Humbatova, Sugra

**Article**

# The impact of oil prices on state budget income and expenses : case of Azerbaijan

International Journal of Energy Economics and Policy

**Provided in Cooperation with:**
International Journal of Energy Economics and Policy (IJEEP)

*Reference:* Humbatova, Sugra (2023). The impact of oil prices on state budget income and expenses : case of Azerbaijan. In: International Journal of Energy Economics and Policy 13 (1), S. 189 - 212.
https://econjournals.com/index.php/ijeep/article/download/13691/7128/32077.
doi:10.32479/ijeep.13691.

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2023, 13(1), 189-212.

# The Impact of Oil Prices on State Budget Income and Expenses: Case of Azerbaijan

**Sugra Ingilab Humbatova***

Department Economics, UNEC/Azerbaijan State University of Economics, Istiqlaliyyat Str. 6, Baku, AZ1001, Azerbaijan; *Email: s.qunbatova2012@yandex.ru; sugra_humbatova@unec.edu.az

**Received:** 06 September 2022 **Accepted:** 20 December 2022 **DOI:** https://doi.org/10.32479/ijeep.13691

**ABSTRACT**

Since Azerbaijan is one of the oil exporting countries, its macroeconomic indicators, especially the exchange rate, the state budget are highly dependent on the oil factor. This study assessed the role of oil in the economy and the impact of the oil factor on the revenues and expenditures of the state budget of Azerbaijan in manat and dollar terms. The study covers the period 2005 m03-2022 m05. Unit root (Augmented Dickey-Fuller [ADF], Phillips-Perron [PP] and Kwiatkowski-Phillips-Schmidt-Shin [KPSS]) tests were applied to check the stationarity of variables (time series). ARDL was applied as a research method. In terms of the reliability of the obtained results, the error correction model (ECM) was used, standard tests were carried out, and the joint integration methods of FMOLS, DOLS and CCR were also applied in the evaluation. Engel-Granger and Phillips-Ouliaris tests have been used to test for cointegration interactions between variables. Short-term, long-term, and strong associations between variables were also calculated. The results of the study showed that the state budget depends on the oil and gas sector, and fluctuations in world oil prices functionally and along the chain affect oil revenues and the state budget. A different impact of oil prices (oil revenues) on the state budget in terms of manat and dollar was the devaluation of the manat, which was carried out to reduce the impact of the global financial and economic crisis on Azerbaijan. The general conclusion of the study was a recommendation to further accelerate work on the diversification of the economy and the development of the non-oil sector. The results of the conducted research can serve as a scientific basis for the economic policy of the state aimed at reducing the impact of external oil price shocks on the economy of Azerbaijan and other similar oil-exporting countries, including on the state budget, and diversifying the economy. The functional dependencies of the income and expenses of the state budget in terms of manat and dollar on world oil prices are given below.

**Keywords:** Budget Expenditures, Budget Revenues, World Oil Prices, FMOLS, ARDL
**JEL Classifications:** H50 H60 Q35 Q37 Q38

## 1. INTRODUCTION

The state budget is the main financial plan of each state. Like any budget, it consists of income and expenses. The income part of the budget depends on the results of economic activities of the main, competitive areas, its financial indicators. Thus, the role of internal and external (world-international) competitiveness of its economy in the formation of the state budget is undeniable.

As a result of economic activity, all economic entities in one way or another pay taxes and other payments to the budget. Of course, the increase or rise of these taxes and other payments is in direct proportion to the expansion of their activities.

Although Azerbaijan surpasses many developing countries in terms of population income, in order to be a developed country, it must export finished products to the world market. Currently, Azerbaijan is known as an oil country in the world market (Mukhtarov et al., 2020). This means that the oil sector plays a key role in the formation of its state budget. However, taxes and other payments paid by certain economic entities to the state budget, in one way or another, do not fully act as a financial source of the socio-economic policy successfully implemented in the country (Musayev and Aliyev, 2017; Aliyev et al., 2016).

Transfers from funds created in one form or another in almost all resource-exporting countries are the main source in the formation of the state budget. In our republic, the State Oil Fund makes transfers to the state budget. The volume of its transfers depends on the financial results of the Oil Fund, and the financial results themselves depend on the volume of oil exports and world oil prices. Since the production and export of oil in our republic is somewhat stable (or relatively stable), the main dependence is on world oil prices. From this point of view, the article examines the dependence of the income and expense part of the state budget of Azerbaijan on world oil prices.

The article has the following structure: Abstract, (1) Introduction, (2) Analysis of economy and state budget in Azerbaijan, (3) Literature review, (4) Data, (5) Method and methodology, (6) Interpretation and discussion of model results, (7) Conclusion and policy recommendations. In the end, the literature list and appendices are given.

## 2. ANALYSYS OF THE ECONOMY AND THE STATE BUDGET IN AZERBAIJAN

Macroeconomic indicators act as the main indicator of every economy. Among them, the main indicator is Gross Domestic Product (GDP). GDP in our republic in 2021 will amount to 92,857.7 million manats (54,622.2 dollars/46,140.5 euros), although these figures have been steadily growing since 1995, in some years unrest in the world political and economic situation gave know about yourself. Thus, in 2008, when oil prices were at their highest, GDP amounted to 40,137.2 million manats (−141.57% compared to the previous period), 48,852.5 million US dollars −(−147.81% compared to with the previous period), EUR 33,174.0 million in EUR. (against the previous year −137.65%), decreased as a result of falling oil prices in 2009: Respectively 35.601.5 million manat (against the previous year −11.39%), 44,297.0 million dollars (against the previous year −9.36%), amounted to 31,738.9 million euros (−6.57% compared to the previous year). Since 2010, there has been an increase again. Fluctuations in oil prices in 2014-2015 affected GDP. In 2015, GDP amounted to AZN 54,380.0 million, USD 52,996.8 million and EUR 47,785.6 million, which decreased by −8.12%/29.39%/25.00% compared to the previous year. The first devaluation of the manat caused such a strong drop in GDP in foreign currency. In 2016, GDP growth began to stabilize. However, since 2017, this increase in foreign exchange has begun to stabilize. The reason for this was the second devaluation of the manat in 2015. This growth continued until 2020. However, the negative impact of the Covid-19 pandemic on the global economy has also manifested itself in Azerbaijan. Thus, in 2020, GDP decreased by −11.65%/11.65%/13.89% compared to the previous year and amounted to 72,578.1 million manats, 42,693.0, 54,622.2 million dollars and 37 407.5 million dollars in terms of euros. In 2021, as mentioned above, compared to the beginning, it increased by −127.97%/127.97%/123.88% and amounts to 92.857.7 million manats, 54.622.2 million dollars and 46140.5 million euros.

This trend was observed in all the activities of economic entities, in the activities of their households, in the income and expenses of the population, in their savings, in the structure of their savings, as well as in the income and expenditure part of the state budget. The specific weight of the oil and gas sector and the non-oil sector in GDP is of great importance for countries with resource economies. As we have mentioned, the GDP of the Republic in 2021 was 92.857.7 million manats. Of these, 33.930.6 million manats falls on the oil and gas sector and 51.082.9 million manats-on the non-oil sector. This may act as a result of the policy of economic diversification of the Republican leadership. So, before the oil boom in Azerbaijan, this ratio was completely different: in 2000, of the 4,718.1 million manat GDP, 1,371.0 million manats were allocated to the oil and gas sector and 3,055.9 million manats to the non-oil sector. In 2005, it had to change in favor of the oil sector. Thus, in 2004, 2,672.0 million manats of the 8,530.2 million manat GDP were allocated to the oil and gas sector and 5,242.5 million manats to the non-oil sector, and in 2005, 5,520.0 million manats were allocated to the 12,522.5 million manat GDP. 9 million manats fell to the oil and gas sector and 6,055.1 million manats to the non-oil sector. Already in 2006, out of 18,746.2 million manats of GDP, the oil and gas sector accounted for 10,091.8 million manats, and the non-oil sector −7,630.0 million manats. This advantage of the oil and gas sector continued until 2009, and fluctuations in oil prices in 2008, in other words, oil prices fell by 2-3 times over several months (the maximum price in July 2008 was −133.9 dollars/bbl and the minimum price-February 2009-41.5 USD/bbl) equalized this ratio in 2009. However, in the next 2 years, this ratio slightly increased due to the oil sector, but from 2012 to the present, the non-oil sector has dominated GDP.

Since 2005, state budget revenues have been increasing many times due to the influence of the oil factor and the oil shortage. Although transfers from the Oil Fund play a major role in this growth, the development of the oil and gas sector, the diversification of the economy due to oil revenues, and the rapid growth of state investments have led to the development of the non-oil sector and economic growth there, and the volume of taxes and other payments to the state budget from these areas has increased. So, since 2005, in the revenue part of the state budget, the profit tax (income) of legal entities, value added tax, taxes related to foreign economic activity, other taxes, other revenues and excises have increased 6-10 times.

### 2.1. Transfers from the oil Fund to the State Budget in Azerbaijan

Transfers of the State Oil Fund to the state budget (this is the main revenue part of the budget and expenses mainly depend on it).

Azerbaijan, as an oil exporting country, aims to direct the main part of the funds it receives to the development and diversification of the economy, or, if not officially, to the collection, efficient management and preservation of the revenues obtained by the Republic of Azerbaijan in connection with the implementation of agreements on oil and gas resources for future generations. The State Oil Fund of the Republic of Azerbaijan, which was established by Decree No. 240 of the President of the Republic of Azerbaijan, Heydar Aliyev dated December 29, 1999, for the purpose of providing it, during the years 2004-2021 (the volume of transfers in 2021 is 12.200.000.00 thousand manats) to the State budget 117.170.300.00 thousand manats were deposited.

This is 45.61% of the entire state budget over these 18 years. It should be noted that the transfer to the state budget in the amount of 130,000.00 thousand manats (8.61% of the state budget) in 2004 was already received in 2008 in the amount of 11,000.000.00 thousand manats (14.87% of the state budget). After that, as a result of the rapid growth of oil exports and world oil prices exceeding $100, deductions to the state budget began to increase rapidly. Thus, already in 2009 the transfer reached 4,915.000.00 thousand manats and exceeded the figure of the previous year by 4.5 times (40.36% of the State budget).

The peak period of transfers was 2012 (transfer −9,905.000.00 thousand manats and 60.26% of the state budget) and 2013 (transfer −11,350.000.00 thousand manats and 59.25% of the state budget). However, as a result of the continued fall in world oil prices from June 2014 ($111.87) to February 2016 ($33.2), Azerbaijan's oil revenues also decreased, and this was reflected in the state budget (Table 1).

Thus, transfers to the state budget from 2013 (transfer-AZN 11,350.000.00 thousand and 59.25% of the state budget) to 2017 (transfer-AZN 6,100.000.00 thousand and 36.38% of the state budget) decreased by 1.86 times.

Subsequently, relative stability was established in the world oil market, and in the period from 2018 to 2020, an average of 11,224,433.33 thousand manats was transferred per year, which averaged 47.51% of the State budget.

Since its inception, the State Oil Fund of the Republic of Azerbaijan has spent 122,303.5 million manats on the economy of the republic and its development, of which 108,792.8 million manats have been transferred to the state budget, and 3,949.5 million manats to the Central Bank of the Republic of Azerbaijan. Currently, according to the information as of October 1, 2020, the assets of SOFAZ are: 43288.6 mln. equal to US dollars.

In 2015, changes were made in the amount of transfers to the state budget, and the originally planned amount was reduced by 21.72%. In 2015, changes were made in the state budget expenditures and the originally planned amount was reduced by 10.00%.

In 2016, changes were made in the amount of transfers to the state budget, and the originally planned amount was increased by 26.91%.

In 2016, changes were made in the state budget expenditures and the originally planned amount was increased by 20.18%.

In 2018, changes were made in the amount of transfers to the state budget, and the originally planned amount was increased by 18.91%.

In 2018, changes were made in the state budget expenditures and the originally planned amount was increased by 11.83%.

## 3. LITERATURE REVIEW

The influence of the oil factor on the economy, macroeconomic indicators, government revenues and expenditures of oil exporting countries.

In the last 60 years, when the role of oil in the world economy began to increase rapidly, most of the economic scientists and specialists, politicians, national and international financial institutions and research centers touched on this topic. Grennes and Winokur (1974), Lienert (1981), Jan Fabritius and Petersen, (1981), Jones (1982), Shaffer and Fischer (1982), Helliwell et al. (1982), Looney (1985), Stauffer (1985), Hammoudeh (1988), Adelman (1989), Choucri et al. (1990), Smith (1992), Huntington (1998), Acemoglu et al. (2013), Caselli and Michaels, (2013), Kennedy and Tiede (2013), Pierru and Matar (2014), Brueckner and Gradstein, (2016),Usman (2017), Hassler et al. (2017), El-Radhi (2018), El-Radhi (2018), Murshed (2018), Baumeister et al. (2018), González (2018), Boyd et al. (2000), Zallé (2022).

### 3.1. The "Oil Curse" Phenomenon

Al-Abri et al. (2019) have identified and examined the phenomenon of the "oil curse" for Oman, the long- and short-term interactions between economic growth from non-extractive sectors, oil revenues and government expenditures by using quarterly data covering the period 2000-2015 together with the use of a vector autoregressive regression (VAR) co-integration model. Furthermore, causality tests and impulse responses are used to measure the extent of short-term and long-term macroeconomic consequences of negative oil price shocks for Oman. The results of the study showed that a reasonable tax-budget policy that ensures real sectoral diversification of income can be crucial to prevent the oil curse in Oman.

Kakanov et al. (2018) between 1982 and 2012, based on the ECM model, there is strong evidence for the resource curse hypothesis for the 25 oil exporters, and no evidence that better firms alleviate this curse. Oil price shocks have an asymmetric effect in the short term. The rise in oil prices is positive, and when they fall, there is no statistically significant effect. There is also circumstantial evidence that the impact of an oil price shock is partly offset by fiscal policy, especially in oil-heavy countries. In the long perspective, oil price volatility does not have a statistically significant impact on GDP. Thus, clear evidence of the negative impact of oil dependence on economic development has been presented. On average, increasing the share of oil exports by 10% points leads to a 7% decrease in GDP per capita in the long term. Anti-cyclical tax-budget policy together with a stable exchange rate protects the economy of oil-dependent countries from oil price shocks and helps economic development. Exchange rate regimes also play a role. Thus, countries that allow their currencies to move freely benefit from positive oil price shocks in the short term. But in the long term, a fixed exchange rate regime is associated with higher GDP due to active stabilization by national welfare funds.

### 3.2. Impact of oil Prices on Economic Growth and Economic Development

Abdelsalam (2020), studied the extreme impact of changes in crude oil prices and their volatility on economic growth in the

Middle East and North Africa (MNA). Here, the asymmetric and dynamic interaction between the price of oil and economic growth was examined, and a separate analysis was carried out for each oil exporting country and LAC oil importing country. In addition, it was examined to what extent the quality of institutions will change the impact of fluctuations in oil prices on economic growth. The researchers used a Panel Quantile Regression approach with other linear models such as fixed effects, random effects, and the generalized panel method in the article. According to the results of the study, changes in the price of oil and its volatility have opposite effects for each oil exporting and importing country. Also, the first change in the price of oil has a positive effect, and volatility has a negative effect. However, the latest change in the oil price has a negative impact, while volatility is positive. Moreover, the impact of changes in oil prices and their uncertainty are different for different quantiles. In addition, an asymmetric effect of oil price changes on economic growth was also revealed. Finally, consideration of institutional quality tends to reduce the impact of changes in oil prices on economic growth.

Al Rasasi et al. (2018) examined the relationship between Saudi Arabia's oil revenues and the Kingdom's economic growth over the 47 years between 1970 and 2017. Johansen and Juselius Co-integration Test, OLS Regression Equation-Long Run Relationship, OLS Regression Equation-Error Correction Model, Granger Causality Test were applied. Highly significant short-term and long-term relationships were found based on the ECM assessment. The results of the Ganger causality test confirmed the results of the ECM.

Trang et al. (2017) It consists of a numerical analysis of the impact of the oil price on Vietnam's macroeconomic variables, including inflation, growth rates, budget deficit and unemployment, from 2000 to 2015. Using a vector auto-regression (VAR) model, it can be seen that rising oil prices will lead to higher inflation and budget deficits in Vietnam, while its impact on GDP growth and unemployment is unclear.

In their article, Banafea and Ali (2022) analyzed the impact of major oil shocks on the economic development of Saudi Arabia using quarterly data from Q1 1981 to Q4 2019, a standard VAR model, and a heterochastic Markov transition. The results showed that there were three major negative oil shocks: 1986 Q1, 2008 Q4, and 2014 Q4. But the third quarter of 1990 was just one big positive shock. Analysis of the impulse response and decomposition of variance also shows that both large negative and positive oil shocks have a positive impact on economic growth in Saudi Arabia. Furthermore, major oil shocks have a significantly positive impact on economic growth compared to conventional oil shocks.

The articles by Pavlova et al. (2017) explored the dependence of the Russian economy on world oil prices and the factors influencing the state of the world oil market. It substantiates the growing role of the financial market of oil contracts in the conditions of modern economic development. The situation in which a country's exports are heavily oriented towards energy, while other industries are significantly reduced, has been considered and described as a phenomenon called "Dutch disease" in this economic theory. This phenomenon is characterized by an increase in the production and export of goods. In addition, capital inflows from exports are stimulating consumer demand, but the industrial sector is not signaling an increase in income due to the pressure of the "Dutch disease", which eventually increases inflation. The dependence of the Russian economy on oil prices has become one of the main sources of its imbalance. As a result of high oil prices and increased exports, most of the national economy was directed to the oil sector, along with the strengthening of the national currency, the competitiveness of the Russian manufacturing industry and the development of new sectors of the economy decreased, the economy was struggling. This slowed down the modernization of the entire Russian economy in the long term.

Sadigov (2020) explored ways to achieve economic growth and the role of oil in the economies of oil countries. As a result of the research, it was determined that oil-rich countries should be able to develop the non-oil sector and achieve economic diversification in order to achieve long-term economic growth and sustainable economic development.

Aljarallah's (2020) study applied ARDL and VEM models using time series from 1984 to 2014. The results show that, in the long term, dependency on natural resources has a positive effect on GDP per capita in Saudi Arabia and the United Arab Emirates, but this association is not significant in Kuwait. Resource dependence was later found to have a positive effect on (total factor productivity) in Saudi Arabia and a negative effect in Kuwait.

Luecke, (2011) in his article, based on monthly data covering the period from 1993 to 2016, using the structural VAR model, he analyzed the impact of changes in oil prices on the macroeconomic performance of oil exporting countries (Kazakhstan and Azerbaijan). This study shows that higher oil prices can have a positive effect on real GDP growth, reduce CPI inflation and interest rates, and lead to domestic exchange rate appreciation.

Sultan and Haque (2018) Johansen's cointegration method and vector error correction model (VECM) were used in their work to estimate the long-term interaction of economic growth with exports, oil imports, and government consumption spending in Saudi Arabia. The study shows that economic growth has a long-term relationship with oil exports, imports, and government expenditure on consumption. The study recommends monitoring and regulating imports and diversifying the economic base in exports, as well as intensifying work in import-substituting areas of the country.

### 3.3. The Impact of Oil Prices on Government Revenues and Expenditures

Alekhina and Yoshino (2018) investigated the impact of the world oil price on the economies of countries exporting non-OPEC energy carriers, including monetary policy using a VAR structural model and monthly data covering the period January 1993 to December 2016. Researchers have explained the mechanisms of the transfer of oil prices from the export side to this economy and through the fiscal channel, taking into account the monetary policy factor. The results show that the change in oil prices has a significant impact on the real Gross Domestic Product, Consumer Price Index, inflation rate, interest rate and exchange rate of the oil exporting country. In other words, the increase in the price of oil can always have a positive effect on the real growth of the gross domestic product, can reduce CPI inflation and the interest rate, and can contribute to an increase in the domestic exchange rate either.

Moncazeb et al. (2014) have studied the effect of oil revenues on the budget deficit in individual oil countries (across nine countries) from 1995 to 2011, using the least squares (OLS) method. The results of the model evaluation showed that the impact of oil revenues on the budget deficit is negative. Furthermore, taking into consideration the effect of oil revenues in OPEK members Iran and Kuwait, it implies minor importance in other countries and a higher explanation is achieved.

Osisanwo (2018) evaluated the impact of oil export revenue on government revenue and expenditure in Nigeria from the perspective of sustainable economic development policy. The co-integration methods and least squares method (OLS), based on data from 1986 to 2015, were used as analysis methods in the study. Tests for co-integration showed the existence of long-term equilibrium dependence between oil export revenues, government revenues and expenditures. Thus, the revenues obtained from oil exports have a positive effect on the general state revenues and expenditures. However, the impact of oil export revenues on state revenues was significant. Other variables that affect government revenues and expenditures are total revenue and population. A policy implication from this study is that an increase in government expenditures without a corresponding increase in revenue can lead to an increase in the budget deficit. For this reason, the government should explore other sources of revenue, especially the non-oil minerals sector, as well as reduce large current expenditures and shift to capital and other investment expenditures.

Gurbanov et al. (2017) estimated three different models to examine the relationship between oil prices and oil diversification in Azerbaijan over the period spanning the 2000Q01-2013Q04: (1) a model combining oil prices and government capital expenditure, (2) government capital expenditure and non-oil exports, (3) government capital expenditure and non-oil GDP. VAR, VECM, Johansen Co-integration Method, Fully Modified Ordinary Least Squares Method (FMOLS), Dynamic Ordinary Least Squares Method (DOLS), and Engle-Granger criterion were used in the study and it was concluded that among the variables in all three models, in other words, between oil prices and public capital expenditures (a 1% increase in oil prices increases public capital expenditures by 2.13% on average), between public capital expenditures and non-oil exports (a 1% increase in public capital expenditures decreases non-oil exports by 0.23%), there is a long-run interaction between public capital expenditure and non-oil GDP (a 1% increase in public capital expenditure increases non-oil GDP by 0.45%).

Dizaji, (2014) studied the dynamic interaction between government revenues and government expenditures in Iran, a developing economy based on oil exports, using annual data for the period 1970-2008 and quarterly data for the period 1990Q02-2009Q01. At the same time, it is also important how oil price (income) shocks can affect these relationships. The results of the impulse response functions and the analysis of variance separation showed that the contribution of oil revenue shocks to the explanation of public expenditure is stronger than the contribution of oil price shocks. In addition, the results of vector auto-regression (VAR) and vector error correction (VEC) models show that there is a strong causal relationship between government revenues and government expenditures in Iran's economy. However, the evidence of reverse causality is very weak. Overall, the results confirm the income and expenditure hypothesis for Iran. The study concludes that sanctions aimed at limiting the Iranian government's revenue from oil exports may affect total government expenditures as an important engine of the Iranian economy's development.

Ebaid (2016) the interrelationship between government expenditures, oil prices and economic growth, as well as the cause-effect relationships between them, were investigated by using data from 1974 to 2014 and the ARDL method and the TYDL test. The results of the study showed that an increase in economic growth rates has a negative and significant long-term effect on government investment spending as the dependent variable, but the result contradicts the second model (which uses government consumption spending as the dependent variable). Moreover, there is a positive long-term relationship with GOVINV and a negative relationship with GOVCO as an oil price variable. On the other hand, according to the TYDL result used to test for causation, there is a unidirectional Granger causation from GDP to GOVINV. There also has not been found any causal relationship between GDP and GOVCO.

Eloho and Ekiomado (2019) studied the impact of oil price shocks on income stability and economic performance in Nigeria from 1994 to 2017 using a VAR model, impulse response functions, and dispersion decomposition. The results of the study showed that initially public administration needs its stability.

Because other sources of income can protect it from the effects of oil revenue shocks in the short term. However, over time this will be under threat. The reason is that shocks from oil revenues destabilize it. This results in a very unfavorable reduction. As for GDP, it is noted that shocks from oil revenues do not have an immediate negative impact in the initial stages. In the long-term perspective, GDP begins to drift into negative territory and continues until the end of the period. As for government tax revenues, the effects of oil revenue shocks are not pre-stabilizing, but in the long term there is a sharp decline in the negative area, which continues until the end of the period. In general, the results of the impulse response also show that oil revenue shocks have a significant destabilizing effect on economic performance, government spending and government revenue in the long term. The main recommendation is that the economy become less dependent on oil revenues and diversify to ensure sustainable growth and development.

Kreishan et al. (2018) studied the short-and long-term interactions between oil revenues, government revenues, and government spending in the Kingdom of Bahrain over the period 1990/1991-2017/2018 using the OLS method, the ECM model, and the two-stage Engel-Granger co-integration test. Empirical results show that oil revenues and government expenditure are related, and thus there is a long-term relationship between oil revenues and government expenditure in Bahrain. The Granger Causality Test revealed a unidirectional relationship in the short term. This causal relationship can be traced from government revenue to government expenditure. In addition, the value of delayed ECT confirms a long-term causal relationship between both variables. Thus, there is evidence to support the revenue-expenditure hypothesis, according to which changes in government revenue will lead to changes in government expenditure. On the other hand, the results also showed that oil revenues have a positive and significant impact on government spending (the long-term elasticity of government spending to oil revenues is 1.37). This means that a 1% increase in oil revenue results in a 1.37% increase in government expenditure. Thus, the results show that government expenditure is highly dependent on oil revenues. For this reason, the directive authorities of Bahrain are recommended to increase the income from oil sales by increasing the added value in oil exports or to focus on further diversifying the sources of public revenues through the creation and expansion of non-oil sectors, so that the country, especially in times of weakening of the world oil market, protect the arrow from certain dangers. These results are consistent with the results and hypotheses of our study.

Raouf (2021) studied the impact of oil price shocks on the components of government spending in both oil exporting and oil importing countries in 1980-2018, using a vector auto-regression (VAR) model, an impulse response function and a decomposition of variance in his study. As a result of the study, it was found that oil price shocks have a positive effect on the current spending of the governments of two groups of countries. However, this has a positive effect on public capital expenditures in oil-exporting countries and a negative effect on oil-importing countries.

Zakaria and Shamsuddin (2017) in their study they used annual data from 1978 to 2014, VAR model, co-integration tests, Granger causality tests for evaluation. The results obtained from examining the causal relationships between crude oil variables (average world price of crude oil; crude oil exports, crude oil imports, crude oil production, crude oil consumption) and budget variables (government revenue and government spending).) in Malaysia show that the crude oil variables under study do not have a long-term causal relationship with government spending, but in the long run, this has a significant impact on the revenues of the Malaysian government. However, in the short term, only crude oil consumption has been found to increase government expenditure, suggesting the impact of fuel subsidies on government expenditure. As for government revenues, there is a short-term causal relationship between Production, Exports, imports and government revenues.

Sillah and Alsheikh (2012) in six countries of the Cooperation Council of the Persian Gulf countries, the elasticity of oil revenues and state expenditures and oil prices has been studied. They also used annual data from 1980 to 2010, VAR model, Co-integration Tests, Granger causality Tests. According to the results, no reliable short-term interactions between the data were found. Also, the growth of world oil prices, as a rule, led to an increase in domestic oil consumption in all participating countries, except for Oman. Three member countries-Bahrain, Kuwait and the United Arab Emirates-are saving oil as their per capita GDP goes up and up. The other three countries, Oman, Qatar and Saudi Arabia, tend to increase their domestic oil consumption as GDP per capita rises. It was also concluded that the three oil-saving countries have a higher income elasticity than the three non-oil-saving countries. Finally, domestic oil markets were not sensitive to shocks and fluctuations in world oil prices. For example, with rising oil prices, oil consumption per capita in the Gulf Cooperation Council countries is growing rapidly, while in some developed countries, such as the United States of America and Japan, there is a downward trend.

Ibrahim et al. (2019) in their article, they consider vector auto-regression models and sensitivity to oil price shocks in the short and long term, using Oman's budget balance sheet and annual data for the period 1980-2016. Also, Granger Causality Analysis, Variance Decomposition Analysis and Impulse Response Analysis were conducted. The results of this study showed that oil prices lead to an increase in gross domestic product (GDP), capital accumulation and inflation. Momentum analysis showed that changes in oil prices and, as a result, oil revenues had a similar effect on most macroeconomic variables in Oman. Most of these variables show growth in the first four quarters, excluding government spending and inflation. However, in many cases, this growth was quickly followed by a decline in subsequent quarters, with the exception of inflation, which subsequently showed a steady increase.

In the article by Rahma et al. (2016) the VAR model was applied using quarterly data from the first quarter of 2000 to the second quarter of 2011 to examine the impact of oil price shocks on the main variables of the Sudanese government budget. Empirical results have shown that falling oil prices have a significant impact on oil revenues, current spending and budget deficits. However, an increase in oil prices does not lead to an increase in budget variables. The results of analysis of forecast error variance, impulse response, and decomposition functions show that the oil price shock has an asymmetric impact on the government budget.

Mikhaylov (2019) in his article developed a model for assessing (forecasting) the impact of the crisis in the energy market on Russian budget revenues in 2015. This (modeling the deficit of budget revenues for 2015) confirmed the strong dependence of the oil and gas revenues of the budget system on asset prices in the commodity markets. At the same time, calculations also showed that gas production and export revenues may even increase this year due to the nature of long-term contracts concluded by Russian exporters. However, the revenues of the Russian ruble from oil production and exports will not have a positive impact and will lead to an overall decrease in federal budget revenues by $874 billion.The share of oil and gas revenues in the budget structure may decrease from 46.8% to 40.3%. In conditions of unstable commodity markets, this may have a positive impact on strengthening the stability of budget revenues in the future.

Ali (2021) has examined the symmetry in sensitivity and trends in oil prices, GDP and government spending trends in Saudi Arabia over the period 2011-2018, and the impact of oil price volatility on GDP and PSA. The results of the researcher's calculation of coefficient of variation, ANOVA and correlation variables to obtain normality, similarity and random interaction showed that oil prices have a positive and proportional effect on GDP. There is a negative correlation between oil prices and government expenditure fluctuations. Oil prices and GDP do not affect the dynamics of GDP in the long term, but shocks in oil prices and GDP annually affect government expenditure in Saudi Arabia. Diversification of revenue sources is needed to minimize dependence on oil prices and insure the budget deficit against these oil price fluctuations, given the impact of oil price sensitivity on the economy and government expenditure. Policy makers should consider oil price sensitivity, GDP trends and management, formulate appropriate policies for the transition from an oil economy to a non-oil economy, and minimize the impact of oil price shocks on the economy.

Akbari et al. (2017) attempted to accurately study the relationship between government revenues and expenditures in Iran from 1989 to 2015 using seasonal data and applying the TVP FAVAR method in MATLAB programs. According to the results of the study, the coefficient of interaction between income and expenditure changes so that in most periods the interaction between income and expenditures is positive. In other words, for most periods of the period, government expenditures exceed its revenues, and a two-way relationship between government revenues and expenditures has been proven. Thus, there is a causal relationship between government revenues and expenditures. This means that government spending changes synchronously, and a change in each variable will cause a change in the other variable. Therefore, this ratio between government revenues and expenditures can be used to prevent permanent budget deficits.

Alkhateeb et al. (2017) explored the interaction between oil revenues and employment rates over the period 1991-2016 by adding two more variables, namely GDP and government expenditure. In the long-term perspective, VECM results show that oil revenues and government spending determine the level of employment in Saudi Arabia. In the short-term perspective, oil revenues and government spending affect the level of employment in a country. This study also notes that in the long term, falling oil prices and the subsequent impact on oil revenues could create problems for the economy if it does not diversify its economic base and reduce its dependence on the oil sector. Based on the results, it is recommended to invest oil revenues in other sectors of the economy in order to achieve diversification and support employment in sectors other than oil.

Ali (2020) studied the volatility of oil prices and government expenditure in Saudi Arabia based on sensitivity and trend analysis. As a result, there is a low positive sensitivity between the price of oil and government expenditure, while there is a negative trend between the price of oil and government expenditure in the long term. Oil price shocks affect government expenditure by maintaining a gap between government spending growth trends and the progressive order of oil prices over the long term.

Mammadli et al. (2021) their study examines the main drivers of public debt growth in 184 countries around the world. The study found that oil abundance, economic growth rates, the share of mining rents in total income, interest rates on foreign debt, and developing country status have a statistically significant effect on the growth of public debt. Conversely, defense spending, unemployment and inflation do not have a statistically significant positive effect on the level of public debt.

**Table 1: Budget-transfer measures in Azerbaijan against the backdrop of falling oil prices in 2008-2009 and 2014-2016 (thousands manats)**

| | 2008-2009 | | | 2014-2016 | | |
|---|---|---|---|---|---|---|
| Average monthly price | | 97.66$ | | | 65.59$ | |
| Duration | 2008M06 | 133.9 | 6 months | 2014M06 | 111.87 | 20 months |
| | 2008M11 | 41.58 | | 2016M02 | 33.2 | |
| Budget transfer | 2009 | 4 915 000.00 | | 2014 | 9 337 000.00 | |
| | | | | 2015 | 10 388 000,00 | |
| | | | | 2015* | 8 130 000,00 | |
| | 2010 | 4 915 000,00 | | 2016 | 6 000 000,00 | |
| | | | | 2016* | 7 615 000,00 | |
| | | | | 2017 | 6 100 000,00 | |
| State budget | 2009 | 12 177 000,00 | | 2014 | 18 400 565,20 | |
| | | | | 2015 | 19 438 000,00 | |
| | | | | 2015* | 17 497 964,70 | |
| | 2010 | 10 015 000,00 | | 2016 | 14 566 000,00 | |
| | | | | 2016* | 17 505 679,50 | |
| | | | | 2017 | 16 766 000,00 | |
| Stabilization period | | | | | | |
| Budget transfer | 2011 | 6 480 000,00 | | 2018 | 9 216 000,00 | |
| | 2012 | 9 905 000,00 | | 2018* | 10 959 000,00 | |
| | 2013 | 11 350 000,00 | | 2019 | 11 364 300,00 | |
| Stabilization period | 2011 | 12 061 000,00 | | 2018 | 20 127 000,00 | |
| | 2012 | 16 438 000,00 | | 2018* | 22 508 869,70 | |
| | 2013 | 19 159 000,00 | | 2019 | 24 218 061,70 | |

* Amendments to the State Budget Law

# 4. DATA

## 4.1. Data

The Central Bank of Azerbaijan (CBAR) is the main source used to obtain data on the variables of the models built to achieve the purpose of this study. Econometric models consist of the following variables: budget expenditures and budget revenues in national currency (in manats), budget expenditures and budget revenues in foreign currency (in dollars), world oil prices (in dollars) (Table 2, Figure 1). We used monthly data. Its information corresponds to the time series, and the period of this study covered 2005 m03-2022 m05. World oil prices affect Azerbaijan's oil revenues. Fluctuations in oil prices in 2009-2009 and 2014-2016, as well as in 2017-2018 and 2019-2020, had a negative impact on oil revenues (revenues of the State Oil Fund). This, of course, affected the transfers of the Oil Fund to the State Budget. The revenues of the budget and correspondingly the expenses were decreasing. However, 2 devaluations in February and December 2016 were able to correct the situation. Related to this devaluation are differences between expenditures and revenues of the state budget in national currency (in manats) and expenditures and revenues in foreign currency (in dollars).

The functional dependence of revenues and expenditures of the state budget in manat and dollar terms on world oil prices is given below.

$$BEM=f\,(WOP) \quad (1)$$
$$BRM=f\,(WOP) \quad (2)$$
$$BED=f\,(WOP) \quad (3)$$
$$BRD=f\,(WOP) \quad (4)$$
$$(BEM)_t=\alpha+\beta WOP_t+\varepsilon_t \quad (5)$$
$$BRM_t=\alpha+\gamma WOP_t+\varepsilon_t \quad (6)$$
$$BED_t=\alpha+\delta WOP_t+\varepsilon_t \quad (7)$$
$$BRD_t=\alpha+\vartheta WOP_t+\varepsilon_t \quad (8)$$

The main focus of the study was on the impact of world oil prices (in dollars) on budget expenditures and budget revenues in national currency (manats), as well as on budget expenditures and budget revenues in foreign currency (in dollars). These equations were used to estimate the coefficient of the explanatory variable (world oil prices (in dollars)). Here, $\alpha$ is the point of intersection of the models, $\beta$, $\gamma$, $\delta$ and $\vartheta$ are the coefficients explaining the variable, and is the error of the model.

**Table 2: Data and internet resource**

| Variables | | Source |
|---|---|---|
| *BEM* | Budget expenditures (AZN) | www.cbar.az |
| *BRM* | Budget revenues (AZN) | www.cbar.az |
| *BED* | Budget expenditures (dollars) | www.cbar.az |
| *BRD* | Budget revenues (dollars) | www.cbar.az |
| *WOP* | World oil prices-barrel/(dollars) | www.cbar.az |

## 4.2. Data Description

Before starting the ARDL co-integration assessment, several preparatory steps are contemplated. In the first stage, the data is analyzed by static and graphic methods.

Descriptive statistics of the variables (data) are given in Table 3. Here, only one variable-world oil prices (in dollars) is normally distributed according to the Jarque-Bera criterion. Other variables are budget expenditures and budget revenues, whether in national currency (in manats) or in foreign currency (in dollars), not normally distributed. Kurtosis (excess) range variables-budget expenditures and budget revenues in national currency (in manats) between world oil prices (in dollars) are not more than 1.1, but budget expenditures and budget revenues in foreign currency (in dollars) are between world oil prices (in dollars) More than 1.5. Although the standard deviation is less in world oil prices (in dollars), it is more in national currency (in manats) budget expenditures and budget revenues, and especially in foreign currency (in dollars). Depending on their fluctuations (changes), including world oil prices, budget expenditures and budget revenues have a negative asymmetry both in national currency (in manats) and in foreign currency (in dollars).

Descriptive statistics of variables (data) in first (first) differences are given in Table 4. The Standard Deviation between the variables has a large range due to fluctuations (changes) in world oil prices (in dollars). All other variables except for budget expenditures in national currency (in manat) have negative asymmetry. Here, none of the variables has a normal distribution according to the Jarque-Bera test.

Although there is no trend or trend in world oil prices (in dollars), budget expenditures and revenues tend (trend) to increase either in national currency (in manats) or in foreign currency (in dollars). This trend is related to economic development and economic growth.

**Table 3: Descriptive statistics for the variables**

| İndicators | LOGBRM | LOGBRD | LOGBEM | LOGBED | LOWOP |
|---|---|---|---|---|---|
| Mean | 6.997265 | 6.978206 | 6.912795 | 6.893737 | 4.254011 |
| Median | 7.192182 | 7.170888 | 7.022495 | 6.991208 | 4.228147 |
| Maximum | 8.419735 | 8.541456 | 8.549671 | 8.784293 | 4.897093 |
| Minimum | 4.709530 | 4.521789 | 4.753482 | 4.659558 | 3.265378 |
| Std. Dev. | 0.727484 | 0.774453 | 0.656033 | 0.692658 | 0.339106 |
| Skewness | −1.024169 | −0.839728 | −0.906649 | −0.647905 | −0.169070 |
| Kurtosis | 3.662145 | 3.432688 | 3.896885 | 4.015900 | 2.549224 |
| Jarque-Bera | 39.96929 | 25.94219 | 35.29739 | 23.38390 | 2.738769 |
| Probability | 0.000000 | 0.000002 | 0.000000 | 0.000008 | 0.254263 |
| Sum | 1448.434 | 1444.489 | 1430.949 | 1427.003 | 880.5803 |
| Sum Sq. Dev. | 109.0219 | 123.5541 | 88.65811 | 98.83361 | 23.68859 |
| Observations | 207 | 207 | 207 | 207 | 207 |

**Table 4: Descriptive statistics for the first difference of the variables**

| İndicators | DFLOGBRM | DFLOGBRD | DFLOGBEM | DFLOGBED | DFLOGWOP |
|---|---|---|---|---|---|
| Mean | 0.011743 | 0.011804 | 0.009042 | 0.009103 | 0.002828 |
| Median | 0.030123 | 0.037013 | 0.023336 | 0.030400 | 0.008241 |
| Maximum | 1.660944 | 1.601957 | 1.627296 | 1.598230 | 0.215385 |
| Minimum | −1.293969 | −2.296021 | −1.332092 | −2.294653 | −0.406052 |
| Std. Dev. | 0.431472 | 0.598585 | 0.433438 | 0.602146 | 0.092481 |
| Skewness | 0.161470 | −1.137148 | 0.142791 | −1.154806 | −1.130991 |
| Kurtosis | 4.383729 | 6.971103 | 4.314983 | 6.960431 | 5.564805 |
| Jarque-Bera | 17.32972 | 179.7529 | 15.54217 | 180.4158 | 100.3802 |
| Probability | 0.000173 | 0.000000 | 0.000422 | 0.000000 | 0.000000 |
| Sum | 2.418973 | 2.431686 | 1.862558 | 1.875271 | 0.582603 |
| Sum Sq. Dev. | 38.16437 | 73.45241 | 38.51309 | 74.32879 | 1.753302 |
| Observations | 206 | 206 | 206 | 206 | 206 |

Depending on fluctuations (changes) in oil prices, budget expenditures and revenues have a negative asymmetry both in national currency (in manats) and in foreign currency (in dollars).

## 5. METHOD AND METHODOLOGY

### 5.1. Unit Root Test-Stationarity

As we know, the Autoregressive Distributed Lag Cointegration model (ARDL) does not require checking the unit root as an initial research model, as it tests for the existing co-integration between I(0) or I(1) ordinal variables. This provides information on the degree of integration of each variable (Alabdulwahab, 2021). Furthermore, co-integration can be a combination of I(0) and I(1).Since the I(2) series could not be integrated, the ARDL bounds testing methodology (Pesaran and Shin, 1999, Pesaran et al., 2001) could be invalidated. For this reason, after presenting the descriptive statistics of the time series, the first step in the ARDL analysis should be the analysis of the unit root. That is, all variables used in the study should be checked for stationarity before evaluating ARDL bounds testing. Each variable must be either I(0) or I(1) to allow bounds testing of ARDL models. In no case should it be I(2). In addition, the dependent variable is assumed to be I(1) (De Vita et al., 2006.) has not been widely validated in the current literature.

Three tests were used in our study: Dicky Fuller (ADF) (Dickey and Fuller, 1981), Phillips-Perron testi (PP) (Phillips and Perron, 1988) and Kvatkovski-Phillips-Schmidt-Shin (KPSS) (Kwiatkowski et al., 1992) tests. However, it is suggested that researchers should apply both traditional and unit root structural tests to ensure that the variables are not I(2) related.

### 5.2. ARDL

ARDL is an econometric method used to investigate the possibility of co-integration between time series (variables). The ability to accommodate a sufficient number of delays in the model allows you to best capture the mechanism of the data generation (preparation) process. As mentioned above, this means that the method can be applied whether the time series is I(0) or (1) stationary (integrated) (Pesaran et al. 2001). However, the time series in the ARDL structure should not be I(2), as this (I(2)) integration rule invalidates the F statistic and all the critical values defined by Pesaran. They are for the I(0) and/or I(1) series. In addition, this method confirms that variables will move towards equilibrium in the long-term, and can distinguish between long-term and short-term relationships. ARDL co-integration is also a method for testing long-term associations between variables. Compared to the traditional co-integration method, the ARDL method can evaluate I(0) and I(1) simultaneously or separately. ARDL clarifies autocorrelation and endogeneity. Because variables are set with delays. In addition, it specifies both dependent and independent variables.

In addition, the ARDL method provides unbiased estimates and reliable t-statistics regardless of the endogeneity of some of the regressors. Thus, due to the choice of the appropriate lag, the residual correlation is eliminated, thereby mitigating the endogeneity problem. And short-term corrections can be integrated with the long-term equilibrium through an error correction mechanism (ECM). This is done by linear transformation without damaging the information about the long period.

Another aspect is that this method allows outliers to be corrected using dummy pulses. The interpretation of the ARDL approach and its implementation are quite simple. The ARDL structure requires only one equation. However, in other models-procedures, a system of equations is required. The ARDL approach is more reliable for short time series in other words compared to the Johansen and Juselius co-integration methodology (Johansen and Juselius, 1990). Another advantage of the method is that it can simultaneously evaluate short-term and long-term effects. In addition, it is also possible to test hypotheses about the coefficients evaluated in the long term using the ARDL method, unlike the popular and widely used Engla-Granger method (Engle and Granger, 1987).

$$\Delta LOGBEM_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBEM_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \lambda_1 LOGBEM_{t-1} + \lambda_2 LOGWOP_{t-1} + \varepsilon_t \quad (9)$$

$$\Delta LOGBRM_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBRM_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \lambda_1 LOGBRM_{t-1} + \lambda_2 LOGWOP_{t-1} + \varepsilon_t \quad (10)$$

**Table 5: Unit root test result of the data in its level and in its first difference**

| Variables | | At Level | | | First Difference | | |
|---|---|---|---|---|---|---|---|
| | | ADF | PP | KPSS | ADF | PP | KPSS |
| | | H0: Variable Has a Unit Root | | H0: Variable is Stationary | H0: Variable Has a Unit Root | | H0: Variable is Stationary |
| | | Test Statistics and Prob. | | | | | |
| LOGBRD | $t_m$ | −4.132346***<br>[0.0011] S | −4.388787***<br>0.0004] S | 1.439650 *** S | −23.93758***<br>0.0000] S | −48.52761 ***<br>0.0001] S | 0.315051 N/S |
| | $t_T$ | −3.526826**<br>0.0392] S | −9.764995***<br>0.0000] S | 0.350992 *** S | −23.98151 ***<br>0.0000] S | −53.92007***<br>0.0001] S | 0.089244 N/S |
| | $t_0$ | 1.211616<br>0.9422] N/S | 0.953086<br>0.9094] N/S | N/A | −23.82046***<br>0.0000] S | −43.26151 ***<br>0.0001] S | N/A |
| LOGBRD | $t_m$ | −3.474402***<br>0.0097] | −6.581587***<br>0.0000] | 1.497325*** | −5.519801***<br>0.0000] | −115.6996***<br>0.0001] | 0.205855 |
| | $t_T$ | −3.002819**<br>0.1342] | −13.54011***<br>0.0000] | 0.359231*** | −6.024242***<br>0.0000] | −210.8548 ***<br>0.0001] | 0.191044*** |
| | $t_0$ | 2.169853<br>0.9930] | 0.555181<br>0.8353] | N/A | −4.867919***<br>0.0000] | −53.15562 ***<br>0.0001] | N/A |
| LOGWOP | $t_m$ | −3.128166**<br>0.0261] | −2.490332<br>0.1195] | 0.374232** | −9.005964***<br>0.0000] | −8.535165 ***<br>0.0000] | 0.099595 |
| | $t_T$ | −3.251231**<br>0.0789] | −2.583837<br>0.2882] | 0.189254** | −8.983000***<br>0.0000] | −8.508921***<br>0.0000] | 0.100096 |
| | $t_0$ | 0.096892<br>0.7123] | 0.283583<br>0.8388] | N/A | −9.019941***<br>0.0000] | −8.553652***<br>0.0000] | N/A |
| LOGBRM | $t_m$ | −3.153793**<br>0.0243] S | −3.199906**<br>0.0215] S | 0.527300**S | −15.09334***<br>0.0000] S | −15.09334***<br>0.0000] | 0.025492 |
| | $t_T$ | −3.390314**<br>0.0555] S | −6.132568***<br>0.0000] S | 0.116792 | −15.05642***<br>0.0000] S | −15.05642***<br>0.0000] | 0.023520 |
| | $t_0$ | −0.815724<br>0.3616] N/S | −0.815724<br>0.3616] | N/A | −15.12933***<br>0.0000] S | −15.12933***<br>0.0000] | N/A |
| LOGBEM | $t_m$ | −3.517361* *<br>0.0085] S | −3.366795**<br>0.0133] S | 0.549890**S | −17.07978 ***<br>0.0000] | −17.13071 ***<br>0.0000] | 0.026150 |
| | $t_T$ | −3.837475**<br>0.0165] | −3.771412* *<br>0.0200] S | 0.116676 | −17.03774 ***<br>0.0000] | −17.08803***<br>0.0000] | 0.025671 |
| | $t_0$ | −0.749134<br>0.3909] | −0.780937<br>0.3768] | N/A | −17.12010 ***<br>0.0000] | −17.17122***<br>0.0000] | N/A |

ADF denotes the Augmented Dickey-Fuller single root system respectively. The optimum lag order is selected based on the Shwarz criterion automatically; PP Phillips-Perron is single root system. The optimum lag order in PP test is selected based on the Newey-West criterion automatically; KPSS denotes Kwiatkowski-Phillips-Schmidt-Shin single root system. The optimum lag order in KPSS test is selected based on the Newey-West criterion automatically; ***, ** and *indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively. The critical values are taken from MacKinnon (1996). Assessment period: 2005M03-2022M05

$$\Delta LOGBED_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBED_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \lambda_1 LOGBED_{t-1} + \lambda_2 LOGWOP_{t-1} + \varepsilon_t \quad (11)$$

$$\Delta LOGBRD_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBRD_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \lambda_1 LOGBRD_{t-1} + \lambda_2 LOGWOP_{t-1} + \varepsilon_t \quad (12)$$

Δ - first difference operator, *LOG* – is a logarithm function, $\psi_0$ - constant value, $\varepsilon_t$ - white noise error, *BEM* - Budget expenditures (AZN), *BRM* - Budget revenues (AZN), *BED* - Budget expenditures (dollars), *BRD* - Budget revenues (dollars), *WOP* - World oil prices-barrel/dollars. $\psi_{1i}$,$\psi_{2i}$ - short-term coefficients, $\lambda_1$,$\lambda_2$– long term coefficients.

In addition, it also explores the rate and behavior of adaptation to long-term variable equilibrium. However, this equation contains an error correction model with unconstrained coefficients (Furthermore, the long-term variable examines the speed and behavior of the adjustment toward equilibrium. However, this equation contains an error-correction model with unrestricted coefficients). p- lag is is length. This lag length is determined by applying information criteria. In our example, this is AIC and SC. To proceed with the estimation test, ARDL should test the presence of co-integration by establishing the null and alternative hypotheses. In addition, applicable tests for all lagged regressors are the t-statistic (Banerjee et al.,1998) and the F-statistic (Pesaran et al., 2001). Null and alternative hypotheses:

$H_0$: Cointegration does not exist.

$H_1$: Cointegration exists.

A joint significance F test for lag coefficients was applied as follows:

$H_0$: $\lambda_1 = \lambda_2 = 0$

$H_1$: $\lambda_1 \neq 0, \lambda_2 \neq 0$

However, this stated test is not a standard test for the F-test statistic because there are no exact critical values for the random combination of I(0) and I(1). So, using the previous method

(Pesaran et al. 2001), an appropriate test table was used for this test. The table shows the asymptotic distribution of the F-statistic for different cases. In addition, since the study periods of time series in many investigations are relatively short, Narayan (2005) developed and presented F-statistics for small periods (Alabdulwahab, 2021).

For this reason, many studies have used Narayan's chart to test hypotheses as well as reliability. However, testing with both of these tables is currently performed using the Eviews 9-12 econometric software package. To proceed with the test, the rejection or acceptance of the null hypothesis depends on comparing the test statistic with the critical value in the table. If the test statistic is greater than I(1), there is long-run co-integration between the variables. Because the F-test considers all the variables in the model. If the test statistic is less than I(0), long-term co-integration of the variables is not possible. However, if the test statistic falls between the two bounds, then it is inconclusive and the decision in this case is unclear. As a result, another co-integration method should be applied.

In addition, for cross-validation, the associated t-test is used to test the hypotheses.

The hypotheses are:
$H_0$: $\lambda_1 = \lambda_2 = 0$
$H_1$: $\lambda_1 < 0$

The rule for the test is similar to the restricted F test for accepting or rejecting the null hypothesis.

Thus, if the t-statistic $LOGBEM_{t-1}$, $LOGBRM_{t-1}$, $LOGBED_{t-1}$ and $LOGBRD_{t-1}$ I(1) exceeds the limit (Pesaran et al., 2001), then there is a long-term relationship between the variables, and reliability is tested for the corresponding F-test. The short-term evaluation uses the ARDL Error Correction Mechanism (ECM) to measure the acceleration, deceleration, and correction when the model enters a non-equilibrium state.

$$\Delta LOGBEM_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBEM_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \varphi ECT_{t-1} + \varepsilon_t \quad (13)$$

$$\Delta LOGBRM_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBRM_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \varphi ECT_{t-1} + \varepsilon_t \quad (14)$$

$$\Delta LOGBED_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBED_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGGWOP_{t-i} + \varphi ECT_{t-1} + \varepsilon_t \quad (15)$$

$$\Delta LOGBRD_t = \psi_0 + \sum_{i=1}^{p} \psi_{1i} \Delta LOGBRD_{t-1} + \sum_{i=0}^{p} \psi_{2i} \Delta LOGWOP_{t-i} + \varphi ECT_{t-1} + \varepsilon_t \quad (16)$$

Based on the above equations, the ECM adjusts the long-run model to bring it into equilibrium after accumulating short-run shocks. Without neglecting long-term data, the ECM incorporated short-term and long-term coefficients into the model. $\varphi$ is a long-term causal relationship. It must have a negative sign to represent a model approaching equilibrium, as well as a significant coefficient.

### 5.3. A Diagnostic Test for a Model

The ARDL related test BEMt=$\alpha$+$\beta$WOPt+$\varepsilon$t etc. implies that the error term ($\varepsilon$t) in the equations is sequentially free and normally distributed. Thus, the Breusch-Godfrey LM test (Breusch, 1978; Godfrey, 1978) was used to test for sequential independence, and the Jarque-Bera test (Jarque and Bera, 1987) was used to test for the normality of the error term ($\varepsilon$t) of the model. The Brush-Pagana-Godfrey test (Breusch and Pagan, 1979; Bollerslev, 1986) and the ARCH test (Engle, 1982) were used to test for the presence of heteroscedasticity in the model.

### 5.4. Checking the Stability of the Model

The dynamic stability of the model provides in this case the necessary autoregressive structure of the model. CUSUM and CUSUM squared are the two tests used (Braun və s., 1975; Pesaran və Pesaran, 1997). They and the Ramsey RESET (statistical) (Ramsey, 1969; Ramsey, 1974) test are also used to investigate the stability of the ARDL model.

### 5.5. FMOLS, DOLS, and CCR

The fully modified minimum squares method (FMOLS) propose by Phillips and Hansen (1990) and the dynamic minimum squares method (DOLS) proposed by Stock and Watson (1993) are alternative cointegration methods developed by Park (1992). Other evaluation methods used-FMOLS, DOLS, and CCR-and analysis of the results of Engle-Granger analysis are very useful in the research process. Because reviewing the results several times through the ARDLBT co-integration approach allows for a more reliable analysis. Note that the Engle-Granger and Philips-Ouliaris cointegration tests were used to test for all regression equations evaluated using FMOLS, DOLS, and CCR.

### 5.6. Granger Causality Test

Co-integration between variables indicates a causal relationship between them. The cause-and-effect relationship can be one-way or two-way. Granger (1969) argued that measures of correlation between variables are insufficient to understand the relationship between them due to the lack of an indirect relationship with the third variable in the structure. Furthermore, the presence of co-integration should be re-examined by assessing the causal relationship between the variables. Thus, the VAR model was used to test for lack of Granger causality as follows:

$$LOGBEM_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{1j}LOGBEM_{t-j} + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + u_t \quad (17)$$

$$LOGWOP_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + \sum_{j=1}^{m}\sigma_{1j}LOGBEM_{t-j} + u_t$$

$$LOGBRM_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{1j}LOGBRM_{t-j} + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + u_t \quad (18)$$

$$LOGWOP_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + \sum_{j=1}^{m}\sigma_{1j}LOGBRM_{t-j} + u_t \quad (19)$$

$$LOGBED_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{1j}LOGBED_{t-j} + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + u_t \quad (20)$$

$$LOGWOP_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + \sum_{j=1}^{m}\sigma_{1j}LOGBED_{t-j} + u_t \quad (21)$$

$$LOGBRD_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{1j}LOGBRD_{t-j} + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + u_t \quad (22)$$

$$LOGWOP_t = \sigma_0 + \sum_{j=1}^{m}\sigma_{2j}LOGWOP_{t-i} + \sum_{j=1}^{m}\sigma_{1j}LOGBRD_{t-j} + u_t \quad (23)$$

Here, 2 null hypotheses are proposed:

1. $H_0{:}=\sigma_{21}=\sigma_{22}= =\sigma_{2n}=0$

and $H_1$: LOGWOP is the cause of LOGBEM

2. $H_0{:}=\sigma_{11}=\sigma_{12}= =\sigma_{1n}=0$

and H_1: LOGBEM is the cause of LOGWOP

If the null hypothesis is rejected in any of these tests, then there is Granger causation. If the null hypothesis is rejected in both cases, this means that there is an inverse relationship on both variables. If the null hypothesis is accepted in both cases, then the long-run co-integration relationship between the variables is rejected.

*5.6.1. Granger cause-and-effect relationship for the short term*

For each free variable using statistical values of $F$ or $X_i$ squared statistical values are evaluated by checking all $\Delta LOGWOP_{t-i}$ delayed first-order differences ($H_0$: $\psi_{21} = \psi_{22} =...= \psi_{2i} = 0$, $H_1 : \psi_{21} \neq \psi_{22} \neq ... \neq \psi_{2i} \neq 0$,i=1,…$p$). The rejection of the zero hypothesis indicates that x has an effect on y in the short run.

*5.6.2. Granger cause-and-effect relationship for the long term*

To test this relationship, the statistical significance of the t-test utilization factor $ECT_{t-1}$ is checked. To do this, you need to test the hypothesis of zero ($H_0$: $\varphi = 0$, $H_1$: $\varphi \neq 0$). If, as a result, the null hypothesis is rejected, this long-run period shows that deviations from the equilibrium state have an effect on the dependent variable and will return to the equilibrium state over time.

*5.6.3. Strong cause-and-effect relationship*

This relationship is, in fact, both a short-term and a long-term cause-and-effect relationship. In other words, the Wald test tests the hypothesis as a zero hypothesis for each variable taken using $F$-statistical or $X_i$ squared statistical values. ($H_0$: $\psi_{21} = \psi_{22} =...= \psi_{2i} = \varphi = 0$,$H_1$: $\psi_{21} \neq \psi_{22} \neq . \neq \psi_{2i} \neq \varphi \neq 0$,i = 1,…$p$).

## 6. INTERPRETATION AND DISCUSSION OF MODEL RESULTS

### 6.1. Unit Root Test Results

As you know, autoregressive distributed delay (ARDL) co-integration requires the variables under study not to exceed I(1) to be implemented in the model. Before proceeding to ARDL co-integration, the second step is to check the unit root of the variables. Unit root stationarity criteria and its results are shown in Table 3. Here, 3 tests ADF, PP and KPSS were used. Regarding to the results of the tests at the level of time series (variables), we can say that the BEM and MCR variables (time series) for all three tests (ADF, PP and CPSS) only in the Constant variant (model), and in the variant (model) with a constant and a linear trend - I(0). This is not the case with the none variant (model). Variables BED and BRD (time series) are equal to I(0) for all three tests (ADF, PP and KPSS), but in a Constant variant (models) (were significant at the 1% and 0.1% levels). According to the two tests (ADF and PP), only the Constant and Linear Trend variants (model) are I(0) (significant at the 1% level), but not for the None variant (model). The WOP variable (time series) is also I(0) according to two tests (ADF and KPSS) only in the Constant and Linear Trend variant (model) (they were significant at the 1% level), but not in None variant (model). Here, in some tests and variants (models), the null hypothesis-the non-stationarity of the time series was rejected, and in other tests and variants (models) the non-stationarity of the time series was confirmed. The test of variables with different degrees allows using the ARDL co-integration method. Moreover, the unit root test confirms that no variable (time series) is I(2) that cannot be applied in the ARDL co-integration procedure.

Based on the results of tests conducted at the first (first) difference level of the time series (variables), we can say that all BEM, BRM, BED, BRD variables and VOP variables (time series) are in the Constant variant (model) according to two tests (ADF and PP), the Constant and Linear Trend (model) and None (model) options are I(0), i.e., stationary (they were significant at the 0.1% level). Here, in both tests and variants

**Table 6: VAR lag order selection criteria**

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|---|---|---|---|---|---|---|
| Endogenous variables: LOGBRD LOGWOP | | | | | | |
| 0 | −260.3803 | NA | 0.047894 | 2.636988 | 2.670086 | 2.650384 |
| 1 | 90.74472 | 691.6633 | 0.001463 | −0.851706 | −0.752410 | −0.811518 |
| 2 | 132.7457 | 81.89132 | 0.000998 | −1.233625 | −1.068132 | −1.166646 |
| 3 | 174.9047 | 81.35209* | 0.000680* | −1.617133* | −1.385443* | −1.523362* |
| Endogenous variables: LOGBED LOGWOP | | | | | | |
| 0 | −280.0350 | NA | 0.058354 | 2.834523 | 2.867621 | 2.847918 |
| 1 | 31.72699 | 614.1241 | 0.002647 | −0.258563 | −0.159267 | −0.218375 |
| 2 | 82.18584 | 98.38208 | 0.001660 | −0.725486 | −0.559993 | −0.658507 |
| 3 | 97.97010 | 30.45808 | 0.001474 | −0.843921 | −0.612231* | −0.750150 |
| 4 | 105.3595 | 14.11036 | 0.001425 | −0.877985 | −0.580098 | −0.757422 |
| 5 | 112.5649 | 13.61428* | 0.001380* | −0.910200* | −0.546116 | −0.762846* |
| Endogenous variables: LOGBRM LOGWOP | | | | | | |
| 0 | −223.2386 | NA | 0.032974 | 2.263704 | 2.296803 | 2.277100 |
| 1 | 97.07277 | 630.9650 | 0.001373 | −0.915304 | −0.816009 | −0.875117 |
| 2 | 136.4871 | 76.84807 | 0.000962 | −1.271227 | −1.105735 | −1.204248 |
| 3 | 174.6605 | 73.66123* | 0.000682* | −1.614678* | −1.382989* | −1.520908* |
| Endogenous variables: LOGBEM LOGWOP | | | | | | |
| 0 | −248.0304 | NA | 0.042303 | 2.512868 | 2.545967 | 2.526264 |
| 1 | 41.64671 | 570.6202 | 0.002396 | −0.358258 | −0.258963 | −0.318071 |
| 2 | 84.82485 | 84.18653 | 0.001616 | −0.752009 | −0.586516 | −0.685029 |
| 3 | 97.40994 | 24.28479 | 0.001483 | −0.838291 | −0.606601* | −0.744520* |
| 4 | 103.7550 | 12.11611 | 0.001448 | −0.861859 | −0.563972 | −0.741296 |
| 5 | 110.4071 | 12.56883* | 0.001410* | −0.888513* | −0.524429 | −0.741159 |

*Indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan−Quinn information criterion

(models), the null hypothesis non-stationarity of time series is rejected, and the alternative hypothesis-stationarity of time series (variables) is confirmed. The conducted single root test of the variables (time series) both at their own level and at the initial (first) difference level confirmed that some of the time series have Z I(0) and I(1) in different variants (models) for separate tests. Considering that none of the variables is of I(2) degree, the ARDL co-integration method can be used in the analysis of the interaction of these time series (variables) of different degrees (I(0) and I(1)).

After the unit root test, the maximum lag length of the model is found by using VAR lag order selection criteria. The results are it has confirmed that the maximum lag length of the model is “3” and it is selected based on the minimum value of each criterion and based on that the maximum number of “lag 3” was selected (Table 6).

AIC for ARDL co-integration was used to determine the optimal distribution of lag length in the model. According to the table (VAR Lag Order Selection Criteria) in the first model AIC-ARDL (3.2), in the second model AIC-ARDL (5.5), in the third model AIC-ARDL (3.2) in the first model AIC-ARDL (5.0) contain (Table 7).

For the correlated ARDL test, ARDL should test the co-integration model to ensure that it is free of serial correlation or heteroscedasticity to ensure that the model is normally distributed. $R^2$ for these models is 0.829361, 0.709295, 0.769934 and 0.592480 respectively. The adjusted $R^2$ was equal to 0.823267, 0.690838, 0.762927 and 0.579941 respectively. This indicates that approximately 83%, 71%, 80%, and 60% of the variance of the dependent variables (BEM, BRM, and BED) can be explained by the model, respectively, and the rest can be explained by error and factors not included in the model. Durbin-Watson statistic (Durbin and Watson, 1971) is 2.013029, 2.033674, 2.030945 and 2.070786, respectively. When these indicators are compared with the critical values in the DW table for n > 100 and k = 1, it is found that the statistic exceeds the critical value: $d_u < DW < 4–d_u$ Thus, the models are proven not to be wrong.

And the F-statistic is 136.0890, 38.42866, 109.8795 and 47.25065 respectively, and the P-values are also 0.0000, indicating that null hypotheses are rejected for zero coefficients. Tables 9, 9a, 10 and 10a present the results of tests for serial correlation, serial correlation (Breusch-Godfrey L.M.), heteroscedasticity (Brush-Pagan-Godfrey) and normality (Jarka-Bera). The models were able to pass the test as shown in the table, although not completely.

## 6.2. Stability of Models

In order to ensure the reliability of the results obtained on the ARDL integration models, the structural stability of the parameters of the models should be checked in the long term.

Brown et al. (1975) suggested applying the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of residuals of recursive squares (CUSUMSQ) to ensure long-run stability of parameters in a model. CUSUM and CUSUMSQ

**Table 7: Estimated primary ARDL model**

| Variable | Coefficient | Std. Error | t-statistic | Probability |
|---|---|---|---|---|
| **Model 1. LOGBRD/LOGWOP** | | | | |
| LOGBRD(−1) | 0.117973* | 0.060088 | 1.963342 | 0.0510 |
| LOGBRD(−2) | 0.040734 | 0.060392 | 0.674499 | 0.5008 |
| LOGBRD(−3) | 0.479331*** | 0.058821 | 8.149011 | 0.0000 |
| LOGWOP | 0.600679* | 0.249344 | 2.409032 | 0.0169 |
| LOGWOP(−1) | −0.958288* | 0.412655 | −2.322247 | 0.0212 |
| LOGWOP(−2) | 0.646061** | 0.255606 | 2.527569 | 0.0123 |
| C | 0.965095** | 0.366349 | 2.634359 | 0.0091 |
| @TREND | 0.003567*** | 0.000880 | 4.051419 | 0.0001 |
| **Model 2. LOGBED/LOGWOP** | | | | |
| LOGBED(−1) | −0.120663 | 0.071198 | −1.694739 | 0.0918 |
| LOGBED(−2) | 0.086993 | 0.069798 | 1.246354 | 0.2142 |
| LOGBED(−3) | 0.164400** | 0.068209 | 2.410260 | 0.0169 |
| LOGBED(−4) | 0.154245* | 0.068897 | 2.238756 | 0.0263 |
| LOGBED(−5) | 0.179607** | 0.070900 | 2.533251 | 0.0121 |
| LOGWOP | −0.046437 | 0.352489 | −0.131740 | 0.8953 |
| LOGWOP(−1) | 0.102166 | 0.616489 | 0.165722 | 0.8686 |
| LOGWOP(−2) | 0.282946 | 0.642323 | 0.440504 | 0.6601 |
| LOGWOP(−3) | −0.120816 | 0.642005 | −0.188186 | 0.8509 |
| LOGWOP(−4) | −0.118578 | 0.615873 | −0.192537 | 0.8475 |
| LOGWOP(−5) | 0.292023 | 0.366112 | 0.797632 | 0.4261 |
| C | 1.543859** | 0.563530 | 2.739619 | 0.0067 |
| @TREND | 0.005476*** | 0.001452 | 3.770121 | 0.0002 |
| **Model 3. LOGBRM/LOGWOP** | | | | |
| LOGBED(−1) | 0.198007*** | 0.057894 | 3.420179 | 0.0008 |
| LOGBED(−2) | 0.105773 | 0.058849 | 1.797361 | 0.0738 |
| LOGBED(−3) | 0.537735*** | 0.056481 | 9.520574 | 0.0000 |
| LOGWOP | 0.595040* | 0.258262 | 2.304022 | 0.0223 |
| LOGWOP(−1) | −0.905551* | 0.428544 | −2.113087 | 0.0359 |
| LOGWOP(−2) | 0.520598* | 0.261853 | 1.988134 | 0.0482 |
| C | 0.227349 | 0.315556 | 0.720470 | 0.4721 |
| **Model 4. LOGBEM/LOGWOP** | | | | |
| LOGBEM(−1) | −0.023139 | 0.069162 | −0.334565 | 0.7383 |
| LOGBEM(−2) | 0.171268** | 0.066935 | 2.558728 | 0.0113 |
| LOGBEM(−3) | 0.218126*** | 0.065759 | 3.317029 | 0.0011 |
| LOGBEM(−1) | 0.202365** | 0.065629 | 3.083474 | 0.0023 |
| LOGBEM(−2) | 0.238403*** | 0.067807 | 3.515902 | 0.0005 |
| LOGWOP | 0.223067** | 0.090720 | 2.458852 | 0.0148 |
| C | 0.416892 | 0.461767 | 0.902820 | 0.3677 |

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

**Table 8: The ARDL bounds test**

| Variables | | | LOGBRD/LOGWOP | | LOGBED/LOGWOP | | LOGBRM/LOGWOP | | LOGBEM/LOGWOP | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | AIC-ARDL (3,2) (3 lags, automatic) Case 5: Unrestricted constant and unrestricted trend | | AIC-ARDL (5,5) (5 lags, fixed) Case 5: Unrestricted constant and unrestricted trend | | AIC-ARDL (3,2) (3 lags, automatic) Case 2: Restricted constant and No trend | | AIC-ARDL (5,0) (5 lags, automatic Case 2: Restricted constant and No trend | |
| F-statistics | | | 12.13721*** | | 9.850311*** | | 6.710333*** | | 5.523195*** | |
| | | | Lower bounds I (0) | Upper bounds I (1) | Lower bounds I (0) | Upper bounds I (1) | Lower bounds I (0) | Upper bounds I (1) | Lower bounds I (0) | Upper bounds I (1) |
| Critical values | n=1000 | 10% | 5.59 | 6.26 | 5.59 | 6.26 | 3.02 | 3.51 | 3.02 | 3.51 |
| | | 5% | 6.56 | 7.3 | 6.56 | 7.3 | 3.62 | 4.16 | 3.62 | 4.16 |
| | | 2.5% | 7.46 | 8.27 | 7.46 | 8.27 | 4.18 | 4.89 | 4.18 | 4.89 |
| | | 1% | 8.74 | 9.63 | 8.74 | 9.63 | 4.94 | 5.58 | 4.94 | 5.58 |
| | n=80 | 10% | 5.725 | 6.45 | 5.725 | 6.45 | 3.113 | 3.61 | 3.113 | 3.61 |
| | | 5% | 6.82 | 7.67 | 6.82 | 7.67 | 3.74 | 4.303 | 3.74 | 4.303 |
| | | 1% | 9.17 | 10.24 | 9.17 | 10.24 | 5.157 | 5.917 | 5.157 | 5.917 |
| t−statistic | | | −statistic* | | −tatistic*c | | N/A | | N/A | |
| | | 10% | −0.13% | −3%t | −3%ti | −3%t | N/A | N/A | N/A | N/A |
| | | 5% | −0.41% | −41ti | −41ti | −41ti | N/A | N/A | N/A | N/A |
| | | 2.5% | −0.55% | −55%i | −0.965 | −965i | N/A | N/A | N/A | N/A |
| | | 1% | −0.96% | −965i | −965i | −965i | N/A | N/A | N/A | N/A |
| Diagnostic tests | | | | | | | | | | |
| $R^2$ | | | 0.829361 | | 0.709295 | | 0.769934 | | 0.592480 | |
| $Adj\text{-}R^2$ | | | 0.823267 | | 0.690838 | | 0.762927 | | 0.579941 | |
| F-statistic | | | 136.0890*** | | 38.42866*** | | 109.8795*** | | 47.25065*** | |
| Prob (F-statistic) | | | 0.000000 | | 0.000000 | | 0.000000 | | 0.000000 | |
| D-W stat | | | 2.013029 | | 2.033674 | | 2.030945 | | 2.070786 | |

*** denote statistical significance at the 1% level

**Figure 1:** Variables in its level for the and in its first difference

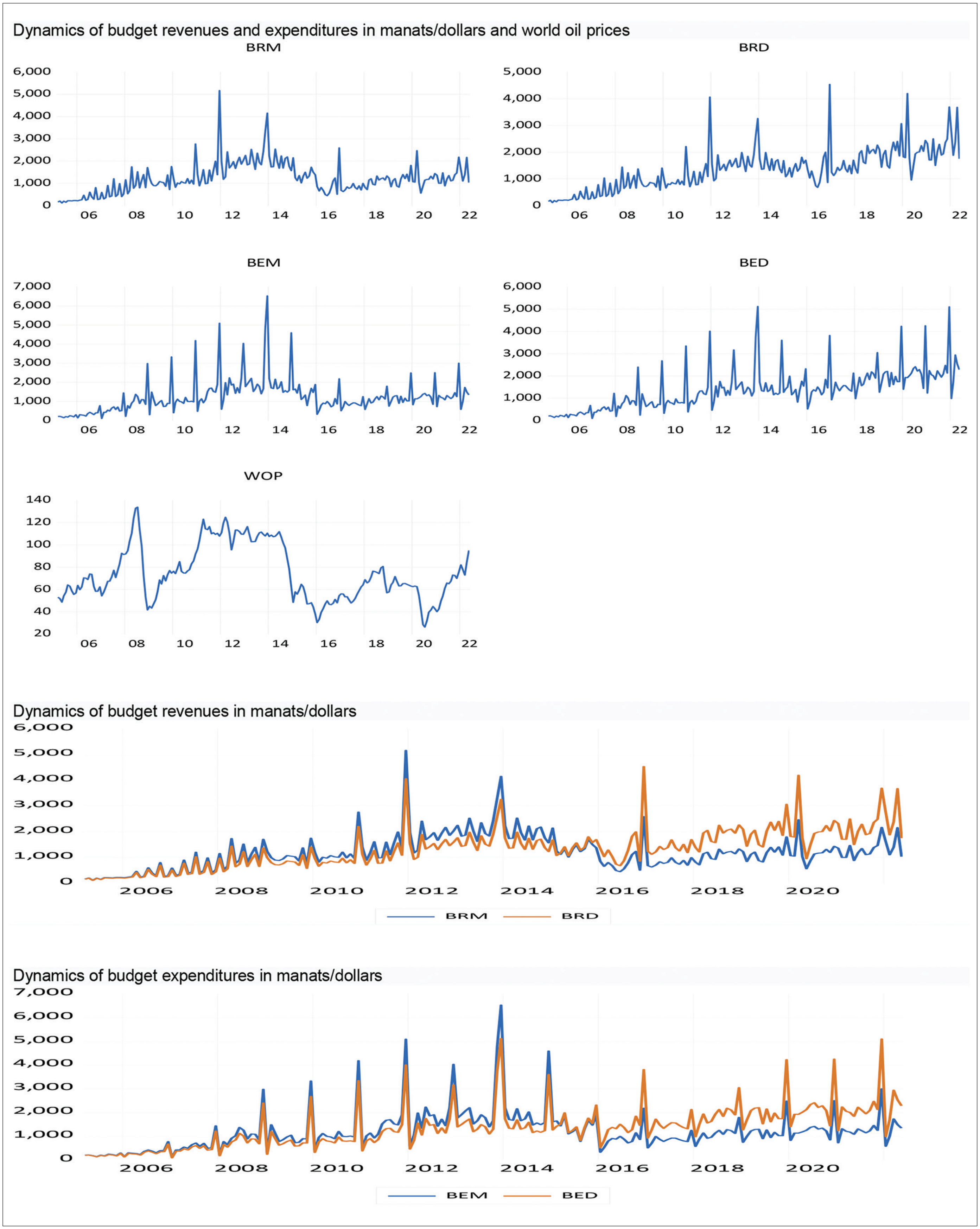

**Figure 1:** *(Continued)*

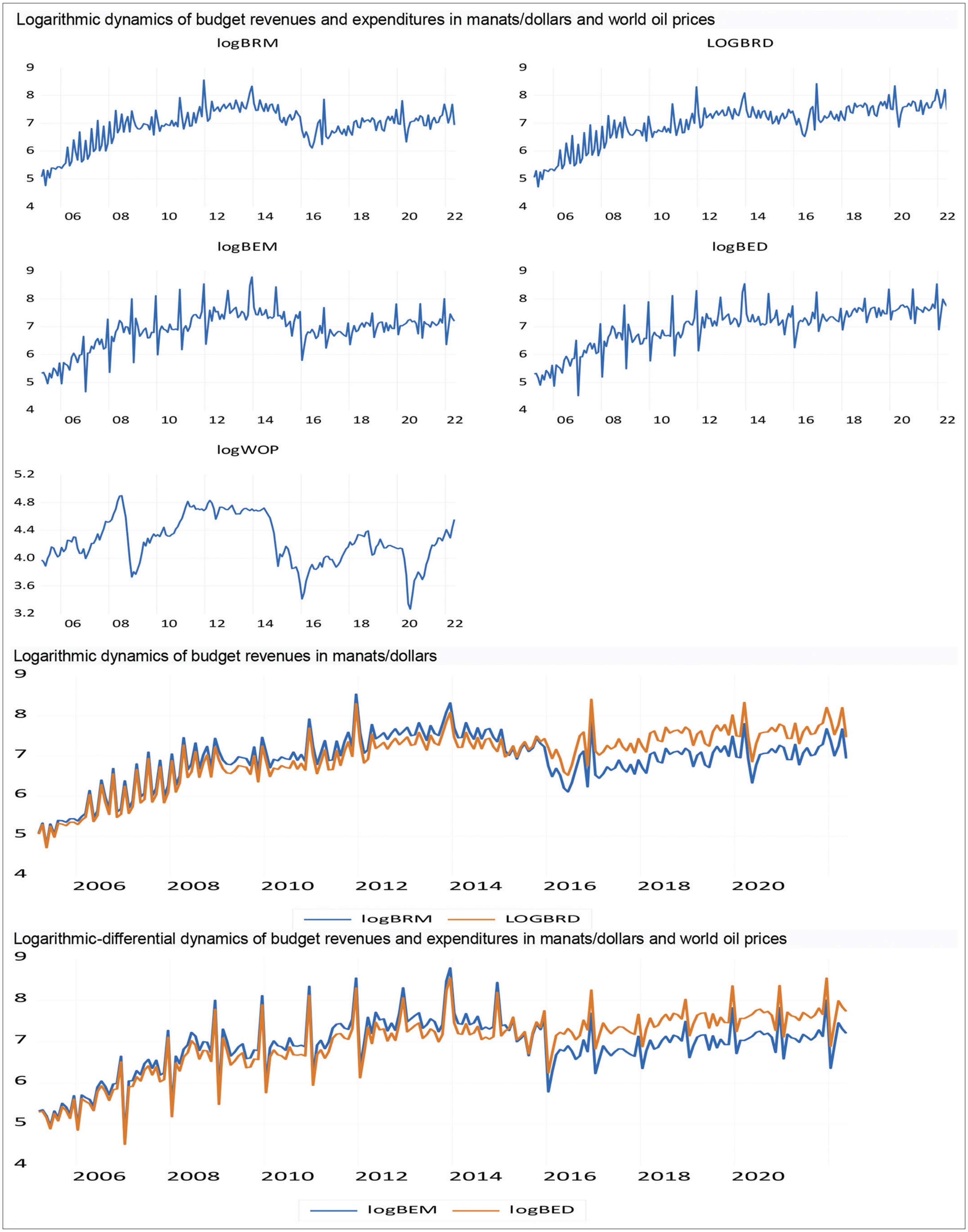

**Figure 1:** *(Continued)*

**Table 9: The long-run and short-run coefficients**

AIC-ARDL (3,2) C@TREND Case 5: Unrestricted Constant and Unrestricted Trend

Dependent variable: LOGBRD

| Variables | Coefficient | SE | T-statistics | Prob. |
|---|---|---|---|---|
| Long-run estimation | | | | |
| C | 0.965095*** | 0.366349 | 2.634359 | 0.0091 |
| @TREND | 0.003567*** | 0.000880 | 4.051419 | 0.0001 |
| LOGBRD(−1) | −0.361962*** | 0.074126 | −4.883071 | 0.0000 |
| LOGWOP(−1) | 0.288452*** | 0.082372 | 3.501828 | 0.0006 |
| DFLOGBRD(−1) | −0.520065*** | 0.071886 | −7.234575 | 0.0000 |
| DFLOGBRD(−2) | −0.479331*** | 0.058821 | −8.149011 | 0.0000 |
| DFLOGWOP | 0.600679* | 0.249344 | 2.409032 | 0.0169 |
| DFLOGWOP(−1) | −0.646061** | 0.255606 | −2.527569 | 0.0123 |
| Short-run estimation | | | | |
| C | 0.965095*** | 0.184807 | 5.222181 | 0.0000 |
| @TREND | 0.003567*** | 0.000878 | 4.061775 | 0.0001 |
| DFLOGBRD(−1) | −0.520065*** | 0.071306 | −7.293477 | 0.0000 |
| DFLOGBRD(−2) | −0.479331*** | 0.058512 | −8.192018 | 0.0000 |
| DFLOGWOP | 0.600679* | 0.242329 | 2.478779 | 0.0140 |
| DFLOGWOP(−1) | −0.646061** | 0.250646 | −2.577584 | 0.0107 |
| CointEq(−1) | −0.361962*** | 0.073280 | −4.939460 | 0.0000 |
| Diagnostic tests | | | | |
| $R^2$ | 0.562017 | | | |
| $Adj{-}R^2$ | 0.548678 | | | |
| F-statistic | 42.13161*** | | | |
| Prob. (F-statistic) | 0.000000 | | | |
| | 2.013029 | | | |
| Breusch-Godfrey Serial Correlation LM Test: | | | | |
| $\chi^2$ *SERIAL* | 1.198150 | | | |
| Probability | 0.5493 | | | |
| F-statistic | 0.573074 | | | |
| Probability | 0.5647 | | | |
| Heteroskedasticity Test: Breusch-Pagan-Godfrey | | | | |
| $\chi^2$ | 11.53613 | | | |
| Probability | 0.1169 | | | |
| F-statistic | 1.678298 | | | |
| Probability | 0.1162 | | | |
| Heteroskedasticity Test: ARCH | | | | |
| $\chi^2$ *ARCH* | 0.035726 | | | |
| Probability | 0.8501 | | | |
| F-statistic | 0.035380 | | | |
| Probability | 0.8510 | | | |
| χ2 RESET | 5.168482 | | | |
| Probability | 0.0000 | | | |
| F-statistic | 26.71321 | | | |
| Probability | 0.0000 | | | |
| Jarque-Bera | | | | |
| $\chi^2$ *NORMAL* | 49.94515 | | | |
| Probability | 0.000000 | | | |
| CUSUM | Stable | | | |
| CUSUMSQ | Stable | | | |

***,**and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

results are tabulated respectively at 5% significance level. The test requires that the CUSUM and CUSUMSQ graphs remain within the 5% critical limits to ensure the significance of the parameters in terms of constancy and stability of the model. In this study, the plots for CUSUM and CUSUMSQ are within 5%, which means that the model is stable and there is no systematic change in the coefficients during the study period.

**Table 9a: The long-run and short-run coefficients, diagnostic tests results**

AIC-ARDL (5,5) C@TREND Case 5: Unrestricted Constant and Unrestricted Trend

Dependent variable: LOGBED

| | | | | |
|---|---|---|---|---|
| Long-run estimation | | | | |
| C | 1.543859** | 0.563530 | 2.739619 | 0.0067 |
| @TREND | 0.005476*** | 0.001452 | 3.770121 | 0.0002 |
| LOGBED(−1) | −0.535418*** | 0.120954 | −4.426611 | 0.0000 |
| LOGWOP(−1) | 0.391303** | 0.126742 | 3.087397 | 0.0023 |
| DFLOGBED(−1) | −0.585245*** | 0.117407 | −4.984751 | 0.0000 |
| DFLOGBED(−2) | −0.498252*** | 0.114062 | −4.368249 | 0.0000 |
| DFLOGBED(−3) | −0.333852*** | 0.101139 | −3.300922 | 0.0012 |
| DFLOGBED(−4) | −0.179607** | 0.070900 | −2.533251 | 0.0121 |
| DFLOGWOP | −0.046437 | 0.352489 | −0.131740 | 0.8953 |
| DFLOGWOP(−1) | −0.335574 | 0.393993 | −0.851725 | 0.3954 |
| DFLOGWOP(−2) | −0.052628 | 0.390192 | −0.134877 | 0.8929 |
| DFLOGWOP(−3) | −0.173444 | 0.388245 | −0.446739 | 0.6556 |
| DFLOGWOP(−4) | −0.292023 | 0.366112 | −0.797632 | 0.4261 |
| Short−run estimation | | | | |
| C | 1.543859*** | 0.328430 | 4.700720 | 0.0000 |
| @TREND | 0.005476*** | 0.001447 | 3.785115 | 0.0002 |
| DFLOGBED(−1) | −0.585245*** | 0.116833 | −5.009260 | 0.0000 |
| DFLOGBED(−2) | −0.498252*** | 0.113596 | −4.386169 | 0.0000 |
| DFLOGBED(−3) | −0.333852*** | 0.100801 | −3.311986 | 0.0011 |
| DFLOGBED(−4) | −0.179607** | 0.070683 | −2.541004 | 0.0119 |
| DFLOGWOP | −0.046437 | 0.345277 | −0.134491 | 0.8932 |
| DFLOGWOP(−1) | −0.335574 | 0.389133 | −0.862361 | 0.3896 |
| DFLOGWOP(−2) | −0.052628 | 0.387558 | −0.135794 | 0.8921 |
| DFLOGWOP(−3) | −0.173444 | 0.385820 | −0.449547 | 0.6536 |
| DFLOGWOP(−4) | −0.292023 | 0.360046 | −0.811070 | 0.4183 |
| CointEq(−1) | −0.535418*** | 0.120311 | −4.450265 | 0.0000 |
| Diagnostic tests | | | | |
| $R^2$ | 0.574989 | | | |
| $Adj{-}R^2$ | 0.550383 | | | |
| F-statistic | 23.36795*** | | | |
| Prob. (F-statistic) | 0.000000 | | | |
| Durbin-Watson stat | 2.033674 | | | |
| Breusch-Godfrey Serial Correlation LM Test: | | | | |
| $\chi^2$ *SERIAL* | 5.943933 | | | |
| Probability | 0.0512 | | | |
| F−statistic | 2.834688 | | | |
| Probability | 0.0613 | | | |
| Heteroskedasticity Test: Breusch-Pagan-Godfrey | | | | |
| $\chi^2$ | 18.46373 | | | |
| Probability | 0.1023 | | | |
| F-statistic | 1.584448 | | | |
| Probability | 0.0989 | | | |
| Heteroskedasticity Test: ARCH | | | | |
| $\chi^2$ *ARCH* | 7.548363 | | | |
| Probability | 0.0060 | | | |
| F-statistic | 7.764857 | | | |
| Probability | 0.0058 | | | |
| Ramsey RESET Test | | | | |
| $\chi^2$ *RESET* | 5.205726 | | | |
| Probability | 0.0000 | | | |
| F-statistic | 27.09958 | | | |
| Probability | 0.0000 | | | |
| Jarque-Bera | | | | |
| $\chi^2$ *NORMAL* | 73.7036 | | | |
| Probability | 0.000000 | | | |
| CUSUM | No-stable | | | |
| CUSUMSQ | No-stable | | | |

***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

## 6.3. ARDL co-Integration Test

Since the model passed the diagnostic test, I can therefore start the text on co-integration. When evaluating ARDL cointegration

**Table 10: The long-run and short-run coefficients, diagnostic tests results**

AIC-ARDL (3,2) C (3 lags, automatic) Case 2: Restricted Constant and No Trend

Dependent variable: LOGBRM

Long-run estimation

| Variables | Coefficient | SE | T-statistics | Prob. |
|---|---|---|---|---|
| C | 0.227349 | 0.315556 | 0.720470 | 0.4721 |
| LOGBRM(−1) | −0.158485*** | 0.039052 | −4.058278 | 0.0001 |
| LOGWOP(−1) | 0.210088** | 0.070115 | 2.996338 | 0.0031 |
| DFLOGBRM(−1) | −0.643508*** | 0.060161 | −10.69652 | 0.0000 |
| DFLOGBRM(−2) | −0.537735*** | 0.056481 | −9.520574 | 0.0000 |
| DFLOGWOP | 0.595040* | 0.258262 | 2.304022 | 0.0223 |
| DFLOGWOP(−1) | −0.520598* | 0.261853 | −1.988134 | 0.0482 |
| Short-run estimation | | | | |
| DFLOGBRM(−1) | −0.643508*** | 0.058451 | −11.00942 | 0.0000 |
| DFLOGBRM(−2) | −0.537735*** | 0.055705 | −9.653189 | 0.0000 |
| DFLOGWOP | 0.595040* | 0.250918 | 2.371453 | 0.0187 |
| DFLOGWOP(−1) | −0.520598* | 0.257622 | −2.020784 | 0.0447 |
| CointEq(−1) | −0.158485*** | 0.035145 | −4.509476 | 0.0000 |
| Diagnostic tests | | | | |
| $R^2$ | | 0.529491 | | |
| $Adj{-}R^2$ | | 0.520033 | | |
| F-statistic | | N/A | | |
| Prob. (F-statistic) | | N/A | | |
| Durbin-Watson stat | | 2.030945 | | |
| Breusch-Godfrey Serial Correlation LM Test: | | | | |
| $\chi^2$ *SERIAL* | | 1.706337 | | |
| Probability | | 0.4261 | | |
| F-statistic | | 0.822408 | | |
| Probability | | 0.4409 | | |
| Heteroskedasticity test: Breusch-Pagan-Godfrey | | | | |
| $\chi^2$ | | 10.84378 | | |
| Probability | | 0.0933 | | |
| F-statistic | | 1.843262 | | |
| Probability | | 0.0925 | | |
| Heteroskedasticity test: ARCH | | | | |
| $\chi^2$ *ARCH* | | 1.484916 | | |
| Probability | | 0.2230 | | |
| F-statistic | | 1.481121 | | |
| Probability | | 0.2250 | | |
| Ramsey RESET Test | | | | |
| $\chi^2$ *RESET* | | 3.335618 | | |
| Probability | | 0.0010 | | |
| F-statistic | | 11.12634 | | |
| Probability | | 0.0010 | | |
| Jarque-Bera | | | | |
| $\chi^2$ *NORMAL* | | 22.75279 | | |
| Probability | | 0.000011 | | |
| CUSUM | | Stable | | |
| CUSUMSQ | | Stable | | |

***,**and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

models with lag lengths AIC-ARDL (3,2), AIC-ARDL (5,5), AIC-ARDL (3,2) and AIC-ARDL (5,0), the F-statistics were 12.1372, 9.850311, respectively, were equal to 6.710333 and 5.523195 (Table 8). For this reason, the existence of co-integration between variables can be checked by comparing the F statistic with the critical values in the tables given in (Pesaran et al. 2001) and (Narayan, 2005). We can also get it automatically in the Eviews program. Table "Critical values for the bounds test: case V: unrestricted intercept and unrestricted trend/" and "Critical values for the bounds test: Case II: restricted intercept

**Table 10a: The long-run and short-run coefficients, diagnostic tests results**

AIC-ARDL (5,0) C (5 lags, automatic) Case 2: Restricted Constant and No Trend

Dependent variable: LOGBEM

Long-run estimation

| Variables | Coefficient | SE | T-statistics | Prob. |
|---|---|---|---|---|
| C | 0.416892 | 0.461767 | 0.902820 | 0.3677 |
| LOGBEM(−1) | −0.192978*** | 0.053883 | −3.581449 | 0.0004 |
| LOGWOP(−1) | 0.223067** | 0.090720 | 2.458852 | 0.0148 |
| DFLOGBEM(−1) | −0.830162*** | 0.076669 | −10.82781 | 0.0000 |
| DFLOGBEM(−2) | −0.658894*** | 0.091356 | −7.212337 | 0.0000 |
| DFLOGBEM(−3) | −0.440768*** | 0.089812 | −4.907668 | 0.0000 |
| DFLOGBEM(−4) | −0.238403*** | 0.067807 | −3.515902 | 0.0005 |
| Short-run estimation | | | | |
| DFLOGBEM(−1) | −0.830162*** | 0.072662 | −11.42502 | 0.0000 |
| DFLOGBEM(−2) | −0.658894*** | 0.088877 | −7.413532 | 0.0000 |
| DFLOGBEM(−3) | −0.440768*** | 0.088422 | −4.984795 | 0.0000 |
| DFLOGBEM(−4) | −0.238403*** | 0.067178 | −3.548818 | 0.0005 |
| CointEq(−1) | −0.192978*** | 0.047167 | −4.091397 | 0.0001 |
| Diagnostic test | | | | |
| $R^2$ | | 0.534688 | | |
| $Adj{-}R^2$ | | 0.525240 | | |
| F-statistic | | N/A | | |
| Prob. (F-statistic) | | N/A | | |
| Durbin-Watson stat | | 2.070786 | | |
| Breusch-Godfrey Serial Correlation LM Test: | | | | |
| $\chi^2$ *SERIAL* | | 10.17711 | | |
| Probability | | 0.0062 | | |
| F-statistic | | 5.119780 | | |
| Probability | | 0.0068 | | |
| Heteroskedasticity Test: Breusch-Pagan-Godfrey | | | | |
| $\chi^2$ | | 14.09235 | | |
| Probability | | 0.0286 | | |
| F-statistic | | 2.437375 | | |
| Probability | | 0.0270 | | |
| Heteroskedasticity Test: ARCH | | | | |
| $\chi^2$ *ARCH* | | 12.21085 | | |
| Probability | | 0.0005 | | |
| F-statistic | | 12.87129 | | |
| Probability | | 0.0004 | | |
| Ramsey RESET Test | | | | |
| $\chi^2$ *RESET* | | 2.758041 | | |
| Probability | | 0.0064 | | |
| F-statistic | | 7.606790 | | |
| Probability | | 0.0064 | | |
| Jarque-Bera | | | | |
| $\chi^2$ *NORMAL* | | 48.11382 | | |
| Probability | | 0.000000 | | |
| CUSUM | | Stable | | |
| CUSUMSQ | | No-Stable | | |

***,**and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively

**Table 11: Granger causality tests**

| Pairwise granger causality tests | | | |
|---|---|---|---|
| **Null Hypothesis:** | **Obs** | **F-Statistic** | **Prob.** |
| LOGWOP does not Granger Cause LOGBRD | 205 | 0.75824 | 0.4698 |
| LOGWOP does not Granger Cause LOGBED | 205 | 0.75824 | 0.4698 |
| LOGWOP does not Granger Cause LOGBRM | 205 | 3.27616 | 0.0398 |
| LOGWOP does not Granger Cause LOGBEM | 205 | 2.54436 | 0.0811 |

**Table 12: FMOLS, DOLS, CCR results**

| | | ECT | | | Cointegration test | | | |
|---|---|---|---|---|---|---|---|---|
| | | ADF/PP/KPSS | | | Engle-Granger | | Phillips–Ouliaris | |
| | | Constant | Constant, Linear Trend | None | Tau-statistic | Z-statistic | Tau-statistic | z-statistic |
| Fully Modified Least Squares (FMOLS) Model 1 | | | | | | | | |
| LWOP | 0.756372*** | –4.017644*** | –11.25316*** | –0.256227*** | –4.076425* | –33.75382** | –10.65394*** | –163.6317*** |
| C | 2.676549*** | | /–11.22060*** | /–11.26665*** | 0.0260 | 0.0108 | 0.0000 | 0.0000 |
| @ | 0.010799*** | /–4.003715*** | /–11.26665*** | /N | | | | |
| TREND | | /027239*** | | /A | | | | |
| Dynamic Least Squares (DOLS) Model 1 | | | | | | | | |
| LWOP | 0.755775*** | –4.512264*** | –12.06359*** | 0.256404 | –4.076425* | –33.75382** | –10.65394*** | –163.6317*** |
| C | 2.678048*** | /–4.523076*** | /–12.02880*** | /0.256404*** | 0.0260 | 0.0108 | 0.0000 | 0.0000 |
| @ | 0.010825*** | /–4.514185*** | /–12.02880*** | /N | | | | |
| TREND | | / | / | /A | | | | |
| Canonical Cointegrating Regression (CCR) Model 1 | | | | | | | | |
| LWOP | 0.752657*** | –4.018645*** | –11.25862*** | 0.257870 | –4.076425* | –33.75382** | –10.65394*** | –163.6317*** |
| C | 2.693277*** | /–4.005087*** | /–11.22598*** | /0.257680*** | 0.0260 | 0.0108 | 0.0000 | 0.0000 |
| @ | 0.010794*** | /–4.028366*** | /–11.27154*** | /N | | | | |
| TREND | | | | /A | | | | |
| Fully Modified Least Squares (FMOLS) Model 2 | | | | | | | | |
| LWOP | 0.661570*** | –2.818623 | –2.894518 | –2.790853** | –2.535433 | –18.78085 | –13.58580*** | –231.4740*** |
| C | 3.031079*** | /–14.20555*** | /–14.17962*** | /–14.22391*** | 0.5062 | 0.1934 | 0.0000 | 0.0001 |
| @ | 0.011079*** | /0.272177 | /0.272061*** | /N | | | | |
| TREND | | | | /A | | | | |
| Dynamic Least Squares (DOLS) Model 2 | | | | | | | | |
| LWOP | 0.641746*** | –2.989495 | –3.187045* | –2.918780*** | –2.535433 | –18.78085 | –13.58580*** | –231.4740*** |
| C | 3.119148*** | /–14.60050*** | /–14.57208*** | /–14.62779*** | 0.5062 | 0.1934 | 0.0000 | 0.0001 |
| @ | 0.011046*** | /0.296111 | /0.296111*** | /NA | | | | |
| TREND | | | | | | | | |
| Canonical Cointegrating Regression (CCR) Model 2 | | | | | | | | |
| LWOP | 0.658476*** | –2.814702 | –2.893322 | –2.787727*** | –2.535433 | –18.78085 | –13.58580*** | –231.4740*** |
| C | 3.045135*** | /–14.20944*** | /–14.18348*** | /–14.22731*** | 0.5062 | 0.1934 | 0.0000 | 0.0001 |
| @ | 0.011074*** | /0.273388 | /0.273256*** | /NA | | | | |
| TREND | | | | | | | | |
| Fully Modified Least Squares (FMOLS) Model 3 | | | | | | | | |
| LWOP | 0.827120*** | –3.084464** | –3.138187 | –3.085408*** | –3.188035 | –12.72549 | –5.532269*** | –46.26637*** |
| C | 3.408242*** | /–5.807865*** | /–8.284613*** | /–5.828660*** | 0.0763 | 0.2185 | 0.0000 | 0.0001 |
| | | /1.117551*** | /0.335744*** | /NA | | | | |
| Dynamic Least Squares (DOLS) Model 3 | | | | | | | | |
| LWOP | 0.802530*** | –3.338714** | –3.554403*** | –3.554403*** | –3.188035 | –12.72549 | –5.532269*** | –46.26637*** |
| C | 3.517533*** | /–6.424905*** | /–9.156784*** | /–6.452991*** | 0.0763 | 0.2185 | 0.0000 | 0.0001 |
| | | /1.144211*** | /0.345270*** | /NA | | | | |
| Canonical Cointegrating Regression (CCR) Model 3 | | | | | | | | |
| LWOP | 0.824016*** | –3.085448*** | –3.137132 | –3.086794*** | –3.188035 | –12.72549 | –5.532269*** | –46.26637*** |
| C | 3.421713*** | /–5.808469*** | /–8.280945*** | /–5.829278*** | 0.0763 | 0.2185 | 0.0000 | 0.0001 |
| | | /1.116252*** | /0.336192*** | /NA | | | | |
| Fully Modified Least Squares (FMOLS) Model 4 | | | | | | | | |
| LWOP | 0.717103*** | –3.275109** | –2.665442 | –3.002290*** | –2.889901 | –8.548601 | –7.645912*** | –88.97475*** |
| C | 3.856332*** | /–8.703221*** | /–12.00439*** | /–8.723096*** | 0.1436 | 0.4497 | 0.0000 | 0.0000 |
| | | /1.158668*** | /0.349597*** | /NA | | | | |
| Dynamic Least Squares (DOLS) Model 4 | | | | | | | | |
| LWOP | 0.675997** | –3.603881** | –2.904208 | –3.171720*** | –2.889901 | –8.548601 | –7.645912*** | –88.97475*** |
| C | 4.034741*** | /–9.429924*** | /–9.429924*** | /–9.454068*** | 0.1436 | 0.4497 | 0.0000 | 0.0000 |
| | | /1.167717*** | /0.360261*** | /NA | | | | |
| Canonical Cointegrating Regression (CCR) Model 4 | | | | | | | | |
| LWOP | 0.714450** | –3.278139 | –2.665360 | –3.004955*** | –2.889901 | –8.548601 | –7.645912*** | –88.97475*** |
| C | 3.867888*** | /–8.703993*** | /–12.00178*** | /–8.723803*** | 0.1436 | 0.4497 | 0.0000 | 0.0000 |
| | | /1.157551*** | /0.349944*** | /NA | | | | |

ADF denotes the Augmented Dickey–Fuller single root system respectively. The optimum lag order is selected based on the Shwarz criterion automatically; PP Phillips-Perron is single root system. The optimum lag order in PP test is selected based on the Newey-West criterion automatically; KPSS denotes Kwiatkowski-Phillips-Schmidt-Shin single root system. The optimum lag order in KPSS test is selected based on the Newey-West criterion automatically; ***,**and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively. The critical values are taken from MacKinnon (1996). Assessment period: 2005M03-2022M05

and no trend" (Narayan, 2005). Table "CI(v) Case V: Unrestricted intercept and unrestricted trend" v(v"CI(ii) Case II: Restricted intercept and no trend" The F-statistic exceeds the upper limit of Pesaran and Narayan's critical values at 1% level, indicating that there is a long-term interaction between the variables in the model.

**Table 13: Granger cause-and-effect analysis evaluation results. Wald Test**

| | Short-term period | | | Long-term period | | | Strong impact | |
|---|---|---|---|---|---|---|---|---|
| | ΔLWOP | | | $EC_{T-1}$ | | | $EC_{T-1}$ and Δ LWOP | |
| | Chi-sq. | F-st. | t-st. | Chi-sq. | F-st. | t-st. | Chi-sq. | F-st. |
| Model 1 | 0.248231 | 0.248231 | 0.498228 | –5.819796*** | 33.87003*** | 33.87003*** | 35.19290*** | 17.59645*** |
| | (0.6183) | (0.6189) | (0.6189) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Model 2 | 0.728713 | 0.728713 | −0.853647 | 44.88372*** | 44.88372*** | −6.699531*** | 44.89576*** | 22.44788*** |
| | (0.3933) | (0.3943) | (0.3943) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |
| Model 3 | 1.109720 | 1.109720 | 1.053432 | 11.76110*** | 11.76110*** | −3.429446*** | 13.31434*** | 6.657169*** |
| | (0.2921) | (0.2934) | (0.2934) | (0.0006) | (0.0007) | (0.0007) | (0.0013) | (0.0016) |
| Model 4 | 0.229492 | 0.229492 | −0.479054 | 35.67280*** | 35.67280*** | −5.972671*** | 35.73011*** | 17.86506*** |
| | (0.6319) | (0.6324) | (0.6324) | (0.0000) | (0.0000) | (0.0000) | (0.0000) | (0.0000) |

**$EC_{T-1}$ ADF Unit root test**

| | Model 1 | Model 2 | Model 3 | Model 4 |
|---|---|---|---|---|
| $t_m$ | −4.289296*** | −3.524098*** | −4.289296*** | −3.217249** |
| $t_T$ | −3.702582** | −3.014141 | −3.702582** | −2.520834 |
| $t_0$ | −2.746367*** | −2.591764*** | −2.746367*** | −2.889901*** |

ADF denotes the Augmented Dickey–Fuller single root system respectively. The optimum lag order is selected based on the Shwarz criterion automatically; ***, ** and * indicate rejection of the null hypotheses at the 1%, 5% and 10% significance levels, respectively. The critical values are taken from MacKinnon (1996). Assessment period: 2005M03-2022M05

## 6.4. Long-term and Short-term Interactions

### *6.4.1. Long-term interactions*

Long-term relationships between variables were tested using the ARDL methodology. In addition, the models were also tested for serial correlation, heteroscedasticity, and normal distribution to ensure statistical properties. Tables 9, 9a, 10 and 10a present the results of the long-term evaluation of the variables. WOP with a lag of 1 lag is estimated at 0.01% with a positive sign in the first model and 0.1% in the remaining models. This ensures the co-integration of the model, also the first difference order of WOP. Thus, WOP-world oil prices have a positive impact on BEM, BRM, BED and BRD in the long term at the levels of 0.01% and 0.1%. The increase implies the exclusion of oil revenues flowing into the Republic and contributions to the Oil Fund, respectively. This, of course, leads to an increase in revenues and expenditures of the state budget, respectively.

### *6.4.2. Short-term dynamics*

AIC-ARDL (3,2), AIC-ARDL (5,5), AIC-ARDL (3,2) and AIC-ARDL (5,0) ARDL structure was used to test short-term dynamics in the form of OLS equation.

Table 9 shows the results of short-term relationships. In all models, the coefficients of the error correction term (ECT) are negative and significant at the 0.01% level, so the short-term dynamics is confirmed. This implies that there is a long-term relationship between the dependent variable and the regressors. Furthermore, the ECT coefficient confirms that the models are approaching their equilibrium when they (rapidly) move away from equilibrium with an annual adjustment rate of 36.2% in the first model, 53.5% in the second model, 15.8% in the third model, and 19.2% in the next. Thus, he guarantees that the first model will close short-term gaps in about two and a half months, and the rest of the models, respectively, in just over 2 months, about 6 months and just over 5 months. In the first model, WOP (in order of initial (first) difference) has a significant positive impact on the OIE in the short term at the level of 0.5% in a lag-free time series and a negative impact at the level of 0.1% in one lag period. Similarly, in subsequent models, WOP (in first difference order) has a negative effect on BRM in non-lagged time series and with lower significance levels across different lag periods. WOP (in order of initial (first) difference) affects BED positively with a significance of 0.5% in a lag-free time series and negatively with a significance of 0.5% in one lag period.

## 6.5. Granger Causality Test

The Granger causality test is a method used to determine cause and effect relationships between variables. This method was used to visualize the direction of interaction between variables after examining the long-term interaction. However, in this test, only one of the variables is the absolute cause (WOP) and the others (BEM, BRM, BED and BRD) are the effect. Table 9 below shows the results of the Granger causality test. Here, the significance level of WOP acting as a cause of BEM and BRM is low. The reason is the expression of state budget revenues and expenses in manats. Another main reason is the devaluation carried out twice by the Central Bank of Azerbaijan in 2015. However, a completely different situation is obtained in the expression of state budget revenues and expenses in dollars. Thus, the significance level of WOP acting as a cause of BED's outcome was 0.5%, and the significance level of BRD's acting as a cause of consequences was close to 0.9% (Table 11).

Another aspect of the co-integration relationship between variables is that the white noise errors in the estimates are stationary. Table 12 presents the results of stationary tests using ADF, PP and KPSS unit root tests for white noise errors of each long-term equation evaluated by FMOLS, DOLS and CCR. In general, all white noise errors are stationary. Based on these results, the white noise errors are stationary in all models, and thus the co-integration relationship is confirmed once again. This result indeed confirms the results of Engle-Granger and Phillips-Ouliaris co-integration tests mentioned above. In addition, short-term and long-term causal relationships and strong causal relationships can be more accurately analyzed with Granger causation using the Angle-Granger co-integration method.

Thus, it is confirmed in Table 13 that although there is no mutual cause-and-effect relationship between the variables in the short-term period, there is a mutual cause-and-effect relationship and a strong cause-and-effect relationship in the long-term period. Also, here the white noise errors are stationary in all models. For this purpose, tests for the unit root of ADF were applied and the results of stationary tests were presented (Table 13).

## 7. CONCLUSION AND POLICY IMPLICATIONS

The main idea we put forward is to note the role of Azerbaijan's oil revenues in economic development and economic growth, noting its significant place in the income and expenditure part of the state budget, and recommending further acceleration of the work on the diversification of the economy and the development of the non-oil sector. Thus, the oil factor will influence the economic growth in Azerbaijan for a long time in the short, medium and long term. Furthermore, in 2008-2009 and 2014-2017, against the background of the rapid increase in oil prices and oil revenues, as well as the sudden decrease, the following results were obtained during the investigation of the changes in the income and expenditure part of the state budget on scientific and empirical grounds:

1. Oil prices (oil revenues) have a great impact not only in the short term, but also on the state budget and economic development in the medium and long term. This result leads to a deeper assessment of the general dynamics of economic development in terms of its structure and quality
2. Depending on the fluctuations in oil prices on the world oil market in 2008-2009 and 2014-2017, changes in the contributions of the State Oil Fund to the state budget were fully synchronized as a result of serious measures taken
3. Differences between revenues and expenses of the state budget in terms of manat and dollars and certain differences in the results of econometric models are associated with the devaluation of the Azerbaijani manat in February and December 2015
4. Overdependence on oil could exacerbate macroeconomic uncertainty. 2008-2009 and 2014-2017 are proof of this. Low oil prices can lead to a reduction in government revenues, which, in turn, can lead to the development of the non-oil sector, an increase in employment, a reduction in government spending aimed at improving the social welfare of the population, and a slowdown in economic development
5. Regulation of fiscal, monetary policy, and the exchange rate can become a solid basis for diversifying the economy and eliminating the impact of changes in oil prices on revenues and expenditures of the state budget and the national economy.

In addition, based on the results of this study, it can be concluded that Azerbaijan, as an oil exporting country, is very sensitive to fluctuations in oil prices. Thus, it is possible to emphasize the usefulness and importance of the economic policy pursued in this area in order to eliminate the dependence of the economy and, in particular, the state budget, on oil prices (oil revenues), at least to reduce this dependence and direct the country to more sustainable growth. In the future, Azerbaijan and other similar oil-exporting countries can act as a scientific basis for the state's economic policy aimed at reducing the impact of external oil price shocks on their economy and, of course, on the state budget, diversifying the economy.

## REFERENCES


Abdelsalam, M.A.M. (2020), Oil price fluctuations and economic growth: The case of MENA countries. Review of Economics and Political Science, Vol. ahead-of-print No. ahead-of-print.

Acemoglu, D., Finkelstein, A., Notowidigdo, M. J. (2013), Income and health spending: Evidence from oil price shocks. The Review of Economics and Statistics, 95(4), 1079-1095.

Adelman, M.A. (1989), Mideast governments and the oil price prospect. The Energy Journal, 10(2), 15-24.

Akbari, J., Bakhtiari, S., Sameti, M., Ranjbar, H. (2017), The re-analysis of the relationship between government's income and expenditure in an oil-based economy with TVPFAVAR approach (Iran as the case of study). International Journal of Energy Economics and Policy, 7(2), 243-249.

Alabdulwahab, S. (2021), The linkage between oil and non-oil GDP in Saudi Arabia. Economies, 9, 202.

Al-Abri, I., Önel, G., Grogan, K. (2019), Oil revenue shocks and the growth of the non-oil sector in an oil-dependent economy: The case of Oman. Theoretical Economics Letters, 9, 785-800.

Al Rasasi, M. (2018), The response of G7 real exchange rates to Oil Price Shocks. International Journal of Economics and Finance, 10(4), 191-205.

Alekhina, V., Yoshino, N. (2018), Impact of World Oil Prices on an Energy Exporting Economy Including Monetary Policy. ADBI Working Paper 828. Tokyo: Asian Development Bank Institute.

Ali, A. (2020), Volatility of oil prices and public spending in Saudi Arabia: Sensitivity and trend analysis. International Journal of Energy Economics and Policy, 11(1), 165-172.

Ali, A. (2021), Do oil prices govern GDP and public spending avenues in Saudi Arabia? sensitivity and trend analysis. International Journal of Energy Economics and Policy, 11(2), 104-109.

Aliyev, K.H., Dehning, B., Nadirov, O. (2016), Modelling the impact of fiscal policyon non-oil GDP in a resource rich country: Evidence from Azerbaijan. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 64, 1869-1878.

Aljarallah, R.A. (2020), The economic impacts of natural resource dependency in gulf countries. International Journal of Energy Economics and Policy, 10(6), 36-52.

Alkhateeb, T.T.Y., Sultan, Z.A., Mahmood, H. (2017), Oil revenue, public spending, gross domestic product and employment in Saudi Arabia. International Journal of Energy Economics and Policy, 7(6), 27-31.

Banafea, W.A., Ali, A.A. (2022). Large Oil Shocks and Economic Growth: Evidence from Saudi Arabia. International Journal of Energy Economics and Policy, 12(2), 268-275.

Banerjee, A., Juan, D., Ricardo, M. (1998), Error-correction mechanism tests for cointegration in a single-equation framework. Journal of Time Series Analysis, 19, 267-283.

Baumeister, C., Kilian, L., Zhou, X. (2018), Is the discretionary income effect of oil price shocks a hoax? The Energy Journal, 39, 117-138.

Bollerslev, T. (1986), Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31(3), 307-327.

Boyd, R., Doroodian, K., Thornton, D. (2000), The impact of oil price volatility on the future of the U.S. economy. Energy and Environment, 11(1), 25-48.

Breusch, T.S. (1978), Testing for autocorrelation in dynamic linear models. Australian Economic Papers, 17, 334-355.

Breusch, T.S., Pagan, A.R. (1979), A simple test for heteroskedasticity and random coefficient variation. Econometrica, 47(5), 1287-1294.

Brown, R.L., Durbin, J., Evans, J.M. (1975). Techniques for testing the

constancy of regression relationships over time. Journal of the Royal Statistical Society: Series B (Methodological), 37(2), 149-163.
Brueckner, M., Gradstein, M. (2016), Income and schooling: Evidence from international oil price shocks. Journal of Human Capital, 10(2), 212-234.
Caselli, F., Michaels, G. (2013), Do oil windfalls improve living standards? Evidence from Brazil. American Economic Journal: Applied Economics, 5(1), 208-238.
Choucri, N., Heye, C., Lynch, M. (1990), Analyzing oil production in developing countries: A case study of Egypt. The Energy Journal, 11(3), 91-115.
De Vita, G., Endresen, K., Hunt, L.C. (2006), An empirical analysis of energy demand in Namibia. Energy Policy, 34, 3447-3763.
Dickey, D.A., Fuller, W.A. (1981), Likelihood ratio statistics for autoregressive time series with a unit root. Econometrica: Journal of the Econometric Society, 49, 1057-1072.
Dizaji, S.F. (2014), The effects of oil shocks on government expenditures and government revenues nexus (with an application to Iran's sanctions). Economic Modelling, 40(C), 299-313.
Durbin, J., Watson, G.S. (1971), Testing for serial correlation in least squares regression. III. Biometrika, 58(1), 1-19.
Ebaid, A. (2016), The Relationship between Government Expenditure, Oil Price and Economic Growth: A Case Study Of Kuwait. Available from: https://eprints.usm.my/38728/1/The_relationship_between_government_expenditure%2C_oil_price_and_economic_growth_A_case_study_of_Kuwait.pdf
Eloho, A.R., Ekiomado, E.B. (2019), Oil revenue shocks, revenue profile and economic performance in nigeria. IOSR Journal of Economics and Finance (IOSR-JEF), 10(1), 60-68.
El-Radhi, Y. (2018), Does public expenditure cause economic growth? In: Economic Diversification in the Gulf States: Public Expenditure and Non-Oil Economic Growth in Bahrain, Oman and Qatar. Berlin, Germany: Gerlach Press. pp45-60.
El-Radhi, Y. (2018), The impact of public expenditure on non-oil GDP and on labour productivity: An econometric analysis. In: Economic Diversification in the Gulf States: Public Expenditure and Non-Oil Economic Growth in Bahrain, Oman and Qatar. Berlin, Germany: Gerlach Press. pp63-124.
Engle, R.F. (1982), Autoregressive conditional heteroskedasticity with estimates of the variance of United Kingdom inflation. Econometrica, 50(4), 987-1007.
Engle, R.F., Granger, C.W.J. (1987), Co-integration and error correction: Representation, estimation, and testing. Econometrica: Journal of the Econometric Society, 55(2), 251-276.
Fabritius, J.F., Petersen, C.E. (1982), OPEC respending and the economic impact of an increase in the price of oil. In the impact of rising oil prices on the World Economy. Palgrave Macmillan: London (pp. 80-96)
Godfrey, L.G. (1978), Testing against general autoregressive and moving average error models when the regressors include lagged dependent variables. Econometrica, 46, 1293-1301.
González, L.I. (2018), Oil rents and patronage: The fiscal effects of oil booms in the argentine provinces. Comparative Politics, 51(1), 101-119.
Granger, C.W.J. (1969), Investigating causal relations by econometric models and cross-spectral methods. Econometrica, 37, 424-438.
Grennes, T.J., Winokur, H.S. (1974), Oil and the US balance of payments. In: Erickson, E.W., Waverman, L., editors. The Energy Question Volume One: The World: An International Failure of Policy. Toronto, Canada: University of Toronto Press. pp311-334.
Gurbanov, S., Nugent, J.B., Mikayilov, J. (2017), Management of oil revenues: Has that of Azerbaijan been prudent? Economies, 5, 19.
Hammoudeh, S. (1988), The oil market and its impact on the economic development of the oil-exporting countries. The Journal of Energy and Development, 13(2), 297-324.
Hassler, J., Krusell, P., Shifa, A.B., Spiro, D. (2017), Should developing countries constrain resource-income spending? A quantitative analysis of oil income in Uganda. The Energy Journal, 38(1), 103-131.
Helliwell, J.F., Boothe, P.M., McRae, R.N. (1982), Stabilization, allocation and the 1970s oil price shocks. The Scandinavian Journal of Economics, 84(2), 259-288.
Huntington, H.G. (1998), Crude oil prices and U.S. economic performance: Where does the asymmetry reside? The Energy Journal, 19(4), 107-132.
Ibrahim, O.A., Devesh, S., Hassan, H.M. (2019), Sensitivity of fiscal balances to oil price shocks: Short and long term effects in the context of Oman. International Journal of Energy Economics and Policy, 9(2), 146-155.
Jarque, C.M., Bera, A.K. (1980), Efficient tests for normality, homoscedasticity and serial independence of regression residuals. Economics Letters, 6(3), 255-259.
Jarque, C.M., Bera, A.K. (1981), Efficient tests for normality, homoscedasticity and serial independence of regression residuals: Monte Carlo evidence. Economics Letters, 7(4), 313-318.
Jarque, C.M., Bera, A.K. (1987), A test for normality of observations and regression residuals. International Statistical Review, 55(2), 163-172.
Johansen, S., Juselius, K. (1990), Maximum likelihood estimation and inference on co-integration with application to the demand for money. Oxford Bulletin of Economics and Statistics, 52, 169-210.
Jones, R.C. (1982), Regional income inequalities and government investment in Venezuela. The Journal of Developing Areas, 16(3), 373-390.
Kakanov, E., Blöchliger, H., Demmou, L. (2018), Resource Curse in Oil Exporting Countries. (OECD Economics Department Working Papers 1511). Paris, France: OECD Publishing.
Kennedy, R., Tiede, L. (2013), Economic development assumptions and the elusive curse of oil. International Studies Quarterly, 57(4), 760-771.
Kreishan, F.M., Elseoud, M.S., Selim, M. (2018), Oil revenue and state budget dynamic relationship: Evidence from Bahrain. International Journal of Energy Economics and Policy, 8(6), 174-179.
Kwiatkowski, D., Phillips, P., Schmidt, P., Shin, Y. (1992), Testing the null hypothesis of stationarity against the alternative of a unit root. Journal of Econometrics, 54(1-3), 159-178.
Lienert, I. (1981), The macroeconomic effects of the 1979/80 oil price rise on four Nordic economies. The Scandinavian Journal of Economics, 83(2), 201-219.
Looney, R.E. (1985), The impact of oil revenues on the pre-revolutionary Iranian economy. Middle Eastern Studies, 21(1), 61-71.
Luecke, M. (2011), Stabilization and savings funds to manage natural resource revenues: Kazakhstan and Azerbaijan versus Norway. Comparative Economic Studies, 53, 35-56.
Mackinnon, JG. (1996), Numerical distribution functions for unit root and cointegration tests. Journal of Applied Econometrics, 11, 601-618.
Mammadli, M., Sadik-Zada, E.R., Gatto, A., Huseynova, R. (2021), What drives public debt growth? A focus on natural resources, sustainability and development. International Journal of Energy Economics and Policy, 11(5), 614-621.
Mikhaylov, A. (2019), Oil and gas budget revenues in Russia after crisis in 2015. International Journal of Energy Economics and Policy, 9(2), 375-380.
Monjazeb, M., Choghayi, A., Rezaee, M. (2014), The impact of oil revenues on budget deficit in selected oil countries. Arabian Journal of Business and Management Review, 3(11), 197-205.
Mukhtarov, S., Aliyev, S., Zeynalov, J. (2020), The effect of oil prices on macroeconomic variables: Evidence from Azerbaijan. International Journal of Energy Economics and Policy, 10(1), 72-80.

Murshed, S.M. (2018), Growth and the institutional resource curse. In: The Resource Curse. Newcastle upon Tyne: Agenda Publishing. pp31-46.
Musayev, A., Aliyev, K.H. (2017), Modelling oil-sector dependency of tax revenues in a resource rich country: Evidence from Azerbaijan. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis, 65, 1023-1029.
Narayan, P. (2005), The saving and investment nexus for China: Evidence from cointegration tests. Applied Economics, 37(17), 1979-1990.
Osisanwo, B.G. (2018), The impact of oil export earnings on government income and expenditure: A policy implication on sustainable development of the Nigerian economy. Iranian Economic Review, 24, 621-638.
Park, J.Y. (1992), Canonical cointegrating regressions. Econometrica: Journal of the Econometric Society, 60(1), 119-143.
Pavlova, E.V., Duborkina, I.A., Sokolova, A.P., Doronkina, I.G., Konovalova, E.E. (2017), Dependence of the Russian economy on oil prices in the context of volatility of the global oil market: Articulation of issue. International Journal of Energy Economics and Policy, 7(3), 225-230.
Pesaran, M.H., Shin, Y. (1999), An autoregressive distributed lag modelling approach to cointegration analysis. In: Strøm, S., editor. Econometrics and Economic Theory in the 20th Century the Ragnar Frisch Centennial Symposium. Ch. 11. Cambridge: Cambridge University Press. pp371-413.
Pesaran, M.H., Shin, Y., Smith, R.J. (2001), Bounds testing approaches to the analysis of level relationships. Journal of Applied Econometrics, 16, 289-326.
Phillips, P.C., Ouliaris, S. (1990), Asymptotic properties of residual based tests for cointegration. Econometrica, 58(1), 165-193.
Phillips, P.C.B., Hansen, B.E. (1990), Statistical inference in instrumental variables regression with I (1) processes. Review of Economics Studies, 57, 99-125.
Phillips, P.C.B., Perron, P. (1988), Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.
Pierru, A., Matar, W. (2014), The impact of oil price volatility on welfare in the Kingdom of Saudi Arabia: Implications for public investment decision-making. The Energy Journal, 35(2), 97-116.
Rahma, E., Perera, N., Tan, K. (2016), Impact of oil price shocks on Sudan's government budget. International Journal of Energy Economics and Policy, 6(2), 243-248.
Ramsey, J.B. (1969), Tests for specification errors in classical linear least squares regression analysis. Journal of the Royal Statistical Society, Series B, 31(2), 350-371.
Ramsey, J.B. (1974), Classical model selection through specification error tests. In: Zarembka, P., editor. Frontiers in Econometrics. New York: Academic Press. pp13-47.
Raouf, E. (2021), Oil prices shocks and government expenditure. International Journal of Energy Economics and Policy, 11(5), 78-84.
Sadigov, O.T. (2020), Effective ways to inject oil revenues into the economy in oil countries. International Journal of Energy Economics and Policy, 10(2), 319-323.
Shaffer, R.E., Fischer, D.W. (1982), Local and national impacts from landing North Sea gas in Western Norway. The American Journal of Economics and Sociology, 41(3), 281-301.
Sillah, B.M.S., Alsheikh, H.M. (2012), Income, price, and government expenditure elasticities of oil in the gulf cooperation council countries. International Journal of Energy Economics and Policy, 2(4), 333-341.
Smith, R.S. (1992), Income growth, government spending, and wasting assets: Alberta's oil and gas. Canadian Public Policy/Analyse de Politiques, 18(4), 387-412.
Stauffer, T.R. (1985), Accounting for "wasting assets": Measurements of income and dependency in oil-rentier states. The Journal of Energy and Development, 11(1), 69-93.
Stock, J.H., Watson, M. (1993), A simple estimator of cointegrating vectors in higher order integrated systems. Econometrica, 61, 783-820.
Sultan, Z.A., Haque, M.I. (2018), Oil exports and economic growth: An empirical evidence from Saudi Arabia. International Journal of Energy Economics and Policy, 8(5), 281-287.
Trang, N.T.N., Tho, T.N., Hong, D.T.T. (2017), The impact of oil price on the growth, inflation, unemployment and budget deficit of Vietnam. International Journal of Energy Economics and Policy, 7(3), 42-49.
Usman, A.K. (2017), Economic and political impact of the oil and gas industry. In: Nigerian Oil and Gas Industry Laws: Policies, and Institutions. Lagos, Nigeria: Malthouse Press. pp417-422.
Zakaria, Z., Shamsuddin, S. (2017), Causality relationship between crude oil variables and budget variables in Malaysia. International Journal of Energy Economics and Policy, 7(2), 132-138.
Zallé, O. (2022), Natural resource dependence, corruption, and tax revenue mobilization. Journal of Economic Integration, 37(2), 316-336.