of this study is to examine, whether impact differences between public, private and external health raise or not; firstly, the impact on growth in the presence of capital and labor; secondly, the impacts on fertility rate; and thirdly, the impacts on growth in the presence of CO2, also. The growth equations include capital and labor force. This disaggregation clarifies not just whether each type is sufficient or not, but whether is it efficient or not, also.

Furthermore, the nexuses impact of life expectancy and fertility rate on economic growth and current health expenditure, have been examined, as shown in the various model's equations below. Finally, the impact of CO2 emissions on economic growth in the presence of the health expenditure, either totally or disaggregated, have been examined according the model's equations below. In fact, Carbon dioxide is the most proxy represent the environmental degradation and the impact of climate change on the humans and workers health. On the other hand, we detect the impact of growth, fertility rate, life expectancy and population on CHE. The nexus relationships between growth and life expectancy, from one side; and life expectancy and fertility rate have been detected. The impacts of health expenditure types and life expectancy also have been detected on fertility rate. The impact of CO2 on growth has been detected whether in the presence of aggregated or disaggregated health expenditure. Finally, the dynamic analyses show the lagged dependent variable, which is the strongest explanatory variable determine the future behavior.

3.1.1. Model one

It consists of three equations; equation 1.1 and 2.1, health expenditure, (total and disaggregated) impacts on economic growth. And transversely, equation 3.1, which detect the impact of growth on current health expenditure.

Equation 1.1: the impact of current health expenditure on economic growth, in the presence of growth determinants.

$$\mathbf{Ln\ GDP} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \Delta\ \mathbf{Ln\ GDP}_{\boldsymbol{t-1}} + \boldsymbol{\beta_2} \Delta\, \boldsymbol{GCF}$$

$$+\boldsymbol{\beta_3} \Delta\ \mathbf{Ln\ Labor} + \boldsymbol{\beta_4} \Delta\ \mathbf{Ln\ CHE} + \mu + \Delta \nu_t$$

Equation 1.1

Equation 1.2: the impact of public, private and external health expenditure on economic growth, in the presence of growth determinants.

$$\Delta \text{ Ln GDP } = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \Delta \text{ Ln GDP}_{t-1} + \boldsymbol{\beta_2} \Delta \boldsymbol{GCF} + \boldsymbol{\beta_3} \Delta \text{ Ln Labor}$$

$$+ \boldsymbol{\beta_4} \Delta \text{ Ln GHE} + \boldsymbol{\beta_5} \Delta \text{ Ln PHE} + \boldsymbol{\beta_6} \Delta \text{ Ln EHE} + \mu + \Delta v_t$$

Equation 1.2

Equation 1.3: the impact of economic growth on current health expenditure.

$$\Delta \text{ Ln CHE } = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \Delta \text{ Ln } \boldsymbol{CHE_{t-1}} + \boldsymbol{\beta_2} \Delta \boldsymbol{POP} + \boldsymbol{\beta_3} \Delta \text{ Ln Fertility}$$

$$+ \boldsymbol{\beta_4} \Delta \text{ Ln Life} + \boldsymbol{\beta_5} \Delta \text{ Ln GDP} + \mu + \Delta v_t$$

Equation 1.3

3.1.2. Model Two

It consists of three equations; equation 2.1 measures the impact of both fertility rate and life expectancy on economic growth, in the presence of health expenditure types and the other output determinants.

Equation 2.2 measures the impact of GDP, CO2 emissions and health expenditure on life expectancy. Equation 2.2 detects the impacts life expectancy and health expenditure types, public, private and external, on fertility rate.

Equation 2.1: the impact of public, private and external health expenditure on economic growth, in the presence of both life expectancy and fertility rate and growth determinants.

$$\Delta \text{ Ln GDP } = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \Delta \text{ Ln GDP}_{t-1} + \boldsymbol{\beta_2} \Delta \boldsymbol{GFCF} + \boldsymbol{\beta_3} \Delta \text{ Ln Labor}$$

$$+ \boldsymbol{\beta_4} \Delta \text{ Ln GHE} + \boldsymbol{\beta_5} \Delta \text{ Ln PHE} + \boldsymbol{\beta_6} \Delta \text{ Ln EHE} + \boldsymbol{\beta_7} \Delta \text{ Ln Fertility}$$

$$+ \boldsymbol{\beta_8} \Delta \text{ Ln Life } \mu + \Delta v_t$$

Equation 2.1

Equation 2.2: the impact of health expenditure, economic growth, population, fertility rate and CO2 emissions on life expectancy.

$$\Delta \text{ Ln Life } = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \Delta \text{ Ln } \boldsymbol{Life_{t-1}} + \boldsymbol{\beta_2} \Delta \boldsymbol{POP} + \boldsymbol{\beta_3} \Delta \text{ Ln CHE}$$

$$+ \boldsymbol{\beta_4} \Delta \text{ Ln GDP} + \boldsymbol{\beta_5} \Delta \text{ Ln CO2} + \boldsymbol{\beta_6} \Delta \text{ Ln Fertility } \mu + \Delta v_t$$

Equation 2.2

Equation 2.3: the impact of public, private, external health expenditure and life expectancy on fertility rate.

$$\Delta \text{ Ln Fertility } = \boldsymbol{\beta_0} + \boldsymbol{\beta_1} \Delta \text{ Ln } \boldsymbol{Fertility_{t-1}} + \boldsymbol{\beta_2} \Delta \text{ Ln GHE} +$$

$$\boldsymbol{\beta_3} \Delta \text{ Ln PHE} + \boldsymbol{\beta_4} \Delta \text{ Ln EHE} + \boldsymbol{\beta_5} \Delta \text{ Ln Life } \mu + \Delta v_t$$

Equation 2.3

3.1.3. Model Three

It consists of two equations; equation 3.1 detects the impact of public, private, external health expenditure and CO2 emissions on economic growth, in the presence of growth determinants.

$$\Delta \text{ Ln GDP } = \beta_0 + \beta_1 \Delta \text{ Ln GDP}_{t-1} + \beta_2 \Delta GCF + \beta_3 \Delta \text{ Ln Labor}$$

$$+ \beta_4 \Delta \text{ Ln GHE} + \beta_5 \Delta \text{ Ln PHE} + \beta_6 \Delta \text{ Ln EHE} + \beta_7 \Delta \text{ Ln CO2} \quad \mu + \Delta v_t$$

Equation 3.1

Equation 3.2: the impact of current health expenditure and CO2 emissions on economic growth, in the presence of growth determinants.

$$\Delta \text{ Ln GDP } = \beta_0 + \beta_1 \Delta \text{ Ln GDP}_{t-1} + \beta_2 \Delta GCF + \beta_3 \Delta \text{ Ln Labor}$$

$$+ \beta_4 \Delta \text{ Ln CHE} + \beta_5 \Delta \text{ Ln CO2} \quad \mu + \Delta v_t$$

Equation 3.2

Where GDP is gross domestic product as a proxy of economic growth, and GDP_{t-1} is the lagged GDP as best explanatory variable explains GDP. GCF, GFCF and labor force are gross capital formation, gross fixed capital formation and total labor force respectively, which are proxies for physical capital and human capital as main determinants of economic growth. GHE, PHE, EHE and CHE are government, private, external and current health expenditure, whereas the lately term is the sum of the first three types of health expenditure. Fertility is the fertility rate; and life is the life expectancy at birth; pop is the total population as a proxy of country size. Finally, CO2 is carbon dioxide emissions as a proxy of pollution. μ represents the unobserved country specific effects, and v_t is the standard error. Dynamic Panel Data (DPD) system takes into consideration the cross-country heterogeneity raises from pooled OLS estimation with cross sectional data. In addition, DPD system analysis provides more coherent estimation, for time invariant or rarely variant variables, compared to fixed or random effect models, which addresses several biases related to heterogeneity across countries and time, Mitze, & RWI, (2010), as mentioned in methodology.

4. Econometric Methodology

Standard estimators of the Fixed Effects Model (FEM) and Random Effects Model (REM) approaches, which are normally used for the static panel data model, control for the existence of individual effects. The empirical estimation with these models addresses multiple biases, these biases concern heterogeneity across panels and periods. The problem with the FEM is that it neglects time-invariant variables parameters and cannot estimate. Conversely, the REM defect is the biases realized by the endogeneity problem due to the possible correlation between one or several independent variables, on one hand, and the residuals, on the other hand. However, choosing among the FEM and REM estimators rests on an all-or-nothing decision concerning the assumed correlation of right-hand side variables (independent variables) with the error term. In empirical applications, "the truth may often lie in between these two extremes", Mitze, & RWI, (2010). Arellano-Bover, Blundell-Bond is a notable econometric technique that estimates panel data dynamically in a system of equations. This method is based on the Generalized Method of Moment GMM that has been intensively employed in empirical work of panel data dynamic models. Blundell & Bond, (1998) proposed system GMM estimators to overcome the inconsistent instrumental variables estimators realized by weak instruments. Firstly, it proved that the level GMM estimators by Arellano & Bover (1995) are free from weak instruments when even the parameters concerning the lagged variables are close to unity, and then combined the moment conditions, which are used in first differencing, and the level GMM estimators to improve the efficiency of the estimators, Hayakawa, (2005), Arellano, & Bond, (1998).

This GMM systems technique estimates the parameters from a system of equations: the model differenced using lagged levels of dependent variables, GDP, CHE, fertility rate and life expectancy as instruments for the lagged difference of, GDP, CHE, fertility rate and life expectancy equations. Secondly, it uses the differences as instrumental variables in the model, Arellano & Bover, (1995); Arellano & Bond (1998); Blundell & Bond, (1998). Therefore, the article estimates dynamic panel data system analysis, which is Arellano-Bover Blundell-Bond. Furthermore, the DPD system estimation is more reliable to detect the impact of the nexus relationships between all health expenditure and economic growth; health expenditure and fertility rate; health expenditure and life expectancy and finally life expectancy and fertility rate. Other impact has been detected such as CO2 on economic growth and life expectancy. Furthermore, this technique allows to detect dynamic and long run impacts for the variables. Moreover, this technique allows to estimate time rarely variant variable that would be such as life expectancy and fertility rate. Finally, the long-run coefficients are calculated by the equation: long-run parameter (coefficient) = determinant (independent variable) coefficient / 1-parameter correspondent to lagged coefficient, Sabra, (2015).

5. Data

We use secondary panel data of six middle-income selected MENA countries, namely (Algeria, Egypt, Jordan, Lebanon, Morocco, and Tunisia) during the period from 2000 to 2019, according the availability of health expenditure data types in the world economic indicators of the world bank. In addition, health data is not available for Palestine. All value data measured in US dollar. The estimations and variables included are economic growth proxied by Gross Domestic Product (GDP), Gross Capital Formation (GCF) and Gross Fixed Capital Formation (GFCF) as proxies for physical capital as a determinant of growth, government health expenditure per capita (GHE), private health expenditure per capita (PHE), External health expenditure per capita (EHE), current health expenditure per capita (CHE), which is the aggregation of the other previous three types of health expenditure; total labor force as a determinant of GDP, fertility rate births per woman, life expectancy at birth, total (years), CO2 emissions (metric tons per capita), total population as a measure of country size. The variables proxies are intensively included in the previous literature. All row data for the variables are collected from the World Bank database. Limited missing values exist. All variables are taken in an algorithm to provide elasticities, ensure linearity and reduce any potential multicollinearity with STATA software being employed for the estimations, and postestimations.

6. Empirical results

We introduce results for the models and equations shown before.

The following tables show the estimations results of our models.

Table 1: Dynamic Panel Data System estimations for model one; equations 1.1, 1.2 and 1.3.

	L. GDP	GCF	Labor	CHE				Constant	chi2
GDP	.59* (14.41)	.18* (8.36)	.26* (4.8)	.12* (3.24)				1.2* (5.2)	14606*
Long-run coef.	-	.44	.63	.29				-	
							H0: overidentifying restrictions are valid 253.3*		
	L. GDP	GCF	Labor	GHE	PHE	EHE		Constant	chi2
GDP	.61* (15.2)	.214* (8.2)	.21* (3.75)	.01 (.48)	.05** (2.04)	.02* (3.99)		1.23* (4.69)	13836*
Long-run coef.		.55	.54	.026	.13	.05		-	
							H0: overidentifying restrictions are valid 225.5*		
	L. CHE	POP	Fertility	Life	GDP			Constant	Chi 2
CHE	.49* (14.3)	-.64* (-14.6)	.28* (3.93)	1.03** (2.13)	.54* (15.34)			-4.7** (-2.35)	9417*
Long-term coef.		-1.25	.55	2.01	1.06				
							H0: overidentifying restrictions are valid 200.5*		

*Figures in parentheses are z statistics. The symbols *, **, *** indicate significance at 1%, 5%, and 10%*

Table 1 shows estimations for model one, which includes equations 1.1, 1.2 and 1.3. It presents a robust model, all variables coefficients are significant at 1%, except private health expenditure in equation 1.2 and life expectancy in equation 1.3, whereas both are significant at the 5% level; and government health expenditure, which is insignificant. Furthermore, as shown in the table above, the Sargent tests show that all moment restrictions are satisfied for the dynamic specifications can't be rejected, for each equation. This indicates that the instruments are valid for each equation in the model, the model is robust and correctly specified. All signs are compliant and in accordance with the economic theory and expectations. In addition, table 1 shows the long-run parameters.

Health expenditure either in aggregated term, (current health expenditure), or disaggregated term, (government, private and external health expenditure, have a positive impact on the economic growth in term of GDP. On the other hand, GDP has a strong positive impact on current health expenditure. Capital and labor have been considered as main growth determinants. Moreover, the lagged CHE highly and positively, of course, influence the actual CHE that indicates increasing of health expenditure during time. In addition, fertility rate and life expectancy are positively associated with CHE, meanwhile life expectancy is highly increase health spending as long as elderly needs more social, health and care for chronic diseases. Finally, higher population decreases health expenditure as long as higher burden will raise for more population, moreover, more population, which means higher country size that decrease the government size, which in turn, the higher participant in the health expenditure comparing to the private and external health expenditures, separately.

Table 2: Dynamic Panel Data System estimations for model two; equations 2.1, 2.2 and 2.3.

	L. GDP	GFCF	Labor	GHE	PHE	EHE	Fertility	Life	Constant	chi2
GDP	.59* (15.16)	.19* (3.05)	.29* (5.22)	.14* (4.27)	.1* (4.08)	.02* (3.05)	-.34* (-5.75)	-2.8* (-6.13)	12.93* (6.78)	15332*
Long-run coef.	-	.46	.71	.34	.24	.049	-.83	-6.8	-	
							H0: overidentifying restrictions are valid 221.3*			

	L. Life	POP	CHE	GDP	Co2	Fertility		Constant	chi2
Life	.92* (254.9)	.003* (7.63)	.002* (5.85)	-.0012* (-4)	-.003* (-5.07)	-.005* (-7.6)		-.34* (-.25.9)	789028*
Long-run coef.		.038	.025	-.015	-.038	-.063		-	
							H0: overidentifying restrictions are valid 2220.7*		
	L. Fertility	GHE	PHE	EHE	Life			Constant	chi2
Fertility	.94* (188.4)	.03* (16.8)	-.004** (-2.37)	-.004* (-10.9)	-.13* (-2.84)			.46** (2.51)	
Long-run coef.		.5	-.067	-.067	-2.17				
							H0: overidentifying restrictions are valid 2094.6*		

*Figures in parentheses are z statistics. The symbols *, **, *** indicate significance at 1%, 5%, and 10%*

Table 2 shows estimations for model two, which includes equations 2.1, 2.2 and 2.3, respectively. It presents a robust model, all coefficients are significant at 1%, except private health expenditure in equation 2.3, which is significant at the 5% significance level. Furthermore, as shown in the table above, the Sargent tests show that all moment restrictions are satisfied for the dynamic specifications can't be rejected, for each equation. This indicates that the instruments are valid for each equation in the model, the model is robust and correctly specified. All signs are compliant and in accordance with the economic literature, theory and expectations. In addition, table 2 shows the long-run parameters for different variables.

The first equation (2.1) shows the regular positive impacts of previous income, capital, labor, types of health expenditure on economic growth, and in the presence of both fertility rate and life expectancy. Fertility rate associates negatively on economic growth, whereas higher fertility rate requires higher health expenditure, governmental in specific, and in addition, it increases burdens on family and individual's income and reduces growth. Similarly, life expectancy impacts negatively on fertility rate, in equation 2.3.

Furthermore, higher life expectancy increases health spending burdens on elderly. Moreover, higher fertility rate and higher life expectancy with a high unemployment rate, between youth in specific[2], must reflect negatively on economic growth; whereas it will increase burdens with no essential participations in expenses, directly through PHE, or indirectly through taxes that finance government budget, as a result of high unemployment rate. Fertility rate associates negatively with the life expectancy, as long as increasing fertility rate increases infant mortality, which in turn decreases life expectancy at birth. Increasing pollution through more CO2 emissions reflects badly on children and elderly health and lives, in specific, which in turn decrease the life expectancy. More health expenditure increases life expectancy.

Private and external health expenditure reduce fertility rate meanwhile government health expenditure increases it. This implies several health activities encourage big families, moreover, it may indicate more efficient awareness activities in private health sector toward birth-control, meanwhile government sector doesn’t have such activities or have inefficient ones. Finally, GDP impacts negatively on life expectancy that may seem surprising, meanwhile increasing GDP impacts positively and strongly on government expenditure[3], including government health expenditure that increases fertility rate by 0.03% for each 1% increase in GHE, and then, fertility rate increasing decreases the life expectancy, equation 2.2.

[2] Youth unemployment, total, in the sample countries for available date during period is around 30%, in average.
3 Wagner (1835-1917) states that there is a functional relationship between economy growth and government activities growth, where there are inherent tendencies of central and state governments to increase intensively and extensively. Musgrave explains Wagner's hypothesis through the public sector share of the total economy, which known as the government size.

Table 3: Dynamic Panel Data System estimations for model three; equations 3.1 and 3.2.

	L. GDP	GCF	Labor	GHE	PHE	EHE	CO2	Life	Constant	chi2
GDP	.59* (15.08)	.25* (8.35)	.18* (3.09)	.08** (2.25)	.007* (2.93)	.02* (3.77)	-.12** (-1.89)	-1.95* (-4.39)	9.4* (5.12)	13651*
Long-run coef.	-	.61	.44	.2	.02	.05	-.29	-.4.8	-	
							H0: overidentifying restrictions are valid 201.3*			
	L. GDP	GCF	Labor	CHE	CO2				Constant	chi2
GDP	.56* (13.88)	.21* (8.79)	.25* (4.38)	.144* (3.59)	-.15* (-2.67)				1.43* (6.06)	14032*
Long-run coef.		.48	.57	.33	-.34				-	
							H0: overidentifying restrictions are valid 241.2*			

*Figures in parentheses are z statistics. The symbols *, **, *** indicate significance at 1%, 5%, and 10%.*

Table 3 shows estimations for model three, which includes equations 3.1 and 3.2, respectively. It presents a robust model, all coefficients are significant at 1%, except government health expenditure and CO2 emissions in equation 3.1, which are significant at the 5% significance level. Furthermore, as shown in the table above, the Sargent tests show that all moment restrictions are satisfied for the dynamic specifications can't be rejected, for each equation. This indicates that the instruments are valid for each equation in the model, the model is robust and correctly specified. All signs are compliant and in accordance with the economic literature, theory and expectations. In addition, table 3 shows the long-run parameters for all variables.

CO2 emissions associate negatively and strongly with GDP, in the presence of capital, labor force and health expenditure whether disaggregated, in the equation 3.1, or aggregated, in the equation 3.2. In both cases, CO2 emissions negative impact on growth crowd out essentially the positive impact of health expenditure on growth. This indicates the importance of adapting policies toward facing pollution. Finally, health expenditures associate positively with economic growth, similarly to previous growth equations.

7. Conclusions, recommendations and policy implications

The study detected the interrelationships between health expenditure and economic growth, fertility rate and life expectancy. We employed four proxies of health expenditure; current, governmental, private and external. In addition, fertility rate, life expectancy, CO2 and economic growth interrelationships have been examined. Countries panel are middle-income level to avoid income differences affect health expenditure and other variable, furthermore, dynamic analysis ensures the previous behavior of spending, private or public, and fertility behavior and other variables through the lagged variables. Moreover, dynamic panel data system captures country and time specific effects.

Positive association has been detected between health expenditure types and growth, whereas GHE has strongest impact. Different types of expenditure proved to be complementary, whereas CHE has higher impact on growth than the other three types, meanwhile it's the aggregation of these types. In addition, GDP increase in 1% increases health expenditure by 0.54%. This high marginal effect shows a low level of health expenditure in these countries that recommend to increase health expenditure share to both government expenditure and GDP[4].

On the other hand, PHE and EHE have a negative impact on fertility rate that shows awareness in health activities, private and external, towards birth control, on the other hand, GHE encourages fertility rate. Hence, we recommend reformulate and more efficient policies in GHE to face birth control, instead of encourage it, particularly between poor, marginalized and rural population and areas. This is, of course, as long as fertility rate increasing burdens and decreasing both GDP and life expectancy at birth.

Moreover, negative nexus association has been detected between fertility rate and life expectancy that asserts the policy need to face fertility rate in the region; and increase health expenditure that increase life expectancy.

Furthermore, the negative association between life expectancy and growth shows the burden of health care of elderly and childhood under a high rate of unemployment especially in youth participation (around 30%). In fact, this encourages to recommend higher spend on education, besides health, to improve human development that enhances productivity, participation in employment and reduces fertility rate, whereas educated family members have an attitude to spend more in health and education rather than having big families, which is the dominant attitude of developing countries.

Finally, CO2 emissions have a negative impact on growth can crowd out the positive impact of health expenditure. Therefore, policy recommendation towards pollution control, particularly CO2 emissions, enhances technological changes to reduce negative impacts of pollution on environment and health.

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[4] The domestic general government health expenditure as a share of GDP for selected counties for the same period ranges between 1.6% to 4.4, whereas the average is around 3.5%, 1.6%, 4.4%, 3.3%, 1.9% and 3.3% for Algeria, Egypt, Jordan, Lebanon, Morocco and Tunisia, respectively.

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