THE DUAL IMPACT OF OIL PRICE VOLATILITY ON IRAQ'S GROSS DOMESTIC PRODUCT: AN EMPIRICAL ANALYSIS FOR THE PERIOD 2010-2023

Sabah Ahmed Asmaeel

University of Samarra, University Street, Samarra 34010, Iraq
*Corresponding author, email: sabah.ai@uosamarra.edu.iq

doi: 10.17977/um066.v6.i3.2026.1

Keywords
Oil prices
Gross domestic product
Sustainable development
Iraq economy
ARDL model

Abstract
There is clear dependency of the Iraqi economy on crude oil earnings as the major source of funds for spending and developments. This research seeks to explore the effect of the changes in oil prices on the gross domestic product (GDP) of Iraq, a vital indicator of sustainable economic growth. A quantitative approach was used in this study, whereby the ARDL model was applied to analyze the connection between oil prices and GDP from 2010 to 2023. The empirical findings reveal that there is a positive short-run correlation between oil prices and GDP; a unit increase in oil prices is associated with ten units in the value of GDP. On the other hand, a negative long-run correlation is found to exist between oil prices and GDP in Iraq, meaning that overreliance on oil prices can be detrimental to the country's sustainable economic growth. It becomes necessary to utilize oil resources more efficiently by investing more in the productive sectors, better governance, and fighting corruption among others.

1. Introduction

As of 2019, oil has remained one of the major commodities in the world. This commodity has been described as non-renewable, limited and volatile. The pricing mechanism of this commodity depends on the interaction of the cost of production, demand and supply. Additionally, politics and economics play a role in the price determination of oil in the global market. The above factors affect not only countries involved in importing but also those involved in exporting.

Since the start of 2010, there have been many instances of price crises in the global oil market. The price crisis of 2014 has led to great changes in the market. The above repercussions have generated debates on the risk to life due to oil revenue volatility in oil-exporting countries such as Iraq. Iraq has become a major player in the global economic structure.

The Iraqi economy is basically a rentier economy that relies on oil revenues to finance development activities. Consequently, the trends in oil price have a major impact on the trade balance, economic activities and GDP of the country that is an indicator of sustainable development.

1.1. Research Problem

There has been a dependency of Iraqi general budget on oil revenues making its economy vulnerable to changes in the global oil market affecting its sustainability of GDP. What is the research problem?

How do changes in oil price affect the Gross Domestic Product (GDP) of Iraq as a measure of sustainable development??

1.2. Research Hypothesis

According to the exploratory analysis, there is a positive relationship of changes in the global oil prices with the Iraqi GDP which is an indicator of sustainable development in the short run.

1.3. Significance of the Study

Both from the academic and practical perspective, oil is a source of energy and raw material used in the manufacturing process. Thus, this research is very important due to financial crises and market volatility occurring due to price fluctuations.

1.4. Research Objectives

This research seeks to explore the effects of oil price levels on GDP as a measure of sustainable economic growth, where production plays a fundamental role, and also to determine the short-run and long-run directional relationship between GDP and oil prices.

1.5. Theoretical Framework of Oil Price and GDP

1.5.1. Oil Price Concept theoretical framework

Examining What Oil Price Means

Oil is considered a crucial good and an integral part of economic operations. Called "black gold," this natural resource has greatly contributed to the modern history of economic development and determined the features of the global economy. The statement that this finite and scarce core good is a key factor of economy control is not accidental; one single oil shock may disrupt and change modern global economic system (Majeed, 2016).

The oil price can be described as the monetary value of petroleum during a certain period of time and place (Al-Lahibi, 2006). There are other definitions of the oil prices that consider the cash value of petroleum goods during specific periods of time that depend on several factors including economic, social and political ones.

Oil price volatility is understood as sudden and unexpected changes in the price of oil which is often large enough to cause some economic effects on producers and consumers (Al-Tamimi, 2022). Oil price is the value of one barrel (159 litres) of crude oil in US dollars. Since the global oil market operates dynamically and unpredictably, oil price changes constantly and affects all peoples of the world starting from the early 1970s.

The global financial crisis has resulted in unfavorable effects for the oil market; namely, there was a noticeable decrease in oil prices. Based on this information, one can conclude that price changes affect oil economy positively and negatively both for importing and exporting countries (Saudi, 2019). Rising oil prices are favorable for exporters but detrimental for importers, and vice versa. Falling oil prices make importing countries better off due to higher real income, while exporters suffer from it.

Reasons for Oil Price Fluctuations

There exist a number of factors affecting oil prices including economic, political, and climatic factors. These factors include: 1) Economic Factors: It is very crucial to consider the supply and demand equilibrium and world oil reserves. This is because oil plays a key role in economic growth (Abdul Redha, 2011). 2) Technology Development and Renewable Energy: Any advancement in technology and methods of operations in production process helps reduce cost hence making oil prices favorable. There are countries that use oil that formed the International Renewable Energy Agency for the aim of reducing dependency on crude oil and searching for renewable and sustainable energies. They include methanol fuel, electric cars, solar energy, wind energy, tide and current energy, geothermal energy, and nuclear energy. There exists the concept of cosmic electromagnetic energy as an energy source for vehicle transportation in what is referred to as the "third industrial revolution". This is still under study (Ketan, 2017). 3) Political Factors: Geopolitical and global political events affect oil commodities significantly. The analysts agree that the supply–demand equilibrium and stock levels do not provide full explanations to price level disequilibrium. Oil crises, geopolitics, and natural calamities have a great influence on price levels despite the lack of supply disruptions and historically have been the main reasons of changes (Al-Nadawi, 2010). 4) Oil Reserves Size: The new and proved oil reserves discovered and developed which will be extracted at economically attractive costs in comparison to current prices of crude oil

have an influence on price levels (Abdul Redha, 2011). 5) Climate Change: Climatic changes throughout seasons influence the demand of oil as there exist differences in consumption of oil during summer and winter seasons (Ihsan, 2021). 6) USD Exchange Rate: All oil trades are done in US dollars. Hence there is a stable relationship between dollar value and oil prices. Exchange rate fluctuations affect crude oil prices. Weakness in dollar results to increased oil prices (Ketan, 2017).

1.5.2. Second Requirement: Theoretical Framework of Gross Domestic Product

The Concept of Gross Domestic Product

The Gross Domestic Product (GDP) is referred to as the combined value of the entire marketed products and services produced in the economy within a certain year. Other definitions of GDP define it as the value of the goods and services produced in a certain period of time and reflects the production of the country in a year (Al-Rawi, 2011).

GDP calculates the value of goods and services produced in a certain period (usually one year) by residents in the geographic area of the country regardless of the nationality of the producers. As the computation of GDP involves physical location, GDP carries the idea of geography (Al-Jalabi, 2015).

Other definitions define GDP as the total value added by various sectors in the country through the contribution of domestic and foreign productive factors (Alhasnawi, 2014, 190). The use of GDP is also to calculate the gross value of total output, which takes into account production of foreigners in state territory and excludes production of citizens in foreign territories (Al-Rawi, 2011)..

The Importance of GDP

GDP is an indicator that gives an all-round perspective on economic performance. Policy-makers and central banks depend on GDP in order to understand if the economy is growing or declining, and how much stimulus or contraction is needed to deal with impending problems like recession and high inflation. The national income and product accounts, which form the basis of measuring GDP, help policymakers and businessmen in assessing the impact of different variables such as monetary and fiscal policies, economic shocks like the increase in the price of oil, taxes, and spending programs on certain groups and the economy in general. There has been a significant contribution by national accounts in reducing economic cycles since World War II.

Methods of Calculating Gross Domestic Product

There are three major approaches of determining GDP (Sh, 2018):

1) Production Approach: GDP is measured using production items and economic sectors, as it is based on the supply side of the economy. It is determined as the sum of all final production values of all production entities, less the value of goods and services used as intermediate consumption, and the result is the value added to each economic sector; the sum of all value additions gives us GDP.

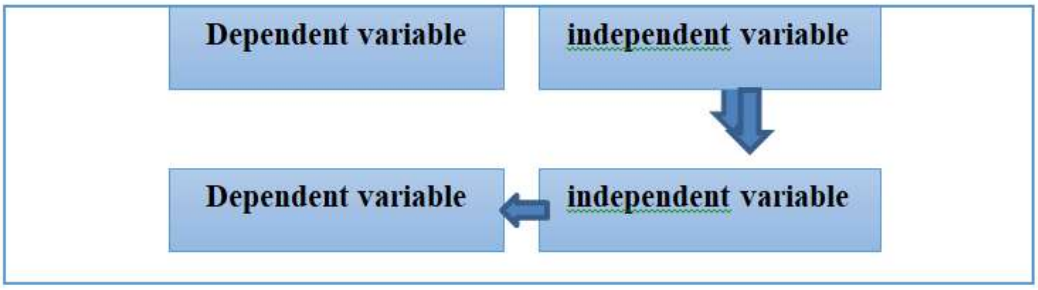
2) Expenditure Approach: The aggregate demand side is emphasized and includes Total Domestic Consumption (personal consumption made by individuals and institutions on domestically produced goods and services) and public consumption (public expenditures on goods and services for public consumption). Total Domestic Investment involves expenditure on public goods (such as power generation, houses, transportations), and fixed capital (production capital and fixed capital of public and private sectors). Net Exports are the difference between total exports and total imports of goods and services.

3) Income Approach: GDP is measured as an aggregate of incomes earned by the factors of production – land, capital, and organization (Majeed, 2016).

2. Method

The research combines oil-GDP relationships' theoretical and empirical analysis using standard econometric methods. The main analytical tool for measurement of the relationship among the variable is ARDL model.

2.1. Research Boundaries



Independent Variable → Dependent Variable
Oil Price Fluctuations Gross Domestic Product

Figure 1. Hypothetical Research Scheme
Source: Prepared by the researcher

3. Results and Discussion

3.1. Analytical Framework for Oil Price and GDP

3.1.1. Analytical Framework for Oil Price

Oil prices exhibited considerable fluctuation during the study period due to prevailing instability. Table 1 indicates oil prices reached $77 per barrel in 2010, thereafter experiencing alternating increases and decreases. The highest price occurred in 2012 at $109 per barrel, while the lowest was recorded in 2016 at $41. The average for 2010-2023 stood at $76.07.

Table 1. Oil Price Developments (2010-2023)

Growth Rate	Oil Price ($)	Years
0.39	77	2010
2.02	107	2011
0.03	109	2012
0.09	106	2013
0.48	96	2014
0.18	50	2015
0.29	41	2016
0.32	53	2017
0.09	70	2018
0.36	64	2019
0.71	41	2020
0.36	70	2021
0.09	95	2022
1.00	86	2023
	76.07	Average

Source: IMF Data, OPEC, various editions

As the Figure 1 shows during the study period (2010-2023) the prices of oil were the highest in 2012 when they reached (109) dollars, and the reason for this is the improvement of the security situation and the political situation in the world and stability while they were the lowest in 2016 when they reached (41) dollars, which it very low because of deteriorating the security situation and economic instability in the countries as in the following graph

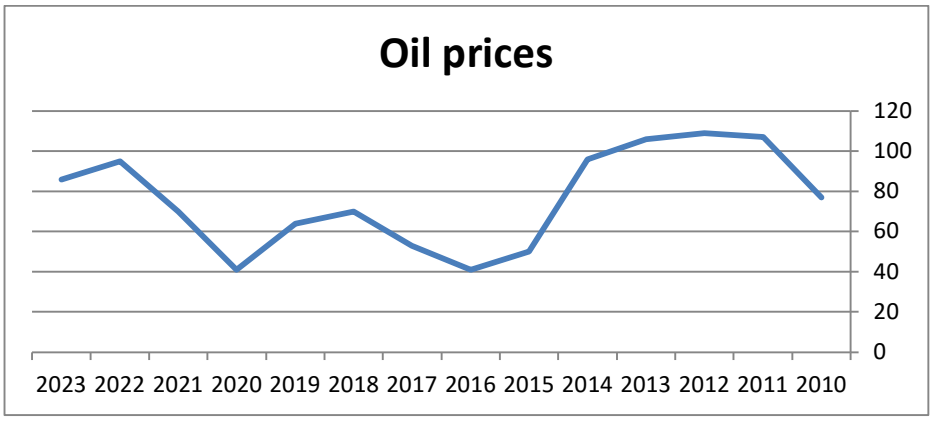


Figure 1. Iraqi Oil Price Trend (2010-2023)
Source: Prepared by the researcher based on Table 1

3.1.2. Analysis of Gross Domestic Product in Iraq

The overall GDP showed considerable growth compared to previous years with contractions happening in rare exceptional cases. The reasons included significant increase in the volume of Iraqi oil exports, economic liberalization after lifting the sanctions, growth in the Iraqi dinar, and better exchange rate dynamics. The growth in sectoral GDP occurred at different speeds due to high levels of added value in the oil sector and high revenues from crude oil as a result of the increased number of export transactions and prices, thus making possible for the recovery of Iraqi economy sectors.

GDP amounting to 132,687,028.6 million dinars in 2010 kept growing subsequently. In 2014, the year saw an increase in demand. However, it was temporary due to the deteriorated security situation (terrorist attacks and loss of territories), the decrease in oil prices, and respective reduction of revenues. GDP grew gradually until reaching 205,130,066.9 million dinars in 2021 with slower growth in subsequent years due to improved security situation, victory over ISIS, recapture of the lost territories, and increase in oil prices and exports..

Table 2. GDP Development in Iraq (2010-2023)

Growth rate	gross domestic product	Years
-	132687028.6	2010
0.07	142700217.7	2011
0.13	162587533.1	2012
0.07	178951406.9	2013
0.02	178951406.9	2014
0.02	183616252.1	2015
0.13	208932109.7	2016
-0.01	205130066.9	2017
0.02	210532887.2	2018
0.05	222141229.7	2019
-0.12	195402549.5	2020
0.015	198496540.5	2021
0.07	212408657.3	2022
0.23	262431112.3	2023
192497785.6		Average

The Figure 2 showing GDP trajectory from 132.7 trillion dinars in 2010, rising to 262.4 trillion in 2023.

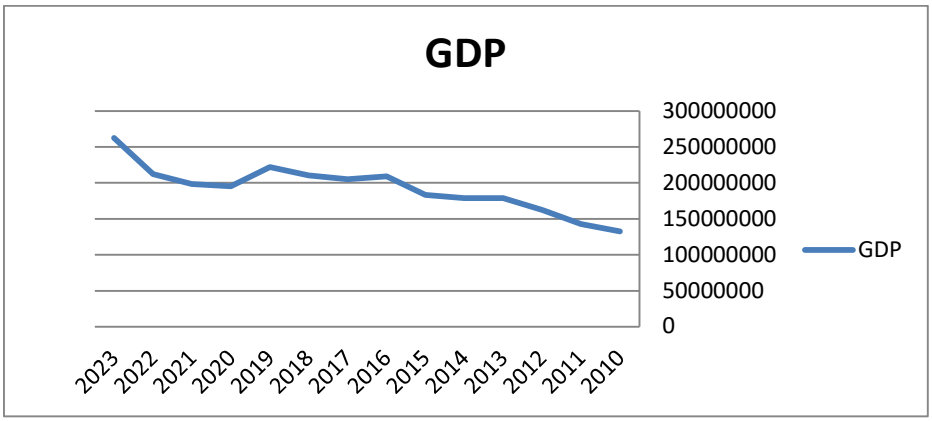


Figure 2. GDP Trend in Iraq (2010-2023)
Source: by the researcher based on Table 2

GDP peaked at 262,431,112.3 million dinars in 2013 (the highest during the study period) and bottomed at 132,687,028.6 million dinars in 2010. This growth reflects current global oil price increases, export expansion, and security improvements driving oil revenue growth.

3.1.3. Contribution of Oil Revenues to Public Revenues and GDP

Oil revenues constitute the primary source of GDP and state income, rendering Iraq's economy what may be termed a quarterly economy. Internal or external changes impacting this sector inevitably affect GDP structure. Table 3 demonstrates that at constant prices, the oil industry contributed 95.2% to GDP formation and state revenues during 2010-2023, with oil earnings comprising 54% of state income.

This proportion continued increasing until 2014, when ISIS incursions and territorial losses coincided with oil price declines to $50, reducing oil revenue contributions to 77.2% of state revenues and 54.2% of GDP. Subsequent price increases restored oil revenues to 94% of governmental revenue and approximately 76.2% of GDP.

Table 3. Contribution of Oil Revenues to Public Revenues and GDP (2010-2023)

Oil price ($)	relative importance	gross domestic product (Million Dinars)	relative importance	General revenues %	Oil revenues %	Years
77	50.4	132687028.6	95.2	70178223	66819670	2010
107	68.7	142700217.7	98.1	99998776	98191214	2011
109	71.7	162587533.1	97.6	119466403	116597176	2012
106	63.2	178951406.9	97.3	113767395	110677542	2013
96	54.2	178951406.9	77.2	105386623	97072410	2014
50	27.9	183616252.1	81.4	66470252	51312621	2015
41	21.2	208932109.7	84.4	54409270	44267063	2016
53	31.7	205130066.9	89.7	77335955	65071929	2017
70	47.2	210532887.2	92.2	106569834	95619820	2018
64	46.8	222141229.7	86.3	107566995	99216318	2019
41	27.9	195402549.5	86.3	63199689	54448514	2020
70	47.8	198496540.5	87.3	109081464	95270298	2021
95	72.1	212408657.3	95	161697437	153623277	2022
86	76.2	262431112.3	94	175787564	165432176	2023

Source: Ministry of Planning, Central Statistical Organization, Baghdad; OPEC, various editions

3.2. Statistical Analysis of Oil Price Impact on Sustainable Development Indicators

3.2.1. Study Indicators

Table 4. Study Indicators

Description	Variable name	Variable symbol
The dimension is dependent	gross domestic product	GDP
The dimension is independent	Oil prices	OIL Price

Source: Prepared by the researcher

3.2.2. Unit Root Test

Prior to statistical measurement, time series stationarity must be established through unit root tests. The Phillips-Perron test was employed for its result accuracy.

Table 5. Phillips-Perron Test Results

Stability test						
	Level			1 st Difference		
Variable	PP	Sig.	Result	PP	Sig.	Result
OIL Price	2.9983	0.0015	stationary	2.1009	0.0000	Stationary
GDP	4.3454	0.0765	stationary	2.6723	0.0000	Stationary

Source: Eviews.13 Output

Results demonstrate data stationarity at both level and first difference, indicating economic measurability.

3.2.3. Simple Regression Model Estimation

ARDL Estimation

Based on stationary data at level and first difference, ARDL estimation proceeds:

Table 6. ARDL Preliminary Estimation Results

Dependent Variable: GDP			
R-squared	0.97846	Mean dependent Var	19304.23
Adjusted R-squared	0.97758	SD dependent var	272836.1
F-statistic	1113.188	Durbin-Watson stat	2.195178
Prob(F-statistic)	0.000000		

Source: Eviews.13 Outputs

The R-squared results indicate oil prices explain 97% of GDP variation, with the remaining 3% attributable to external variables. The F-test demonstrates overall model significance at probability levels below 5%.

Bound Test

The Bound Test determines whether co-integration exists between study indicators:

Table 7. Bound Test Results

Null hypothesis: No relationship levels	
Test Statistic	Value
F-statistic	10.9797

5%	
I(1)	I(0)
4.233	3.34

Source: Eviews.13 Outputs

The F-statistic (10.9797) exceeds the table value at the 5% probability level, confirming strong co-integration between oil price fluctuations and GDP—indicating the dimensions move in a unified direction.

Short-Term Simple Regression

Table 8. Short-Term Oil Price-GDP Relationship

Dependent Variable: D(GDP)				
Method: ARDL				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
COINTEQ*	0.0541857	0.0250729	2.161126	0.0356
OIL Price	10.078656	27.478867	3.667784	0.0006

Source: Eviews.13 Outputs

Short-term results demonstrate a positive effect between oil prices and GDP. Specifically, a one-unit oil price increase yields a ten-unit GDP expansion.

Long-Term Simple Regression

Table 9. Long-Term Parameter Estimation Results

Variable *	Coefficient	Std. Error	t-Statistic	Prob.
OIL Price	-1.860020	7.36528.4	-2.525388798	0.0147
C	2.580178	4.208406	6.797979848	0.0000

Source: Eviews.13 Output

Long-term results reveal a negative effect between oil prices and GDP—an inverse correlation where a one-unit oil price increase produces a 1.8-unit GDP decline.

3.3. Third: Post-Estimation Diagnostic Tests

3.3.1. Autocorrelation Test (LM Test)

Table 10. Serial Correlation LM Test

LM Test			
F-statistic	0. 08764	Prob. F(2,37)	0.6654
Obs*R-squared	0. 08764	Prob. Chi-Square(2)	0. 4432

Source: Eviews.13 Outputs

With probability values exceeding 5%, no autocorrelation problems exist in the model.

3.3.2. Heteroskedasticity Test (ARCH)

Heteroskedasticity test This test shows whether there is a problem of heterogeneity between the independent dimension and the dependent dimension through Prob. If the significance is less than (5%), this means that there are no problems of homogeneity between the dimensions. If the opposite is true.

Table 11. Heteroskedasticity Test

ARCH			
F-statistic	2.0098	Prob. F(1,42)	0.2253
Obs*R-squared	2.7865	Prob. Chi-Square(1)	0.2634

Source: Eviews.13 Outputs

Probability values exceeding 5% indicate no heteroskedasticity problems.

3.3.3. Normality Test

Normal distribution problem: This test shows whether the data is normally distributed. This can be known through the significance of the figure 3 and it showing normal distribution curve

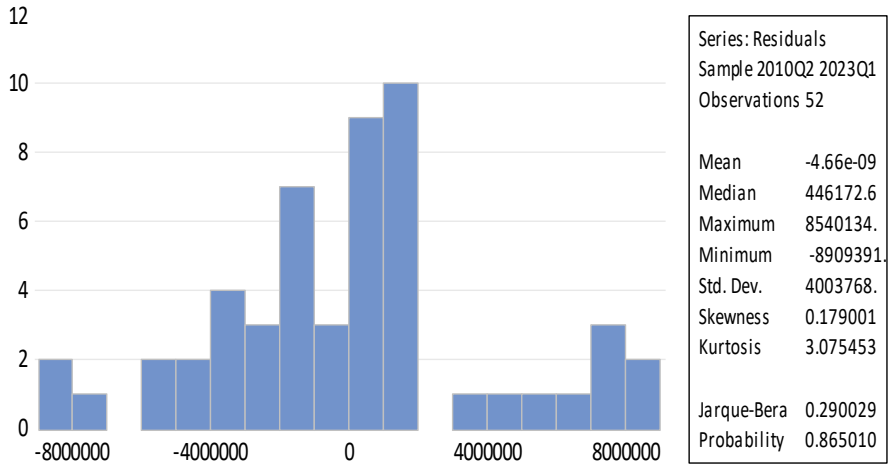


Figure 3. Normal distribution
Source: Eviews.13 Outputs

4. Conclusion

According to the results of the study, it is evident that unit root tests have validated that the variables are stationary. Besides, according to the results of Adjusted R-square, it is clear that oil price contributes to 97% of GDP variation while the rest of 3% contribution is from unobserved external factors. Also, cointegration test results show that the variables have a movement in the same direction and thus a stable long-run relationship exists. The short-run regression results reveal a positive relationship since a one unit rise in oil price brings about a ten unit increase in GDP. Conversely, the long run regression results show an inverse relationship such that a one unit rise in oil price leads to a decrease in GDP by 1.8 units. On the basis of the findings, some recommendations can be made. To start with, effective utilization of oil wealth needs to consider the development of existing and discovered oil fields, improving production capacity and developing export outlets in order to counter abnormal circumstances which may affect production and exports. Secondly, revenue utilization should be effective since the oil money needs to be used quickly in order to make up for the periods when oil money was not utilized due to monopoly of the foreign companies, armed conflicts, sanctions and corruption. Thirdly, high prices of oil need to be used to promote GDP and production through countercyclical policies. Fourthly, the production system should be improved in order to achieve balanced production system.

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