

Asymmetric Effects of Oil Price on Health Expenditure in Some Selected OPEC Countries

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Abstract

Oil prices affect economic activity, especially for countries that rely on oil revenue for budgeting. Whenever the price of oil affects a country, expenditure on economic activities is affected through budgetary allocation. A negative change in oil prices not only affects allocation in the economy but may also lead to deficit financing, and other sectors of the economy may be affected as well. Therefore, this study examined the asymmetric effects of oil prices on health expenditure in selected OPEC countries (United Arab Emirates, Saudi Arabia, Iraq, Nigeria, and Algeria). These countries are the world's top oil producers and spend less than 6% of their Gross Domestic Product (GDP) on healthcare. The study relied on demand for health theory to structure the estimation models. Data were retrieved from 2000 to 2022 for empirical analysis from the World Development Indicators (WDI, 2023) and the World Bank Commodity Price Data (WCPD, 2023). The study used Welch's T-test, panel Autoregressive Distributed Lag (ARDL) and panel Non-linear Autoregressive Distributed Lag (NARD) to estimate models. The results showed that the burden of health expenditure fell more heavily on households in Nigeria and Iraq. Also, there exist symmetric and asymmetric relationships between oil prices and the two types of health expenditures in the long run. Specifically, a reduction in oil prices hurts both government health expenditure (-0.0096) and out-of-pocket health expenditure (-0.0091). This implies that the government's reduction in health expenditure is due to the fall in oil prices. Based on these results, the governments of these countries should be sensitive and closely monitor health expenditure during oil booms and busts to achieve a healthy economy, as proposed in the SDGs. Specifically, increasing government health expenditure will help improve their health sector activities during oil booms and crunches.

Keywords: Asymmetric Effects, Out-of-Pocket expenditure, government health expenditure, Oil price, OPEC

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1. Introduction

Globally, oil prices fluctuate due to supply and demand, the influence of cartels, refining capacity, geo-economics, and political risks, as well as increased oil production from non-OPEC members, which destabilise the market and create volatility (Pazouki, 2019). Price fluctuations in the market affect oil revenue, which may influence the behaviour of other macroeconomic variables, especially in oil-exporting countries among Organisation of the Petroleum Exporting Countries (OPEC) members that depend primarily on oil revenue to finance the annual budget. The effect of oil price fluctuations on revenue not only affects allocations to other sectors of the economy but also leads to deficit financing when oil prices decline. For instance, Angola, Nigeria, and Libya cut their budgets for education and health and imposed very tight production quotas in response to the 2015 war and the reduction in oil prices (Fahey, 2016). This is because most oil-producing countries run fiscal deficits by continually raising expenditures, treating the oil price boom as a permanent shock (Abubaka et al., 2023). In many cases, an oil boom increases income and triggers reactions that affect sensitive economic variables. Some OPEC members depend heavily on oil to the extent that any shock to oil prices affects major economic activities in their economies. Among the members, some are guilty of allocating their entire budget to key sectors such as health and education. Salem (2023) empirically found that, between 2003 and 2019, the United Arab Emirates, Saudi Arabia, Iraq, Nigeria, and Algeria were unable to shield themselves from falling oil prices, a finding undoubtedly due to their reliance on oil to sustain annual operations. As a consequence, oil price fluctuation has implications for the allocation of these key sectors. Over the years, available data has shown that oil prices are unstable. In the last five years, the average oil price per barrel dropped from \$67.07 in 2018 to \$61.72 in 2019, then fell sharply to \$42.14 in 2020 due to COVID-19. During the recovery stage of the COVID-19 pandemic, the price jumped to \$63.14 in 2021 and rose again to \$87.95 in 2022. Recent changes in oil prices have affected many sectors of members' economies through their expenditure, and the health sector is no exception.

The most affected health sector in terms of financing among OPEC members during oil price shocks is the United Arab Emirates, Saudi Arabia, Iraq, Nigeria and Algeria, as noted by Salem (2023). The percentage share of government health expenditure in Gross Domestic Product (GDP) is below 6% annually among these members. The share of health expenditure from economic productivity is low and, as such, can hamper a country's human capital development, potentially reversing growth if care is not taken. This low allocation has consequences for private expenditure, affecting households' out-of-pocket health payments. When the government fails to fulfil its obligations in the health sector, households bear the burden of higher out-of-pocket payments. The impact of this payment has led many households to incur catastrophic health expenditures, and during the height of the COVID-19 pandemic, many people may have faced financial hardship (World Health Organisation [WHO], 2022).

Given the low government contribution to the healthcare financing pool in the selected OPEC countries, this structure may not accelerate progress towards Universal Health Coverage (UHC) and the third Sustainable Development Goal (SDG). The fact that oil prices fluctuate may determine how an allocation to the health sector is made. Raouf (2021) notes fluctuations in oil prices over time, with varying degrees of ups and downs. The varying degrees of ups and downs can be decomposed into positive and negative responses to identified economic variables, such as health expenditure, education expenditure, economic growth, and so on. On the one hand, when the variable responds similarly to changes in oil prices, the relationship is symmetric. On the other hand, if the variable responds differently to the decomposed oil price, the relationship is

asymmetrical. In the statistical form, a Wald test can be used to confirm an asymmetric relationship. When the Wald test is significant, the variable's asymmetry is confirmed; when it is not, the reverse is true. Based on the foregoing concern, the following are the pertinent questions raised for this study: Does the burden of government expenditure shift to private health expenditure? Is there a relationship between oil price and health expenditure (government and out-of-pocket payment)? Moreover, what is the asymmetric nature of the oil price on health expenditure (government and out-of-pocket payment)?

The literature argues that an increase or decrease in oil prices is expected to raise or lower income, which, in turn, will increase or decrease health expenditure (symmetrically). For instance, Acemoglu, Finkelstein, and Notowidigdo (2013) noted that an increase in income, as reflected in higher oil prices, will disproportionately increase health expenditures. A related study in Nigeria by Akintunde and Adagunodo (2020) affirmed that oil revenue has a positive effect on health expenditure. These identified studies did not use oil price and failed to consider the positive and negative changes in oil revenue used in relation to public/government health expenditure. Another notable gap in the literature is that few studies that used oil price in two decomposed ways aggregated public health expenditure with government total expenditure, and did not document out-of-pocket payments as an important element of total health expenditure. These studies were carried out for Iran, a sampled oil-exporting and non-oil-exporting country, and for Saudi Arabia by Pazouki and Pazouki (2014), Raouf (2021), and Ali (2021), respectively. The literature, which serves as the baseline for this study, has shown that analyses of this nature are relatively rare among the selected OPEC countries, to my knowledge. Also, the clarity between the two decomposed positive and negative oil price changes can be an eye-opener for the government on how to treat health expenditure during an oil price shock. If policymakers take a cue from the study's results, the third goal of the SDGs, which aims to ensure good health and well-being, is likely to be achieved by 2030. This study addresses the identified gaps in the literature through three objectives. The study first examines whether the burden of government health expenditure shifts to private expenditure in selected OPEC countries. Secondly, the study examines the relationship between oil prices and health expenditure, with special reference to government and out-of-pocket health expenditure across these countries. Lastly, the study examines the asymmetric effect of oil prices on health expenditure, with particular reference to government and out-of-pocket payments.

Following this section is a stylised fact on oil prices and health expenditure in the United Arab Emirates, Saudi Arabia, Iraq, Nigeria, and Algeria, focusing on government health expenditure and out-of-pocket payments. The following section documents the background to the study. Section 3 discusses the related literature to the study. The fourth section details the data concerns and the methodology for the empirical analysis. The fifth section presents the empirical results and discussion, and the last section concludes with the paper's policy recommendations.

2. Overview of trends on oil price, health expenditure and economic performance indicators among selected OPEC countries.

This section focuses on the pattern of some pertinent variables to give their behaviour over time. In addition, events responsible for the pattern of changes are included, since different economic variables respond to oil price fluctuations at different times. This section presents a geometric representation of the key variables.

In Figure 1, the average GDP growth rate for these countries shows negative growth due to the Great Recession of 2008. At that time, many countries were still battling to readjust their economies. In 2004, the oil price moved from \$36.25 per barrel to approximately \$45.06 per barrel.

This period witnessed the highest average growth rate among the selected OPEC countries. Another episode of the drift of the average GDP growth rate to nearly zero was around 2017, when the price of oil dropped from \$91.49 to \$55.90 between 2014 and 2017. This shows that the previous oil price may drive economic growth for about 2 years before adjustment can take place. A closer scrutiny of the figure below also indicates a negative GDP growth among these countries. This is not surprising, as the price, demand, and supply of oil were affected by the COVID-19 pandemic in 2020. The post-COVID-19 pandemic changed the narrative from average GDP growth to positive growth. The implication of this positive value implies that consumption, investment, and government spending must have improved to achieve positive growth.

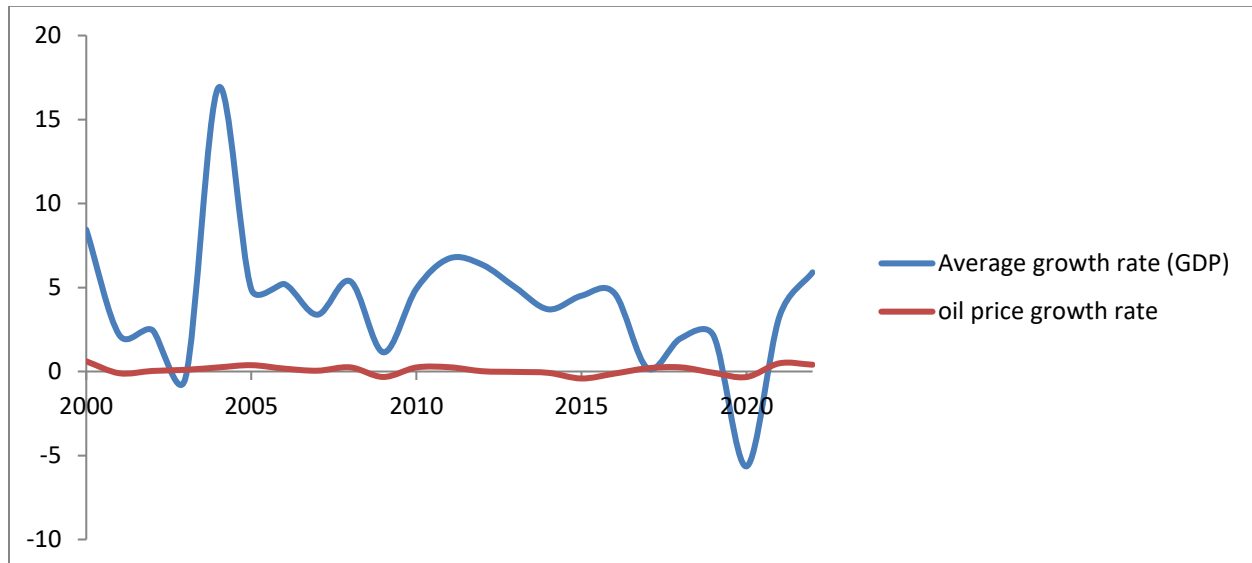


Figure 1: Growth rate of global oil prices and GDP among the United Arab Emirates (UAE), Saudi Arabia, Iraq, Nigeria and Algeria

Sources: World Development Indicators (WDI, 2023) and World Bank Commodity Price Data (WCPD, 2023)

Figure 2 shows that oil prices have fluctuated between 2000 and 2022. A trend was observed between 2000 and 2006, and a continuous drifting shape has persisted since 2007 to the present day. Given the volatile oil prices during these periods, average government health expenditure ranged from 1% to 3% of GDP between 2000 and 2022. The implication is that governments in these countries are not paying close attention to health expenditure, which may jeopardise the chance of achieving Universal Health Care (UHC) in 2030, as speculated. The average government health expenditure line is close to a horizontal line, indicating that most of these countries do not prioritise the health sector, even during oil-price-led economic booms.

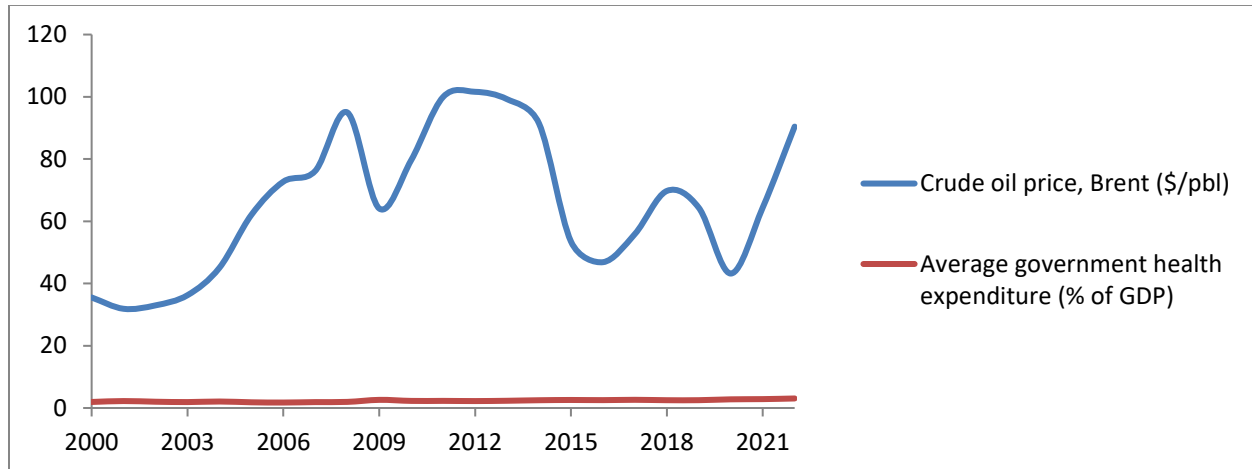


Figure 2: Average oil price and government health expenditure (% of GDP) between 2000 and 2022

Sources: World Development Indicators (WDI, 2023) and World Bank Commodity Price Data (WCPD, 2023)

Among the five selected countries, Nigeria has the lowest average government health expenditure between 2000 and 2022, despite being the largest oil producer in Africa and ranking 11th globally in 2023. Nigeria still struggles to allocate less than 6% of its total budget to the health sector, which is one of the most germane components of human capital. Out-of-pocket payments in Nigeria are almost three times higher than the average government health expenditure. Iraq is another country whose average government health expenditure is almost equal to that of the United States. This may be because the country has no government, and there is no budget approval for the Ministry of Health. As a member of OPEC, ranked as the sixth-largest oil producer in the world, the expectation would have been that out-of-pocket expenditure as a percentage of current health expenditure should not exceed 5%, but the opposite is reflected in Figure 3. This expectation is what the picture should look like for the UAE and Saudi Arabia, but the reverse is true, which necessitates including these countries in the proposed analysis.

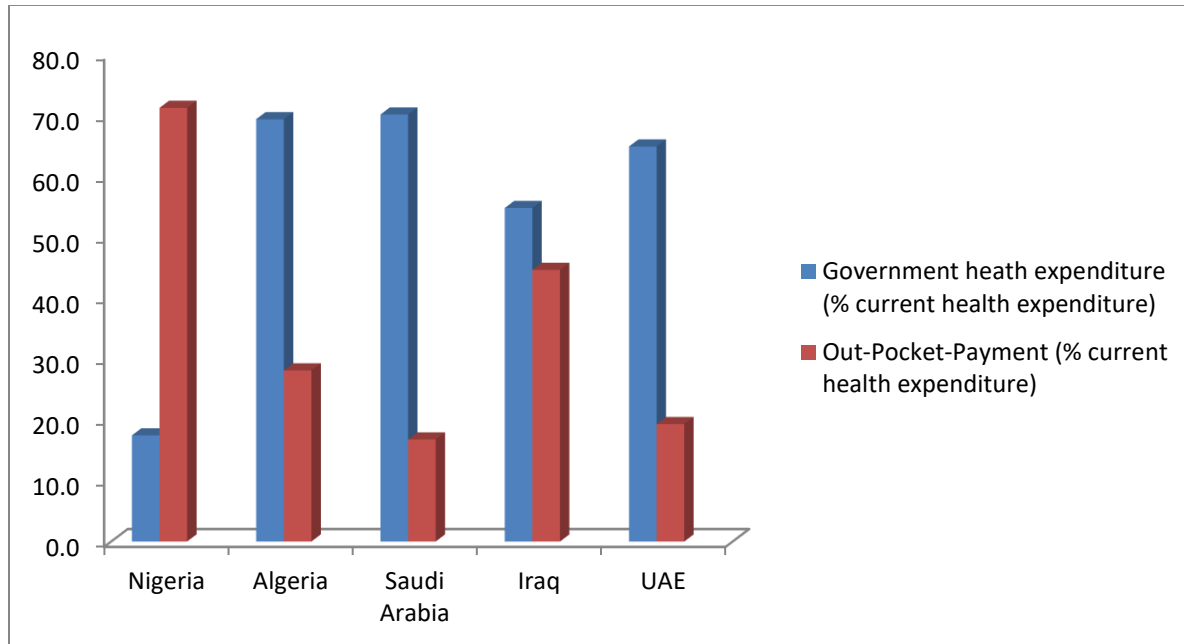


Figure 3: Average government health expenditure and out-of-pocket expenses between 2000 and 2022

Source: World Development Indicators (WDI, 2023)

Based on the three figures above, oil prices drive major economic activities, and the health sector should not be excluded from analyses of oil price shocks.

3. Literature review

The healthcare market cannot function without properly financing the services provided, because the exchange of goods or services requires payment for the market to operate efficiently. In the healthcare market, efficiency also requires government intervention to prevent market failure, necessitating the government's role in financing healthcare. Hence, the standard demand theory of health and healthcare developed by Grossman (1972) holds that medical spending is part of investment in health and is among the drivers of demand for medical care. In his argument, people directly demand medical care but indirectly demand good health to gain healthy time, which is helpful for market and non-market activities. In modelling this theory, it is assumed that the individual inherits an initial endowment of health that depreciates over time and requires periodic replenishment. The model is built on the premise that time, diet, exercise, housing, and so on are required to boost health production. However, the inputs needed to achieve good health cannot be obtained without spending.

Over the years, the application of the model in various simplified versions has elicited support and criticism. Bishai et al. (2015) emphasised that the model's strength can be classified under both human capital theory and consumer theory. Also, the model has a micro-foundation and has been successfully applied to macroeconomic panel data by Hartwig and Sturm (2018). In addition, age and health status, as well as oil prices (for oil-dependent countries), have been identified as drivers of health expenditure and education (Nocera & Zweifel, 1998; Salem, 2022). One of the major missing roles germane to the present day is that of health insurance, which various researchers have refined to reflect the current reality (Nocera & Zweifel, 1998; Opeloyeru & Lawanson, 2023). Hence, the model is flexible and can be adopted or adapted to healthcare demand and related healthcare payments. Also, Zweifel (2012) emphasised that the theory failed by

assuming a fixed ratio between an individual's healthcare and their ability to enhance health, without considering their health status.

The response of fiscal policy (expenditure) to oil price fluctuations can vary across countries due to economic size, the level of oil revenue dependency, and the global economic situation. Abubakar et al. (2023) argued that high government spending may be attributed to an increase in oil prices when an oil-dependent country like Nigeria becomes overly excited and loses its fiscal stance. Alternatively, a country may experience either low or high government expenditure during periods of an oil price crunch, aiming to adjust its fiscal stance in line with oil prices. Salem (2022) affirmed that heavy and sustained reliance on oil as a funding source for oil-dependent countries could undermine the stabilisation of their economies. In a dynamic Generalised Method of Moments (GMM) used by Doğan (2017) for the Middle East and North Africa (MENA), oil prices were found to have no symmetric relationship with public and private health expenditure. He added that public and private spending on healthcare may be due to an increase in the exchange rate, which could lead to a loss of national assets, such as human capital. Pazouki and Pazouki (2014) used inflation as a control variable, recognising that oil revenue involves imports and exports; as such, inflation could be imported through this channel. It was found that oil revenue has no symmetric relationship with public health expenditure in Iran. Contrarily, in an investigation by Akintunde and Adagunodo (2020) in Nigeria, oil revenue was found to be a positive symmetric driver of public health expenditure. In a non-linear panel Autoregressive distributed lag (ARDL) carried out by Hassan (2021) to determine the positive and negative effect of oil revenue on government expenditure for developing oil-exporting countries, health expenditure as an alternative government expenditure, it was found that oil revenue exerts a positive symmetric effect on health expenditure, while the asymmetric effect shows that positive changes of oil revenue enhanced health expenditure and negative changes of oil revenue lessen health. Oyaromade (2020) found an additional claim of a symmetric relationship between oil wealth and health expenditure for Nigeria. On the contrary, the effect of the oil price shock on health expenditure was found to be asymmetrical in the long run but symmetrical in the short run (Ali, 2021).

Based on the review, there is a paucity of research on this topic, and existing studies lack consensus. Also, contributors to this topic in the literature on selected OPEC countries focus more on oil revenue than on oil price changes and fail to recognise health expenditure as a major independent or dependent variable, instead treating it as a control variable or an alternative to government expenditure. In addition, analysis of this nature should also examine out-of-pocket costs as an important health expenditure, which will serve as an eye-opener for policymakers on how households have borne the significant cost of healthcare, potentially changing narratives in subsequent budget allocations in relation to oil prices. Given these gaps in the literature, there is a need to revisit the asymmetric effect of oil price changes in the United Arab Emirates, Saudi Arabia, Iraq, Nigeria, and Algeria.

4. Methodology

4.1 Data source and techniques of analysis

The study used secondary data from the World Development Indicators (WDI) for 2000 to 2022 and World Bank Commodity Price (WBCP) data (The pink sheet). These periods are chosen because data on health expenditure are available. Data extracted from WDI include health expenditure (HE), inflation rate (INF), exchange rate (ER), gross domestic product growth rate (GDPg), and population growth rate (POPg), while oil price (OilP) was obtained from WBCP. The first objective is achieved by using a paired T-test (Welch's T-test) to differentiate between

government and out-of-pocket health expenditure. The second objective used an ARDL test to assess the symmetry of the selected variables. Nonlinear Autoregressive Distributed Lag (NARDL) was used to explain the third objective. This study considered five oil-exporting, oil-dependent OPEC countries, namely the United Arab Emirates, Saudi Arabia, Iraq, Nigeria, and Algeria.

4.2 Theoretical Framework

This study relies on Grossman's (1972) demand for health and medical care. The theory relates to health expenditure through demand for medical care and states that to maintain initial inherited health, investment is needed. This investment, I , needs the purchase of medical services, M , or spending time, t^I , on preventive or curative treatment, which partly depends on health expenditure. The study uses one of the variant models derived by Zweifel, Breyer and Kifmann (2009). This is a one-period plan, and the utility function is of the form:

$$U = u(X, H) \quad (1)$$

$$H = h(I(M, t^I); E, Z) \quad (2)$$

Where H is the health stock, E is education, and Z is other characteristics that may affect the health stock. By substitution, Equation (1) becomes Equation (3):

$$U = u(X, I(M, t^I); E, Z) \quad (3)$$

Equation (3) is subject to income constraint and time constraints below:

$$Wt^w + V = P_X X + P_M M \quad (4)$$

$$T = t^w + t^I \quad (5)$$

Here, W and V denote the wage rate and non-labour income, respectively. The time invested in earning wages in the labour market is t^w . The available time for health and labour markets is T , normalised to 1, so that $tw = 1 - t^I$.

Equation (4) becomes equation (6)

$$W(1 - t^I) + V = P_X X + P_M M \quad (6)$$

$$W + V - W t^I = P_X X + P_M M \quad (7)$$

Let $W + V = Y$, so the equation to maximise the consumer problem becomes:

$$L(M, t^I, X, \lambda) = u(X, I(M, t^I); E, Z) + \lambda (Y - W t^I - P_X X - P_M M) \quad (8)$$

For this model, M and t^I are the interest terms with respect to investment for the First Order Conditions (FOCs):

$$\begin{aligned} \frac{\partial L}{\partial t^I} &= \frac{\partial I}{\partial t^I} - \lambda W = 0 \\ \frac{\partial L}{\partial M} &= \frac{\partial I}{\partial M} - \lambda P_M = 0 \end{aligned} \quad (10)$$

The ratio of adequate time invested in medical consumption and medical services purchased is:

$$\frac{\partial I / \partial t^I}{\partial I / \partial M} = \frac{W}{P_M} \quad (11)$$

Equation (11) implies that the price of medical services deflates labour income. To derive the structural model for investment, Zweifel assumes a Cobb-Douglas investment function of the form:

$$I = M^{\alpha m} (t^I)^{1-\alpha m} E^{\alpha_E} \quad , 0 < \alpha m < 1, \quad \alpha_E > 0 \quad (12)$$

Education in equation (12) is a magnifier for medical care services and time invested in health, and αm and α_E are the production elasticity of M and the effectiveness of E , respectively?

The logarithm transformation of Equation (12) is:

$$\ln I = \alpha m \ln M + (1 - \alpha m) \ln t^I + \alpha_E E \quad (13)$$

$$\delta \ln I / \delta \ln M = \delta I / \delta M * \left(\frac{M}{I} \right) = \alpha m \quad (14)$$

$$\delta \ln I / \delta \ln t^I = \delta I / \delta \ln t^I * \left(\frac{t^I}{I} \right) = (1 - \alpha m) \quad (15)$$

Equations (14) and (15) are the elasticities for M and t^I

The ratio of the two elasticities gives:

$$\frac{\delta \ln I / \delta \ln t^I}{\delta \ln I / \delta \ln M} = \frac{1 - \alpha m}{\alpha m} * \frac{M}{t^I} \quad (16)$$

By substituting Equation (11) into (16), we have:

$$\frac{W}{P_M} = \frac{1 - \alpha m}{\alpha m} * \frac{M}{t^I} \quad (17)$$

Taking the logarithm of Equation (17) gives:

$$\ln \frac{1 - \alpha m}{\alpha m} + \ln M - \ln t^I = \ln W - \ln P_M \quad (18)$$

By making $\ln t^I$ Subject of the formula and substituting into Equation (13), we have:

$$\ln I = \alpha m \ln M + (1 - \alpha m) \left[\ln M + \ln \frac{1 - \alpha m}{\alpha m} - \ln W + P_M \right] + \alpha_E E \quad (19)$$

By making $\ln M$ the subject of the formula and with the assumption that I H, Equation (19) becomes the structural demand function for medical services or health expenditure:

$$\ln M = \text{const.} + \ln H + (1 - \alpha m) \ln W - (1 - \alpha m) \ln P_M - \alpha_E E \quad (20)$$

Equation (20) implies that the higher the price, the lower the quantity of medical services demanded. Also, given the level of education, high wages will increase demand for medical services. This structural form model allows the use of macro data rather than a reduced-form model (Nocera & Zweifel, 1998; Hartwig & Sturm, 2017). According to them, the demand for medical services can be proxied by health expenditure. For example, Nocera and Zweifel (1998) claimed that the demand for medical care was measured by annual gross health expenditure in Swiss Francs. In addition, the variable Z in the utility function allows other variables to be incorporated into the model. Equation (21) is a variant of equation (20), where M is a proxy for health expenditure, Pm is a proxy for oil price, and other variables are subsumed under variable Z in the utility function. Hence, the empirical model adopted for this study follows those of Doğan (2017) and Hassan (2021). The model is specified below:

$$HE_{it} = \alpha_0 + \beta_1 OilP_t + \beta_2 Inf_{it} + \beta_3 ER_{it} + \beta_4 GDPg_{it} + \beta_5 POPg_{it} + \mu_{it} \quad (21)$$

The health expenditure here is HE, decomposed into government health expenditure and out-of-pocket payments. OilP is the oil price (\$), Inf is the inflation rate, ER is the exchange rate, GDPg is the Gross Domestic Product (GDP) growth rate, and the error term is represented by μ . The inclusion of the inflation rate and the exchange rate is intended to adjust for oil imports and exports, as suggested by Pazouki and Pazouki (2014). GDP growth should also be included, as growth is expected to occur through spending. Population growth is included to examine whether its rate affects health expenditure. The exclusion of "i" for the oil price in Equation 8 is because it is a global variable and common to all the countries under consideration.

For the ARDL, a panel unit root test by Pesaran and Shin (IPS) and a Fisher-type unit root test (Dickey-Fuller form) were conducted to justify the use of the Panel-ARDL framework in this study. To carry out robust heterogeneous methods such as the Pooled Mean Group (PMG) estimator and the Dynamic Fixed Effect (DFE) estimators, the order of integration must be a mixture of I(0) and I(1); the results are displayed in Table 3. The fact that N is small and T is large enough necessitated the use of ARDL. N is 5 in this case, and T is 115. Since the order of integration is confirmed, the panel ARDL model with optimal lag length of p1, q1, q2, q3, q4 and q5 is specified below:

$$HE_{it} = \alpha_{0i} + \sum_{j=1}^p p_{ij} HE_{i,t-j} + \sum_{j=0}^{q_1} \beta_{1ij} OilP_{t-j} + \sum_{j=0}^{q_2} \beta_{2ij} Inf_{i,t-j} + \sum_{j=0}^{q_3} \beta_{3ij} ER_{i,t-j} + \sum_{j=0}^{q_4} \beta_{4ij} GDPg_{i,t-j} + \sum_{j=0}^{q_5} \beta_{5ij} POPg_{i,t-j} + \mu_i + \varepsilon_{it} \quad (22)$$

The specified variables are in log forms except for GDP growth rate, population growth rate and inflation rate. Also, $i = 1, 2, \dots, N$ and $t = 1, 2, \dots, T$. The group-specific error term in the model is denoted as μ_i , and the normally distributed error term with zero mean and constant variance is ε_{it} . The above equation is the force difference that reflects the long-run and short-run specifications, as shown in Equation (23).

$$HE_{it} = \sum_{j=1}^p p_{ij} HE_{i,t-j} + \sum_{j=0}^{q_1} \beta_{1ij} OilP_{t-j} + \sum_{j=0}^{q_2} \beta_{2ij} Inf_{i,t-j} + \sum_{j=0}^{q_3} \beta_{3ij} ER_{i,t-j} + \sum_{j=0}^{q_4} \beta_{4ij} GDPg_{i,t-j} + \sum_{j=0}^{q_5} \beta_{5ij} POPg_{i,t-j} + \sum_{j=1}^{p-1} p_{ij}^* \Delta HE_{i,t-j} + \sum_{j=0}^{q_1-1} \beta_{1ij}^* \Delta OilP_{t-j} + \sum_{j=0}^{q_2-1} \beta_{2ij}^* \Delta Inf_{i,t-j} + \sum_{j=0}^{q_3-1} \beta_{3ij}^* \Delta ER_{i,t-j} + \sum_{j=0}^{q_4-1} \beta_{4ij}^* \Delta GDPg_{i,t-j} + \sum_{j=0}^{q_5-1} \beta_{5ij}^* \Delta POPg_{i,t-j} + \mu_i + \varepsilon_{it} \quad (23)$$

The first six terms on the right-hand side of the above equation capture the long run, and the remaining terms represent the short run and error components, respectively. Unlike Equation (23), which suggests that the response of health expenditure to an oil price change is expected to be similar, the nonlinear ARDL allows for different responses to positive and negative oil price changes. Thus, the asymmetric form of Equation (23), which explains the third objective from the long-run model, is stated as Equation (24) below:

$$\Delta HE_{it} = \alpha_{0i} + \beta_{1i}^+ oilp_{t-1}^+ + \beta_{1i}^- oilp_{t-1}^- + \beta_{it}' X_{i,t-1} + \sum_{j=0}^{N1} (\gamma_{ij}^+ \Delta oilp_{t-j}^+ + \gamma_{ij}^- \Delta oilp_{t-j}^-) + \sum_{j=1}^N \lambda_{ij}' \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (24)$$

$Oilp^-$ and $oilp^+$ denote negative and positive oil price changes; X represents other variables as described earlier, and other terms are the same as stated under the symmetric equation. The positive and negative changes in oil price can be decomposed below as established by Shin et al. (2014).

$$Oilp^+ = \sum_{k=1}^t \Delta Oilp_k^+ = \sum_{k=1}^t \max(\Delta Oilp, 0) \quad (25)$$

$$Oilp^- = \sum_{k=1}^t \Delta Oilp_k^- = \sum_{k=1}^t \min(\Delta Oilp, 0)$$

The error correction term for equation (24) is stated as:

$$\Delta HE_{it} = \psi_{i,t-1} + \sum_{j=0}^{N1} (\gamma_{ij}^+ \Delta oilp_{t-j}^+ + \gamma_{ij}^- \Delta oilp_{t-j}^-) + \sum_{j=1}^N \lambda_{ij}' \Delta X_{i,t-j} + \mu_i + \varepsilon_{it} \quad (26)$$

The term, $\psi_{i,t-1}$ The error-correction term captures the long-run equilibrium.

5. Results and discussion

Preliminary analyses are meant to provide insight into the nature of the variables involved. The statistical features of the series in terms of mean, standard deviation, minimum and maximum are displayed in Table 1. The mean value indicates that, among the five countries, government health

expenditure is higher than out-of-pocket health expenditure. A closer look at the minimum and maximum values for government and out-of-pocket health expenditures shows little difference, suggesting that out-of-pocket expenses in some countries are higher than in the selected group.

Table 1: Summary Statistics (Group)

Variable	Observation	Mean	Std. Dev.	Min.	Max.
Oil Price (oilp)	115	65.46314	28.07465	24.42157	111.9656
Inflation (inf)	107	6.592302	8.440164	-10.06749	53.23096
GDP growth rate (gdpgr)	115	4.05563	7.382747	-36.65815	53.38179
Government health expenditure (GHE)	112	55.37016	21.83237	13.02093	78.44077
Exchange rate (er)	115	336.3108	550.6267	3.6725	2002.405
Out-of-pocket health expenditure (OOP)	112	35.80881	22.08269	9.592301	77.7924
Population growth rate (popgr)	115	2.854782	2.741365	-.8502219	18.12798

Source: Author's computation based on retrieved data from World Development Indicators (WDI) and World Bank Commodity Price (WBCP) data (The pink sheet).

The average population growth rate among the selected countries is approximately 3%; the GDP growth rate is approximately 4%; and the average price in the selected year is approximately \$65 per barrel.

To compare the mean difference between government and out-of-pocket health expenditure, the Welch test is used for the first objective, as shown in Table 2. Group estimation shows that the mean difference between the two is relatively high and that government health expenditure is significantly higher than out-of-pocket health expenditure across the five countries considered. Among the countries, out-of-pocket health expenditure is significantly higher than in Nigeria, and the gap is enormous. The government of this country is not doing much, and the burden of health payments is, no doubt, pushed to households. Another observation from the table is that Iraq is almost similar to Nigeria, as the gap between the two payments is not large and is not significantly different from zero, as shown by the Welch test at the 1% level. Overall, there is sufficient evidence to accept the alternative hypothesis in the Welch test that the means of the two variables are significantly different in almost all cases, except for Iraq. Governments of the rest of the countries are spending more on health than on out-of-pocket health expenditure. It is expected that oil-rich countries should allocate more resources to healthcare, as this may promote human capital development and boost economic growth. None of these countries' out-of-pocket payments is less than 15%. Given the health sector's unique role in any economy, much should come from the government, especially in countries with abundant natural resources, as in the five major oil producers investigated in this study.

Table 2: Welch test results by group and individual for government health expenditure and out-of-pocket health expenditure

Countries	Health expenditure	Mean	Mean Difference	Welch
Nigeria	GHE	17.475	-53.775	-40.576*** (0.000)
	OOP	71.250		
Algeria	GHE	69.390	41.234	34.612*** (0.000)
	OOP	28.156		
Saudi Arabia	GHE	70.160	53.366	69.650*** (0.000)
	OOP	16.794		
Iraq	GHE	54.836	10.1525	1.831 (0.0745)
	OOP	44.684		
United Arab Emirates	GHE	64.919	45.602	21.023*** (0.000)
	OOP	19.317		
Group	GHE	55.370	19.561	6.667*** (0.000)
	OOP	35.809		

*** denote level of significance at 1%

Source: Author's computation

The conventional practice for panel data is to test the variables for stationarity; the IPS and Fisher (Dickey-Fuller) unit root tests are conducted in this study and presented in Table 3. The two tests presented below test the null hypothesis of a unit root across the series. The essence of the test is to ensure that none of the series is integrated of order 2, which helps avoid results. As presented above, all the variables are a mixture of order I (0) and I (1) regardless of the type of unit root test used in this study, which is one of the essentials for the use of Panel-ARDL. The results at various levels of significance meet the baseline criteria for Panel-ARDL and affirm its appropriateness for this study.

Table 3: Panel Unit Root Test Results

Variables	Pesaran and Shin test (IPS)			Fisher (Dickey Fuller form)		
	Level	First difference	Order of integration	Level	First difference	Order of integration
Oil Price	-1.8139**	-4.7112***	I(0)	17.1745*	48.5135***	I(0)
Inflation	-1.8014	-5.2489***	I (1)	18.3813**	61.5115***	I(0)
GDP growth rate	-3.6453***	-8.5671***	I(0)	42.0286***	116.3353***	I(0)
Government health expenditure	-0.0567	-4.4376***	I (1)	9.6558	52.8395***	I(1)
Exchange rate	-	-	-	3.5511	18.7956**	I(1)
Out-of-pocket health expenditure	-0.2850	-4.0804***	I (1)	12.5224	43.2956***	I(1)
Population growth rate	-1.6132*	-4.5225***	I(0)	20.9499**	53.5094***	I(0)

***, ** and * denote level of significance at 1%, 5% and 10%, respectively.

Source: Author's computation

The panel regression in Table 4 is for both panel linear and non-linear ARDL. Both PMG and DFE were conducted, and a Hausman test was used to test for differences between the two estimators. The Hausman test indicates that PMG is the best estimator for the models under consideration. This is because the P-values confirm the null hypothesis that adoption of the PMG is the most efficient estimator. The results are presented in two forms: government health expenditure and out-of-pocket health expenditure. Further analysis under the asymmetry models aims to confirm that there is no evidence of linearity between the two variables—oil price increases and decreases—in the long and short runs. In both the short- and long-run, the statistical significance test results indicate that there is no evidence of a linear relationship between the variables. All the models also exhibit evidence of long-run cointegration as the Error Correction Terms (ECT) are found to be significant, negative and less than one at the considered levels of significance.

Table 4: Panel regression results on the relationship between oil price and health expenditure in symmetric and asymmetric forms

Variables	Government health expenditure	Out-of-pocket health expenditure
A: Models without asymmetry		
Oil Price	-0.3978*** (0.0980)	0.0715*** (0.0216)
Exchange rate	-0.5651*** (0.1341)	0.1357*** (0.0421)
Inflation	0.0268*** (0.0067)	-0.0111*** (0.0042)
GDP growth rate	-0.0654*** (0.0136)	0.0096 (.0046)
Population growth rate	0.1628*** (0.0661)	-0.0236** (0.0428)
D (Oil Price)	0.1170 (0.1676)	-0.1063 (0.1052)
D (Exchange rate)	-0.6797* (0.3789)	0.5147** (0.2584)
D (Inflation)	-0.0026 (0.0025)	-0.00003 (0.0041)
D (GDP growth rate)	0.00934** (0.0043)	0.0001 (0.0056)
D (Population growth rate)	-0.1192 (0.1617)	0.1520 (0.1434)
Constant	2.0452* (1.2261)	1.0837* (0.4195)
ECT (-1)	-0.2530* (0.1502)	-0.3899*** (0.1151)
No. of cross sections	5	5
Hausman test	0.01 (1.0000)	0.21 (0.9990)
B: Models with asymmetry		
Oil Price ⁻	-0.0096*** (0.0032)	-0.0091*** (0.0012)
Oil Price ⁺	-0.0104*** (0.0030)	-0.0094*** (0.0014)
Exchange rate	-0.5293*** (0.0825)	0.2267*** (0.0599)
Inflation	0.0218***	0.0052

	(0.0061)	(0.0068)
GDP growth rate	-0.0380*** (0.0098)	-0.0149*** (0.0047)
Population growth rate	0.0881 (0.0546)	-0.0526 (0.0507)
D(Oil Price ⁻)	0.0024 (0.0029)	-0.0016 (0.0012)
D (Oil Price ⁺)	0.0023 (0.0026)	-0.0015 (0.0011)
D(Oil Price ⁻ (-1))	0.0019** (0.0009)	0.0012 (0.0046)
D (Oil Price ⁺ (-1))	0.0017* (0.0010)	0.0035 (0.0046)
D (Exchange rate)	-0.4295* (0.2281)	0.4052 (0.3368)
D (Inflation)	-0.0009 (0.0032)	0.1286 (0.1160)
D (GDP growth rate)	0.0087* (0.0045)	0.0007 (0.0011)
D (Population growth rate)	-0.2860 (0.3353)	0.0006 (0.0011)
Constant	1.7936 (1.1199)	0.1038* (0.0587)
ECT (-1)	-0.2954* (0.1823)	-0.3029* (0.1656)
Hausman test	0.01 (1.0000)	5.21 (0.6349)
Wald Test (Long run)	5.13* (0.0711)	6.29* (0.0592)
Wald Test (Short run)	0.05 (0.8182)	0.03 (0.8666)

***, ** and * denote level of significance at 1%, 5% and 10%, respectively.

Source: Author's computation

Based on the regression results in section A of Table 4, there is strong evidence of a negative and significant relationship between oil prices and government health expenditure. The reaction of out-of-pocket health expenditure to oil price is opposite in the long run. In the short run, oil prices are insignificant for both government and out-of-pocket health expenditures. These results imply that health expenditures are significantly sensitive to oil prices in the long run but insensitive in the short run. The long-run relationship between government health expenditure and oil price is contrary to the findings of Akintunde and Adagunodo (2020) and Pazouki and Pazouki (2014), and this may be because their analyses were based on a single country and used oil revenue rather than oil price. In addition, the estimated long-run coefficient for government health expenditure is higher than that for out-of-pocket health expenditure, but both are negative in absolute value. The exchange rate has a negative and significant impact on government health expenditure, and the opposite is observed for out-of-pocket health expenditure in both the short and long run. Inflation rate elicits a positive response to government health expenditure, and a significant but negative response is observed for out-of-pocket health expenditure in the long run. In the short run, the inflation rate shows no significant relationship with either type of health expenditure used in the analysis. GDP growth rate has similar results on the two types of expenditure, sign, in the long run and the short run.

In section B of Table 4, the long-run results show that, regardless of the type of health expenditure considered, both positive and negative oil price changes have a significant negative impact on the two expenditures. The magnitudes are less than 1, and the two expenditures are price-insensitive to oil prices. The reason for this might be the nature of healthcare as a merit good for households, and governments of the considered oil-dependent countries may be insensitive to changes in the allocation of expenditure to the health sector, irrespective of oil price changes. The exchange rate exhibits the same behaviour as that of symmetry models with different magnitudes. The GDP growth rate has the same sign as both government and out-of-pocket health expenditure, with the magnitude of government health expenditure higher than that of out-of-pocket health expenditure. In addition to the observed results, government health expenditure responds positively to inflation, whereas out-of-pocket health expenditure does not.

In the short run, the positive and negative oil price changes are negatively significant for health expenditure at lag one and are not significant for out-of-pocket health expenditure. The implication is that changes in oil prices may not immediately affect health expenditure within the budget allocation. However, changes in the previous year may affect it negatively in the current year. Government health expenditure responds significantly to both the exchange rate and the GDP growth rate, with opposite signs, and neither variable is significant for out-of-pocket expenditure. The Wald test for both models is statistically significant in the long run, while the short-run results are not. The implication is that an asymmetric relationship prevails in the long run, whereas a symmetric relationship prevails in the short run.

6. Conclusion and policy recommendation

The study found a significant, negative relationship between oil prices and government health expenditure, as well as out-of-pocket expenditures, in the long run. Also, an asymmetric relationship exists between oil prices and the two types of health expenditure in the long run, as the long-run Wald test for the two models is statistically significant, whereas the short-run Wald test is not. This means that an asymmetric relationship is confirmed between the two types of health expenditures and oil price in the long run, and a symmetric relationship exists in the short run. The implication is that, regardless of the type of health expenditure considered, it reacts to oil price changes in the long run. The short-run reaction is not left out of the analysis, especially in the case of government health expenditure, as positive and negative changes in oil prices affect it through short-run lags. At the same time, out-of-pocket payments respond in the current period to short-run oil price changes. Analysis from this study shows that the governments of these countries are insensitive to the health sector in terms of spending, and that households bear the burden of out-of-pocket health expenditures. Although the burden may vary across countries, governments should be sensitive to the health sector during oil price booms and crunches to sustain healthy economies through human capital development. Being sensitive to this sector will help to achieve the third goal of the SDGs. By so doing, human capital will help increase economic activities, and the spillover effect will be felt in other economic activities.

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