Original Research

Effect of Wealth on the Health Expenditure: Application of the Development Approaches Adopted by the OPEC Countries

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Abstract:

Background: Investment in health is considered as an essential requirement in human life. We aim to investigate the relationship between the healthcare expenditure and the wealth for the OPEC countries.

Method: The panel data of 12 countries between 2007 and 2018 were analyzed by the generalized method of moments (GMM) and the Bayesian panel data analysis, applying the healthcare expenditure, GDP per capita, oil price, population growth rate, inflation, life expectancy, and mortality rate as variables.

Results: The results show that the expenditure of healthcare is significantly and negatively linked to the economic growth and the oil price. In addition, the population growth rate, inflation, life expectancy, and the mortality rate have positive effects on the healthcare expenditure. The comparison of the results of these methods supports the convergence and the close relationship between the model parameters; therefore, the model performs well on the available data. The human capital is an essential determinant in the economic situation of the OPEC countries and their growth improvement. The economic planners and policy makers have to consider more health-based investments in the human capital quality to better improve the people's standard of living.

Conclusion: This study helps to develop policies on the health quality and the expansion of biotechnology, pharmaceuticals, and information technology.

Keywords: Healthcare Expenditure, OPEC Member Countries, Wealth, Development Approaches

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Introduction

The produced capital (such as machinery, constructions, and infrastructures), natural capital (such as gas and oil), human capital, and net foreign assets make the national wealth of a country. The largest share of the global wealth is the human capital, which consists two-thirds of the total wealth in the world. Healthy people are the foundation for sustainable development. Consequently, social security expenditures can enhance the labor efficiency by the human capital accumulation, contributes to promotion in sustainable economic development (1). According to the statistics of the World Bank, investment in health is one of the safest fields of investment in the world. Since the beginning of the present century, demographic variations such as population aging and decreasing birth rates have made the social security improvement as a critical issue in developing countries (2, 3). Future health expenditures are likely to be more targeted towards the older population as the age pyramid is shifting towards the elderly in the world (4, 5). Accordingly, diseases and health problems are increasing among the population which would lead to some needs that should be responded. Dealing with these problems and increasing the healthcare service are not, however, possible without absorbing investment in the healthcare domain (6). Previous studies on the oil-rich countries demonstrate that these countries have different behavior in comparison to the countries of the Organization for Economic Cooperation and Development (OECD) in terms of social spending; and additionally, similar patterns of behavior are seen between these countries (7, 8). 'Rentier states' is a term that is applied to refer to the states which rely on their natural resources. These are the countries where a considerable part of the government income is obtained by external rents rather than the national economic activities or taxation (9). Although studies in the field of healthcare costs have focused on the significance of education, income, and health status of families in the OECD member states, a few studies such as Karl (7) have shown that the behavior pattern of the oil-rich countries in the healthcare costs is different from that of the OECD states (10). Since natural resources supply a steady amount of wealth which is independent of transferring human-made capital to the future, the need for investment and saving would decrease (11). The importance of this study is that in developing economies, increased depletion of the natural capital is in direct relationship with the capital accumulation (12). In recent decades, the reduction rate of the natural capital of the developing countries has been averagely five times greater than the eight wealthiest countries. In countries with low and middle income, other investment methods have been employed to a great extent to compensate for the increasing depletion of the natural capital since the late 1990s (13). However, the authors show that this effect can be made up by having a large amount of human capital. In some oil-exporting countries (the OPEC members), revenue changes due to oil price variations would change the political freedom. Democracy suffers when the oil wealth increases. Rentier states have the tendency to be autonomous since countries with larger natural resources are more separate and less responsible, therefore, they feel less need to collect taxes (14, 15). There are shred of evidence of the resource curse in the OPEC member countries which cannot be explained by the Dutch disease syndrome. The economic growth in the oil-exporting countries faces difficulties due to the lack of democracy, and the reprehensible situations of the institutions in these countries ease grabbing of the public resources as well as the oil rents through rent-seeking which result in delays in the economic growth (16). The existence of large reserves of natural resources significantly determines the basis of a country's behavior. Wealth allocation instead of wealth generation is a distinctive characteristic of the rentier states (9). Namely, economic growth is not considered as a necessary measure for income generation; though, some recent investigations have proved that the

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experiences of these countries are more diverse (17). These countries provide their citizens with a broad range of commodities and services, such as healthcare, education, social security, and employment at low or no price (7). However, the importance of this sector relates to the fact that the healthcare costs account for a small share in the GDP, therefore, families have to pay a higher portion which causes their unfair payments that result in the increase in the percentage of families who are faced with backbreaking costs of the healthcare services (7). Papyrakis and Gerlagh (18) studied the income inequality in terms of the time path due to the natural resource booms in countries with rich resources and indicated that after a boom, the inequality drops instantly and then grows steadily over time until the disappearance of the boom's initial impact. This issue is partly associated with the fast-growing costs of the healthcare services since the 1960s affected by various factors including population growth, the change in people's expectations, and the increasing tendency towards the use of modern and expensive healthcare technologies. Fig. 1 compares the average OPEC expenditures on health as a portion of GDP during the time of 2007-2017. By the scientific and detailed study of the subject, the present research can pave the way for further research and help the economic policymakers and planners of the organizations and the relevant authorities to properly plan and achieve their goals. The research applies the Generalized Method of Moments (GMM) and the Bayesian panel data analysis. The Bayesian analysis has some unique features including the ability to incorporate prior information during the analysis, the intuitive interpretation of valid intervals in the character of constant ranges, to which a parameter belongs to a predetermined possibility, and the ability to allocate a real probability to each hypothesis of interest. The data were gathered from the World Bank and the World Health Organization (WHO). To achieve the paper goal and estimate the effect of wealth on the healthcare expenditure, this paper is organized as follows. In section 2, we cover the literature is reviewed; The model is presented in Section 3; Section 4 deals with the model testing and reports the empirical findings of the research, and eventually, we provide conclusions and recommendations in Section 5.

Literature Review

The health expenditures and economic growth relationship

Health expenditures measure the final using of the health care equipment and services containing the personal health care (including the rehabilitative, curative, and long-term cares as well as the medical equipments and supporting services) and collective services (public health and prevention services in addition to the health organization) (OECD library report).

A combination of financing measures such as government expenditure, obligatory and voluntary health insurance, and private financing (including NGOs, families' out-of-pocket payments and private companies) finance the health care. This index is determined as a share of GDP and the total health expenditure.

Studying the relationship between health expenditure and revenue has been evaluated by many research in the literature. Extensive reports from the WHO and the European Commission proposed that the enhancement in healthcare expenditure is employed to promote the GDP growth for the developing and developed countries. In addition, many researchers believe that health expenditures can be considered as a contribution to the economic promotion (19-22).

Under the influence of the Lucas's endogenous growth theory (23), the effect of the social security system in economic development is studied by the economists considering its effect on human capital accumulation. Generally, peoples' health can be improved by providing better health care through increasing the social security spending (24, 25).

Various levels of human capital lead to remarkable interval effects on the health expenditure and economic development. Specifically, in the case of low human capital,

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health expenditure is considerably and negatively related to the economic growth. In the case of being at a medium level, the economic growth is positively affected by the health expenditure but not significantly (26). In the high case, the economic effect of the health expenditure would positively and notably enhance. The population growing older and the fertility reduction would deteriorate the negative effects of the health expenditures on economic development (26). On the other hand, Feldstein (27), Darby (28), Alesina and Rodrik (29), and Ghorbel and Kalai (30) investigated the issue that the social welfare expenditure results in economic growth. They indicated that too much social welfare expenditures would exhaust the private savings leading to detrimental impacts on capital accumulation and economic growth (Fig. 2).

Health expenditure needs to be increased in the developing countries to have healthier populations with more productivity. Moreover, they need to consider policies for rational distribution of the health advantages to decrease the negative effect of excessive healthcare costs on economic development (1, 31). The cause and effect relationship between the expenditure increase of the health care and the economic development is explored by Wang (32) using the data of 31 countries between 1986 and 2007 for the health care expenditure. It was shown that the increase in health care expenditure would effectively lead to the economic development of a country. Nevertheless, considering various growth levels in countries with low and high incomes, effective and enhanced economic growth cannot be derived from the health care expenditure increase. This is mainly because of the various levels of economic growth. In spite of being significantly different, healthcare expenditures growth can still drive economic growth.

The health expenditures and the human capital relationship

The relationships between the theories of health and the human capital and their results for fertility and longevity are straightly related to "modern" endogenous population growth literature (24, 33). Some researchers have studied the relationship between the population growth and development. These studies can be classified as the research of Becker (31), which focused on the demographic behavior and the economic variations in the developed countries and fertility role. Becker, Murphy (34), Barro and Sala-i-Martin (35) analyzed the relationship between the human capital and the expenses of child-rearing. Moreover, Becker and Barro (36) introduced a model where the fertility is endogenously specified and is controlled by per capita quantities of physical and human capital. Currais (37) indicated a direct connection between per capita human and per capita health expenditure.

Novignon, Olakojo (38) determined the effect of health care expenditure on the health condition which is determined by the life expectancy at birth, the rate of crude death, and the rate of infant mortality in SSA. The provided outcomes show that the health care cost is related to the increase of the life expectancy at birth and the decrease in the rates of death and infant mortality.

2.3. The health expenditures and oil price relationship

While the existing literature focuses on the impact of oil prices on manufacturing, agriculture, (public, private, domestic, and foreign) investments, stock exchange, financial sector and etc., there seems to be no analyzed evidence of its effect on health care. In addition, the existing literature on oil rarely explains the existing relationship between oil and socio-economic indices such as corruption and health care (39).

EWUBARE and Obayori (40), tried to specify the effect of oil rent on health care in Nigeria and Cameroon from 1995 to 2015. They showed that the oil rents in Nigeria are lower than that of Cameroon. Moreover, Cameroon performs better in rents of minerals than Nigeria. Therefore, Cameroon’s capital expenditure on health has steadily increased since 1995 up to 2015 while Nigeria does not seem to take serious healthcare expenditures, hence having an inappropriate

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performance in the infant mortality rates. Opaleye, Okowa (39) denoted that the oil rent does not lead to an increase in the government expenditure on health, clearly. Oil rent in the selected oil-producing countries not only reduces the child mortality but also tends to increase it within the studied period. This is a remarkable effect on the oil rent itself. This implies that the oil rent, which is ordinarily expected to improve the health care, has become a factor in increasing child mortality due to mismanagement of the resources. Contradictorily, more dependency to oil, leads to less spending on health as a share of GDP.

Methods

Variables and data

In this study, health expenditure per capita is the dependent variable. The explanatory variables, described below, include GDP per unit of energy use, death rate, oil rents, life expectancy at birth, population, and inflation. GDP is the principal indicator of the economic growth, whose increase shows the growth of the economic levels of a country. A nation's economic growth is a substantial health predictor of its people, a factor which has already been analyzed extensively. The population is the other variable which is considered as a demographic social detriment. Although it is not conventional to be applied as an input to health production, it appears in the food availability function. The index of food production used in the economic factors are in the aggregate form instead of being in per capita form. However, per capita accessibility of food is required. The population variable is introduced in the function for correcting the index of food availability. By increasing the population size, the food availability decreases when keeping all other parameters constant; hence, a negative coefficient is expected for the population variable.

In this study, we focus on the OPEC countries. Data from 12 countries were collected for the period from 2007 to 2018. Health expenditure data were obtained from the database of the WHO's National Health Accounts (NHA) and were complemented with the data from the World Bank on the OPEC member countries. In this section, the data employed in the study are presented first and then the methodology is described.

The generalized method of moments (GMM)

The GMM estimation was introduced by Hansen (41), and since then it has been considered as one of the most widely used methods to estimate the models in economics and finance. GMM estimators possess large sample properties with easy characterization which facilitates comparison. The method represents a natural way of test making which takes into account the sampling and the estimation error.

The variables used in the model are as below:

$$\ln HCE_{it} = \gamma \ln HCE_{it-1} + \beta_1 \ln GDP_{it} + \beta_2 \ln Death_{it} + \beta_3 \ln PO$$

$$Z_{it} = \beta_5 \ln Employ_{it} + \beta_6 \ln CPI_{it} + \beta_7 \ln Life_{it}$$

where Z_{it} indicates endogenous and instrument variables; HCE_{it} represents the healthcare expenditure and HCE_{it-1} is healthcare expenditure of t-1; GDP_{it} expresses GDP per unit of energy use (PPP $ per kg of oil equivalent); $Death_{it}$ represents the death rate, crude (Per *1,000* people); POP_{it} is the population growth (annual *%*); Oil_{it} demonstrates oil rents (% of GDP); U_{it} is the disturbing element; $Employ_{it}$ indicates the employment to population ratio; CPI_{it} is the

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consumer prices (annual %); $Life_{it}$ expresses total life expectancy at birth.

As mentioned, the data on these variables are obtained from the World Bank data and WHO. In this model, the lag of the dependent variable (healthcare expenditures) appears on the right side as an independent variable.

Bayesian dynamic panel model

Eventually, all models are developed in a Bayesian format. The approaches are based on combining the hierarchical prior modeling and the MCMC simulation methods. The Bayesian methods are more straightforward to be used in dynamic models since lagged dependent variables do not make new issues during the estimation process of the Bayesian procedure. In addition, the application of the Arellano-Bond GMM (42) estimator is troublesome when there are weak Arellano-Bond instruments where the GMM sampling behavior can be unreliable and erratic.

The general function representation of the total health expenditure is obtained as follows:

HCE = f (GDP, Employment, GNI, Population, Life expectancy, Inflation, Fertility, Foreign direct investment, Death rate, Birth rate, HDI).

The regression models are constructed as follows:

$$HCE_{it} = \beta_0 + \beta_1 \ln GDP_t + \beta_2 \ln Death_t + \beta_3 \ln POP_t + \beta_6 \ln CPI_t + \beta_7 \ln Life_t + \varepsilon_t$$

Where *t* denotes the time period, i.e. 2007–2018.

Results

In general, empirical studies evaluate the characteristics of the time series for all deterministic variables of the study. In this section, the stationary test is performed on the variables before the model estimation.

Unit root test of Levin-Lin-Chu

To test the stationary of each variable the Levin-Lin-Chu unit root test is done. If the probability of this test would be less than 0.05, the variables are regarded as stable variables and with the probability greater than 0.05, the variables are not considered stable (43). The stationary test results by the Levin-Lin-Chu test (Table 1) show that the studied variables are stationary. Therefore, the variables can be used to estimate the model without any concern over erroneous inferences about the extent of the relationship among the variables.

Analysis of the variance heterogeneity and autocorrelation tests, and selection of the function type

In determining the variance heterogeneity by the maximum likelihood ratio test, if the estimated probability level of this statistic is smaller than *0.01*, the applied model would have the variance heterogeneity and it is reasonable to use the FGLS model. With respect to the autocorrelation of the model, examined by the Wooldridge test, if the estimated probability level of this statistic is smaller than *0.01*, it can be claimed that the model has autocorrelation at *99%* probability level.

According to the results of the estimated probability level, *Probe > Chi = 0.00* (Table 2); since the probability level of the L_r statistic is less than *0.01*, the model has variance heterogeneity. In addition, with respect to the Wooldridge test and considering the results of the estimated probability level (*Prob>F = 0.02*), since the probability level of the statistic is bigger than *0.01*, the model is not autocorrelated.

Analysis of the empirical results

According to the model, the paper analyzes 12 wealth impacts on the healthcare expenditure of 12 members of the OPEC. The results are demonstrated in Table 3.

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It should be noted that the Sargan test (44) has some predetermined constraints and is employed to specify the instrument errors correlation. For the instruments to be valid, there should be no correlation between the terms of instruments and error. Based on the null hypothesis, the instruments are valid until they are not associated with errors in the first-order differential equation. In case the null hypothesis is not rejected, it will indicate the suitability of the instruments. In addition, in testing the null hypothesis of the Sargan's test for the OPEC member countries, the statistic is estimated to be *0.076*. Therefore, the null hypothesis are not refuted (the instrumental parameters are not associated with the residuals), and thus, it can be said that the instrumental variables applied in the model are appropriate.

According to the results in Table 3, as expected, the coefficient of the variable of healthcare expenditure is positive and meaningful with one lag. This shows that the healthcare expenditure is dynamic over time. The signs of all variables are compatible with the theory. The GDP growth rate in terms of per capita consumption (income) has a negative remarkable effect on the healthcare expenditure for the studied countries, so that a *1%* increase in the GDP, results in an approximately *1.06%* decline in the healthcare expenditure, if all other conditions are assumed to be fixed. The extent of the income impact on the healthcare expenditure depends on the extent of resources allocated to the healthcare sector. The higher the extent of this resource is, the more efficient the way it is devoted, and the more likely the production and economic growth impact the healthcare and its expenditure.

The ratio of employed to unemployed population has a negative effect and the p-value (or the probability value) is non-significant on the healthcare expenditure. This finding can be attributed to the fact that the studied states are developing, where the healthcare services are considered as a luxury commodity, the insurance coverage is not full, and the healthcare expenditure is mostly paid by people. The oil price has a negative significant effect on the healthcare expenditure so that a *1%* increase in the oil price will reduce the healthcare expenditure by *0.098%*. Healthcare expenditure is influenced positively and significantly by population growth. As the population grows, the need for the healthcare services increases and as a result, the healthcare expenditure is increased.

Results of the Bayesian linear regression model

According to the Bayesian linear regression model, the results are illustrated in Table 4.

Bayesgraph diagnostics

In the case of convergence of the Markov chain, the Bayesian inference, based on an MCMC sample, would be valid. Trace plots are the most accessible convergence diagnostics. The trace and auto-correlation plots will be shown in the following for the identical parameters applying the same MCMC samples. In Figure 3, there is no reason to suspect non-convergence because the trace plot of Sigma 2 demonstrates good mixing. Quick dying off can be confirmed for the auto-correlation. The posterior distribution of Sigma 2 looks like the normal distribution, as anticipated for the determined likelihood and prior distributions.

Therefore, convergence diagnostics of the variance seems appropriate. Due to the existence of a normal model, many variables are correlated, and some are highly correlated. This indicates high correlations among some of the model parameters.

Discussion

Generally, our results indicate that the highest (7.57) and the lowest (2.15) mean healthcare expenditures of the OPEC countries were reported in Ecuador and Qatar, respectively. Here, the healthcare expenditure showed conflicting effects on the GDP growth rate.

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Therefore, the impact of healthcare spending depends on the effectiveness of the policies. These results are consistent with those of Karl (7), Akanni (16), Smith (15), and Grossman (24) and inconsistent with the results of Wang (32) and Bloom, Chatterji (2). As the population increases, the demand for the healthcare services increases, and as a result, healthcare expenditure is increased. This supports the findings of Currais (37). In addition, increase in the healthcare expenditures has no impact on inflation, contradicting with the findings of Virts and Wilson (45). The oil price has a negative significant effect on the healthcare expenditure. A similar finding was reported by EWUBARE and Obayori (40) and Opaleye, Okowa (39).

The results demonstrate that the healthcare expenditure significantly improves life expectancy, in accordance with the findings of Novignon, Olakojo (38). However, it has no effect on the ratio of the employed to unemployed population, contradicting with the findings of Åhs and Westerling (46).

Increases in the mortality rates are in direct relationship with enhancements in the share of healthcare expenditures. This is consistent with Berger and Messer (47), but inconsistent with Novignon, Olakojo (38) and Rahman, Khanam (48). This finding can be attributed to the fact that the studied states are developing where the healthcare services are considered as a luxury service, the insurance coverage is not full, and the healthcare expenditure is mostly paid by people. The condition of the population health can even become worsen in spite of increasing the healthcare expenditure if the management system is poor. Enhancing the social security spending can provide people with better healthcare improvement (24).

Findings suggest that significant changes are needed in actions in order to enhance the share of the healthcare costs in GDP in the whole studied OPEC member countries. The healthcare facilities should be increased and the healthcare staff should be motivated with reasonable remuneration by the government to assure a productivity growth in all sectors of the economy.

Conclusion and Recommendations

In the present paper, we study the effect of wealth on the healthcare expenditure of the OPEC member countries applying panel data based on the GMM and Bayesian panel data analysis between 2007 and 2018. The empirical evidence showed that the effect of employment, oil price, and GDP on the healthcare expenditure is negative. Moreover, inflation, life expectancy, and the mortality rate have positive effects on the healthcare expenditure in the OPEC member states. The results revealed that the population growth rate has a positive effect on the healthcare expenditure. According to the results obtained from the Bayesian inference based on an MCMC sample, many variables are correlated, and some are highly correlated. This indicates high correlations between some of the model parameters.

Since the allocated credits are mostly spent on current costs in the developing countries and capital credits have a small share of the total healthcare costs, the healthcare expenditure is more of a cost than investment. Therefore, it deviates resources from the production and cannot influence income and economic growth optimally. Thus, proper allocation of the healthcare expenditure and the reliance on the human capital in production can be influential on the effectiveness of the healthcare expenditure of the states. Accordingly, the most prominent policy recommendation is that the economic planners and policy makers in these states increase the capital credits in total healthcare expenditure and adopt policies to enhance production and economic growth, which leads to increasing per capita income and health improvement at the society level. Vulnerable groups of people like children, disabled people, and those having chronic conditions should benefit from the exemptions of paying healthcare expenses themselves; this

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is a necessary step as it helps these people not to face the burden of healthcare costs.

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Compliance with Ethical Standards

We complied with ethical standards. All the data used is from publicly available sources.

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Conflict of Interest

Author A declares that she has no conflict of interest. Author B declares that he has no conflict of interest. Author C declares that he has no conflict of interest. Author D declares that she has no conflict of interest.

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Table & Figure:

Table 1. Levin-Lin-Chu unit root test

Variables	Statistics	Significance level P-value	Test results
InHealth	2.86	0.000	I(0)
LGDP	-4.98	0.000	I(0)
InLife	-2.48	0.012	I(0)
LnEmploy	-6.63	0.001	I(0)
LnPOP	-9.82	0.000	I(0)
InDeath	-6.20	0.000	I(0)
lnOil	-3.13	0.0009	I(0)
lnCPI	-5.94	0.0000	I(0)

Source: Research findings.

Table 2. Results of the heterogeneity variance and autocorrelation tests

Test type	Method	Statistic	Probability level	Results
Heterogeneity variance	Likelihood	Chi2(5) = 50.90	Prob>Chi2 = 0.000	Variance heterogeneity
Autocorrelation	Wooldridge test	F(1,11) = 7.322	Prob>F = 0.02	Is not auto-correlated

Source: Research findings.

Table 3. Model estimation results by the GMM

Variable	Coefficient	SD	z-value	Probability <0.05
$\gamma \ln HCE_{it-1}$	0.533	.0807	6.60	0.000
$\beta_1 \ln GDP_{it}$	-1.067	0.354	-3.01	0.003
$\beta_2 \ln Death_{it}$	0.841	0.256	3.28	0.001
$\beta_7 \ln Life_{it}$	2.497	1.153	2.17	0.030
$\beta_5 \ln Employ_{it}$	-0.134	0.455	-0.30	0.768
$\beta_3 \ln POP_{it}$	0.362	0.095	3.79	0.000
$\beta_4 \ln Oil_{it}$	-0.098	0.048	-2.03	0.043
$\beta_6 \ln CPI_t$	0.032	0.056	0.58	0.561
Constant	-7.469	6.337	-1.18	0.023
Sargan = 0.076 statistic is smaller than 0.05				

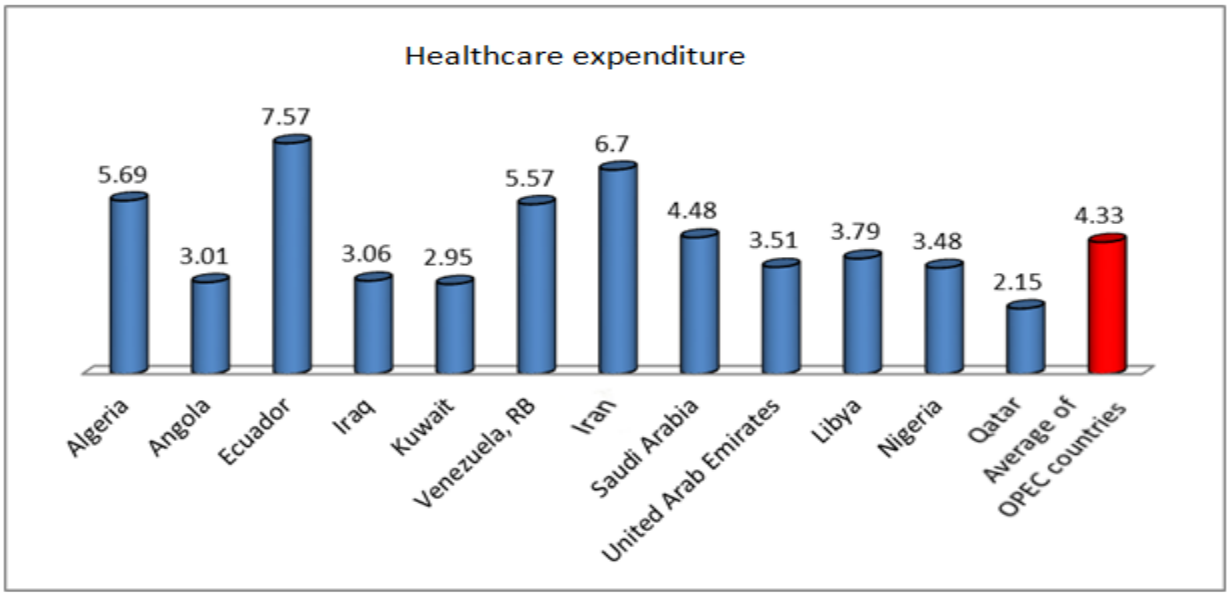
Table 4. Results of the Bayesian linear regression model

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Ln HCE	Mean	Std. Err	MCSE	Median	Equal-tailed [95% Cred. Interval]
$\beta_1 \ln GDP_t$	.1159	.338	.024	.102	-.5240 .7969
$\beta_2 \ln Death_t$	1.12	.176	.025	1.116	.7714 1.450
$\beta_7 \ln Life_t$	4.13	.502	.111	4.15	3.130 5.068
$B_5 \ln Employ_t$	-1.03	.382	.025	-1.05	-1.740 -.2809
$\beta_3 \ln POP_t$	.314	.139	.009	.318	.0299 .5753
$\beta_4 \ln Oil_t$	-.209	.083	.008	-.209	-.3719 -.0484
$\beta_6 \ln CPI_t$	.209	.097	.006	.209	.0187 .3957
cons	-12.08	2.103	.617	-11.9	-15.7 -7.84
sigma2	.905	.122	.003	.896	.694 1.18

MCMC 12,500
Burn- in =2,500
MCMC sample size =10,000
Acceptance rate = .280
Efficiency : min = .0012 , Avg = .029 , Max =.149

Figure. 1 The average healthcare expenditure of the OPEC members as a share of GDP



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Figure. 2 Comparison between the healthcare expenditure graphs and GDP (2007-2017)

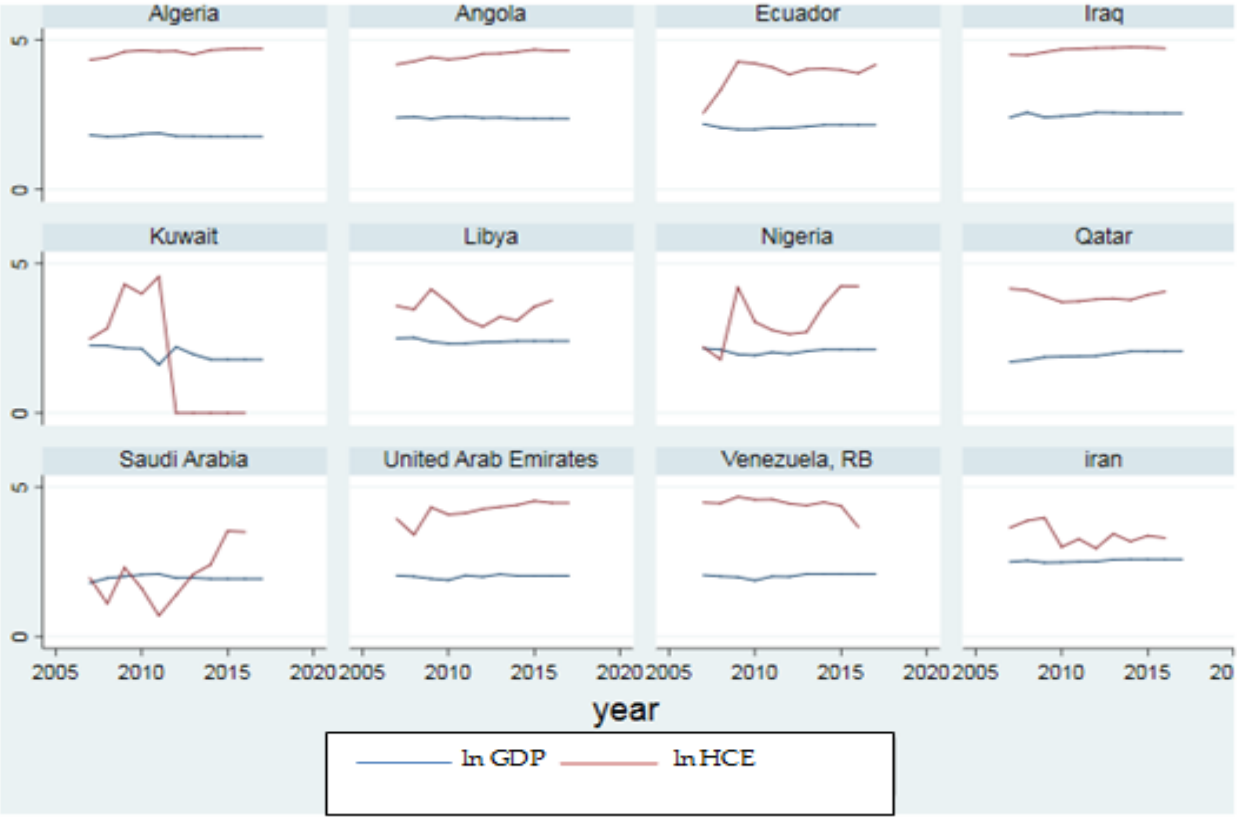
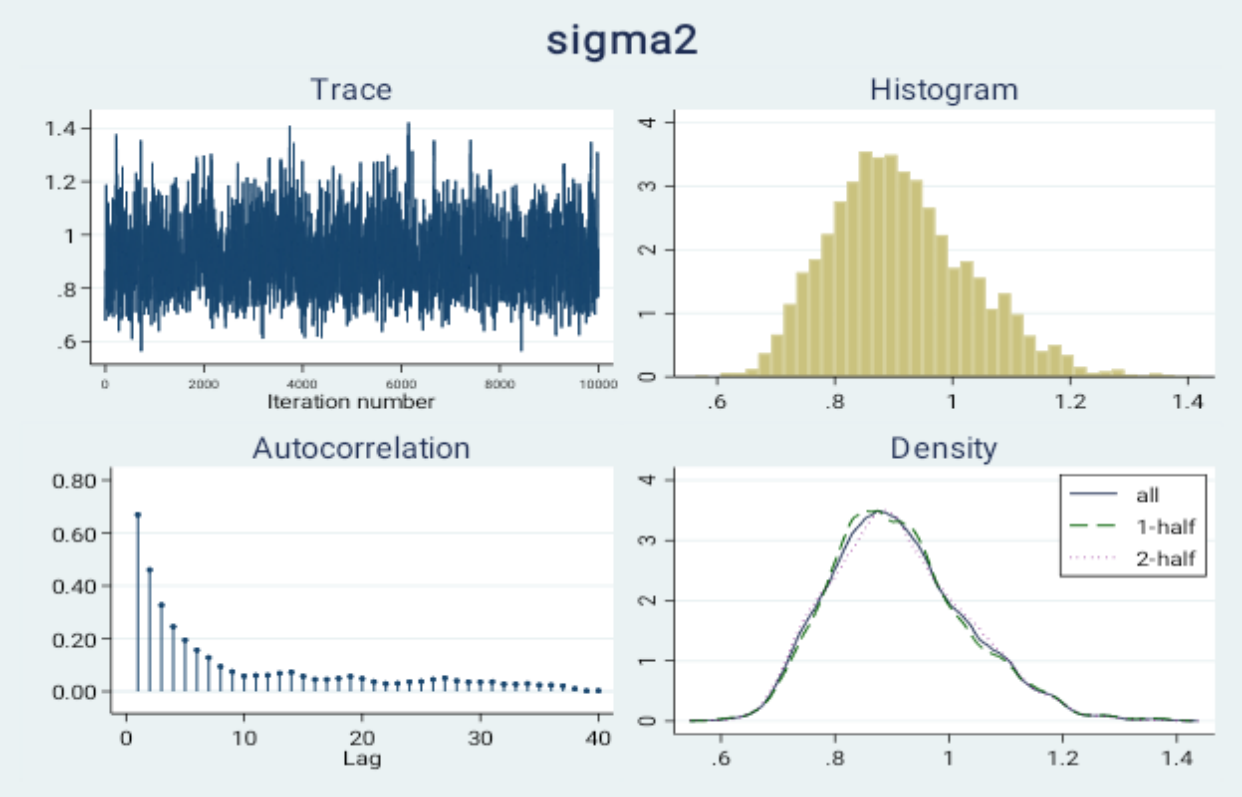


Figure 3. The bayesgraph diagnostics variance



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