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Evaluating the Effects of Resource-Based Shocks on Key Macroeconomic Indicators in Selected Opec Nations

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ABSTRACT

This study looks at how natural resources affect important macro-economic indicators like inflation and exchange rates in OPEC countries. We used data from 10 OPEC countries over 1990-2023. The research used Panel Vector Autoregression (PVAR) method to examine how changes in one economic area affect others. Our results show that natural resource rents had an average of 31.09% of national income, while oil rents made up 50.37% on average. Oil production was very high at 1,379.52 terawatt-hours on average. However, inflation constituted a macroeconomic challenge with an average of 113.57% and some extreme cases reaching 23,773.13%. The exchange rate also changed a lot with an average value of 89.24. The study revealed that inflation shocks were the most detrimental to overall macroeconomic stability. When there is a sudden rise in inflation, the exchange rate drops by -81.88, natural resource rents fall by -174.98, and oil production decreases by -14,864. This shows that controlling inflation is very important for OPEC countries. The forecast error variance decomposition shows that oil production explains 28% of inflation changes in the short term. Oil rents become more important for exchange rates over time, growing from 22.8% in the short term to 52.4% in the long term. Natural resource rents are mostly affected by oil production, which explains 46.1% to 55.7% of the changes. The findings highlight the need for OPEC countries to prioritize inflation control and adopt a more strategic approach to managing oil wealth. Different resource sectors sometimes compete with each other, so countries need better coordination between different resource policies.

Keywords: Natural resources, Oil production, Inflation, Exchange rate, OPEC countries

I.INTRODUCTION

Natural resources like oil and gas are very important for many countries around the world. These resources help countries generate revenue, create jobs, and grow their economies. When countries possess readily available oil or gas, they can sell these resources to other nations and earn foreign currency. The revenue generated can then be used to build roads, schools, hospitals, and other important amenities that help people live better lives. However, having abundant natural resources does not always mean a country will become rich and successful. Some countries with many natural resources still struggle with poverty and economic problems (Jato & Ayaga, 2022).

Around the world, many countries that possess abundant natural resources face similar problems. Scientists and researchers have found that countries with many natural resources sometimes grow slower than countries without these resources. This strange situation is called the "resource curse" by experts like Sachs and Warner (1997). The resource curse happens when countries excessively depend on exporting their natural resources and overlook developing other sectors of their economy like manufacturing, agriculture, or services. When this happens, the country becomes very dependent on the prices of these resources in the world market. If prices go up, the country does well, but if prices go down, the country faces serious economic problems.

Another problem that affects countries with natural resources is called "Dutch Disease." This happens when a country generates substantial revenue from exporting natural resources that other industries in the country become weak and

uncompetitive. For example, if a country generates revenue from oil, the value of its currency might go up. When the currency becomes more expensive, it becomes harder for the country to sell other products like manufactured goods or farm products to other countries because they become too expensive. This can hurt jobs in these other industries and make the country even more dependent on natural resources (Sachs & Warner, 1997).

The Organization of the Petroleum Exporting Countries (OPEC) includes many nations that depend heavily on oil exports for their economic survival. These countries face unique challenges because oil prices fluctuate significantly in the global market. For example, Saudi Arabia, which is the biggest oil producer in OPEC, has seen its economy grow when oil prices are high, but struggle when prices fall. The country's government gets about 70% of its money from oil revenue, so when oil prices dropp ed between 2014 and 2016, Saudi Arabia had a budget deficit of 15.8% of GDP in 2015 (Rahim et al., 2021). This reflects the economic instability that can result from heavy dependence on one resource.

Different OPEC countries have had very different experiences with their oil wealth. The United Arab Emirates (UAE) has been more successful than many other OPEC countries because it has made deliberate efforts to diversify other parts of its economic base like tourism, banking, and technology. By 2019, non-oil industries made up about 70% of the UAE's total economic output (Rahim et al., 2021). This diversification has helped the UAE deal better with changes in oil prices. On the other hand, countries like Venezuela have been grappling with profound macroeconomic instability. Venezuela's economy collapsed dramatically, with GDP per capita falling from over $16,000 in 2011 to less than $4,000 in 2019 (World Bank, 2021).

The main problem that OPEC countries face is that changes in oil prices and production cause unpredictable effects on their economies. Rapid fluctuations in oil prices affect key macroeconomic variables including inflation, exchange rates, interest rates, and overall economic growth. These changes occur rapidly and through complex mechanisms, making it difficult for governments to predict subsequent outcomes and implement appropriate policy measures. For example, between 2020 and 2022, oil prices went from as low as $19.33 per barrel to as high as $123.58 per barrel (U.S. Energy Information Administration, 2023). Such drastic changes make it very difficult for these countries to plan their budgets and economic policies.

Research studies about natural resources and economic growth have produced mixed and sometimes contradictory results. Some studies suggest that natural resource abundance accelerate economic growth, while others find that it hampers long-term development. A study by Havranek, Horvath, and Zeynalov (2016) found that natural resources generally have a negative effect on economic growth, but this effect differs from one country to another and from one time period to another. More recent studies like the one by Haseeb et al. (2021) found that the relationship between natural resources and economic growth is complex - sometimes resources have the potential to support or undermine growth, depending on how they are managed and the broader institutional framework.

Moreover, OPEC countries are struggling with significant economic challenges caused by their dependence on oil. Nigeria, for example, had a GDP per capita of only $2,230 in 2019, which is much lower than other OPEC countries, despite having significant oil wealth (World Bank, 2021). The country faces problems like corruption, poor management of oil money, and failure to develop other industries. Venezuela shows an even worse situation, where political issues and poor economic management led to hyperinflation and currency collapse. The Venezuelan bolivar went from 6.3 per US dollar in 2013 to over 248,000 per US dollar by 2021 (IMF, 2021).

Understanding how resource shocks affect OPEC economies is very important for several reasons. First, these countries are home to millions of people whose lives are directly affected by economic instability. When oil prices decline, government revenue shrinks, limiting public expenditure on healthcare, education, and social services, ultimately impacting the well-being of ordinary citizens. Second, OPEC countries play an important role in the global economy as major oil suppliers. When these economies become unstable, it can affect oil supplies and prices worldwide, which impacts other countries too. Third, if these countries can learn how to better manage their resource wealth, they could provide examples for other resource-rich developing nations around the world.

Despite many studies on natural resources and economic growth, there are still significant gaps in our knowledge. Most existing studies do not focus specifically on OPEC countries as a group, and very few studies look at how oil price shocks affect multiple economic indicators at the same time. There is also a lack of studies that use advanced

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statistical methods like Panel Vector Autoregression (PVAR) to understand how different economic factors influence each other over time in OPEC countries. Ahmed et al. (2020a) noted that there is particularly limited research on how oil price changes work together with other economic factors to affect growth in these countries. This study aims to fill this gap by examining how resource-based shocks affect key economic indicators in OPEC nations, providing new evidence that can help policymakers make better decisions about managing their natural resource wealth for sustainable economic development.

II.LITERATURE REVIEW

This section presents the theoretical underpinning, and the empirical review.

Dutch Disease Theory

Dutch Disease theory explains how natural resource wealth can weaken other parts of a country's economy. Corden and Neary (1982) first described this theory after studying problems in the Netherlands when natural gas discoveries made other industries weaker. The theory shows that when a country generates revenue from natural resources, its currency becomes more valuable, making other exports expensive for foreign buyers. This causes manufacturing and agriculture sectors to shrink because they cannot compete in global markets. Many oil-rich countries experience symptoms of Dutch Disease when rapid growth in oil revenues lead to an appreciation of the real exchange rate, reducing the competitiveness of non-oil sectors and creating macro-economic imbalances.

Rent-Seeking Theory

Rent-seeking theory describes how people and groups try to get wealthy through government favors rather than creating new value. Krueger (1974) developed this theory to explain how natural resource wealth can lead to unproductive economic activities. Abundant natural resource wealth can lead to rent seeking, where elites focus on capturing resource rents instead of fostering private sector development and employment generation. This behavior diverts resources away from productive investment, thereby undermining long-term economic growth by focusing on redistribution rather than wealth creation. Studies by Tornell and Lane (1999) show that rent-seeking activities are common in resource-rich countries and can slow down economic development.

Resource Curse Theory

Resource curse theory suggests that countries with abundant natural resources often experience slower growth than their counterparts. Sachs and Warner (1997) developed this theory after finding that resource-rich countries had lower economic growth rates over time. The theory explains that natural resource wealth can cause several challenges i.e. price volatility, weak institutions, reduced investment in education, and dependence including on resource exports. Countries experiencing the resource curse often struggle with corruption, poor governance, and inability to develop other economic sectors. Research by Gylfason (2001) shows that many oil-rich countries have experienced slower growth and development compared to countries with fewer natural resources.

Empirical Review

The relationship between resource-based shocks on key macroeconomic indicators has been a topic of debate among researchers for many years. Some studies show that natural resources help countries grow economically, while others suggest they can actually hurt economic development. This review looks at recent research from different countries and regions to understand how natural resources affect economic growth.

Studies from different countries show very different results when looking at how natural resources affect economic growth. In Nigeria, Jato and Ayaga (2022) found that natural resources had both positive and negative effects on the economy. They discovered that natural resources helped increase income per capita but hurt the balance of payments. Similarly, Brown and Stephen (2017) studied Nigeria and found that coal helped economic growth, but oil, natural gas, and limestone did not show strong positive effects.

On the other hand, some countries show clear benefits from natural resources. In Ghana, Adabor et al. (2021) found that a 1% increase in oil resource rent led to a 0.84% increase in economic growth. They concluded that oil resources

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were a blessing for Ghana's economy. This shows that the same type of resource can have different effects in different countries.

The effects also vary by region. In Sub-Saharan Africa, Ofor and Grechyna (2021) studied 43 countries and found that forest resources contributed to economic growth, while oil and natural gas resources hurt it. In Asia, Haseeb et al. (2020) looked at five countries and found that natural resources helped economic growth in four countries but hurt growth in India.

Different types of natural resources appear to have different effects on economic growth. Havranek et al. (2016) conducted a meta-analysis of 43 studies and found that the type of natural resource matters a lot. Some resources help growth while others hurt it. This finding was supported by Ofor and Grechyna (2021), who showed that forest resources had positive effects while oil and gas had negative effects in Sub-Saharan Africa.

The way researchers measure natural resources also affects their findings. Some studies use resource rents, others use production data, and some use export values. Singh et al. (2023) studied wealthy countries and found negative relationships between natural resource rents and economic growth overall, but the effects were different when they looked at different levels of resource abundance.

Many studies show that natural resources affect economic growth differently over time. Vandana et al. (2022) found that in India, natural resources hurt economic growth in the long run but helped in the short run at certain time periods. This suggests that the timing of the analysis matters a lot.

Ben-Salha et al. (2018) studied resource-rich countries and found support for resource blessing in the long run but not in the short run. This is the opposite of what Vandana et al. (2022) found for India, showing that time effects vary by country. Gerelmaaa and Kotanib (2016) found interesting time-related patterns. Countries with various resources in 1970 grew slower over the next 20 years, but countries with resources in 1990 grew faster between 1990 and 2010. This suggests that the effects of natural resources on growth may have changed over time.

Many studies show that natural resources alone do not determine economic growth. Other factors like education, financial development, and good government play important roles. Rahim et al. (2021) studied the Next Eleven countries and found that while natural resources hurt economic growth, human capital development helped it. More importantly, when human capital and natural resources worked together, they had positive effects on growth. Zallé (2018) studied 29 African countries and found that human capital and anti-corruption measures were very important for making natural resources help economic growth. This suggests that countries need good education and governance to benefit from their natural resources.

Financial development also matters. Ridena et al. (2021) studied Indonesia and found that better financial systems could help reduce the negative effects of natural resources. Ahmed et al. (2020a) studied Pakistan and found that natural resources actually contributed positively to financial development, which goes against what many other studies found.

Recent studies have started looking at how natural resources affect both economic growth and the environment. Zhang et al. (2021) studied Pakistan and found that natural resources reduced carbon emissions in the long run but increased them in the short run. This shows that environmental effects can be different from economic effects. Awosusi et al. (2022) studied Colombia and found that economic growth increased CO_2 emissions, but renewable energy and globalization helped reduce them. This suggests that countries need to balance economic growth with environmental protection. Rusiadi et al. (2024) studied ASEAN countries and found that natural resources, foreign investment, and renewable energy all positively contributed to economic growth, while CO_2 emissions did not have strong effects. This shows that some regions are moving toward cleaner economic development.

The way researchers conduct their studies affects their results. Havranek et al. (2016) found that studies using different methods often get different results. Studies that control for government quality, investment levels, and different types of resources tend to find weaker evidence for the resource curse.

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Some studies use simple methods like regular regression, while others use advanced techniques. Jie and Lan (2024) used new mathematical models and found that the relationship between financial markets, economic growth, and natural resources follows a curved pattern rather than a straight line.

The time period studied also matters. Studies looking at longer time periods often find different results than those looking at shorter periods. Topcu et al. (2020) studied 124 countries over 38 years and found that the effects of natural resources depend on how rich the country is. In the same vein, studies that examined single country often find different results than studies that look at many countries together. Single-country studies like those on Nigeria (Jato & Ayaga, 2022; Brown & Stephen, 2017), Ghana (Adabor et al., 2021), and Pakistan (Yasmeen et al., 2021) provide detailed information about specific countries but may not apply to other places. Cross-country studies like those by Nasir and Redmond (2020) and Topcu et al. (2020) look at many countries together and can find general patterns, but they may miss important differences between countries. Ben-Salha et al. (2018) found that even in cross-country studies, individual countries can have very different results.

The research suggests several important policy lessons. First, countries cannot rely on natural resources alone for economic growth. They need to invest in education, improve government quality, and develop other parts of their economy. Jato and Ayaga (2022) recommended policies for better resource use in Nigeria, while Rahim et al. (2021) suggested that human capital development is crucial. Second, the type of natural resource matters. Countries with different types of resources may need different policies. Forest resources seem to help growth more than oil resources, based on the findings of Ofor and Grechyna (2021). Third, countries need to think about environmental effects as well as economic effects. The studies by Zhang et al. (2021) and Awosusi et al. (2022) show that natural resources can affect the environment in different ways than they affect the economy.

III.METHODOLOGY

The variables used in this study consisted of annual data series sourced from the World Bank Development Indicator (WDI) database and the U.S. Energy Information Administration (EIA) website. Six (6) variables were employed, namely total natural resources rents (% of GDP), oil production in terawatt-hours (TWh), oil rents (% of GDP), inflation (consumer prices, annual %), and the real effective exchange rate index (RER, 2010 = 100), covering the period from 1990 to 2023. The choice of the time period was based on data availability. Based on available and consistent data, a total of 10 OPEC countries were sampled for the study, including Algeria, Republic of the Congo, Equatorial Guinea, Gabon, Islamic Republic of Iran, Republic of Iraq, State of Kuwait, Great Socialist People's Libyan Arab Jamahiriya, Federal Republic of Nigeria, and the Kingdom of Saudi Arabia.

Panel Vector Auto-regression (Panel VAR)

The Panel VAR approach was employed to examine how resource-based shocks affected selected macroeconomic indicators across OPEC countries. This method is very useful for examining how resource-based shocks influence key macroeconomic indicators in OPEC countries. Canova and Ciccarelli (2013) explain that Panel VAR combines regular VAR methods with panel data, allowing researchers to look at patterns across different countries and time periods at the same time. This approach is particularly helpful when studying OPEC economies because it can show both common patterns and differences between oil-producing countries.

One major benefit of Panel VAR is that it treats all economic variables as potentially connected to each other, which helps solve endogeneity problems that often happen in economic studies. Love and Zicchino (2006) note that this feature allows researchers to explore how resource-based shocks affect macroeconomic indicators like inflation, exchange rates, and interest rates. This method is especially good for studying OPEC countries because oil price changes can affect many different parts of these economies. Abrigo and Love (2016) also mention that Panel VAR can include country-specific effects, which helps capture unique characteristics of each OPEC country that might influence their economic performance.

Econometric Model Specification

The basic Panel VAR model used in this study follows the framework developed by Abrigo and Love (2015). The model can be written as:

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$$y_{it} = A_1 y_{it-1} + A_2 y_{it-2} + \ldots\ldots + A_{p-1} y_{it-p+1} + A_p y_{it-p} + \beta x_{it} + c_i + \varepsilon_{i,t} \quad \ldots\ldots (1)$$

The dynamic form presented by Lennman (2016) is as follow

$$y_{it} = \rho y_{i,t-1} + \beta x_{it} + c_i + \varepsilon_{i,t} \quad \ldots\ldots (2)$$

When considering multiplier dependent variables, the dynamic model is transformed into the panel VAR model of lag order p with k variables. The study exemplifies this in (1) which is a panel VAR model representation just like (2) but in matrix form, with k variables but only 1 lag length. Presenting the matrix form with longer lag lengths is space-consuming and redundant it basically just adds extra rho matrixes and a y_{t-p} matrix.

$$\begin{pmatrix} y_{1,t} \\ y_{2,t} \\ \vdots \\ y_{k,t} \end{pmatrix} = \begin{bmatrix} \rho_{11} & \rho_{12} \cdots & \rho_{1k} \\ \rho_{21} & \rho_{22} \cdots & \rho_{2k} \\ \vdots & \vdots \ \ddots & \vdots \\ \rho_{k1} & \rho_{k2} \cdots & \rho_{kk} \end{bmatrix} \begin{pmatrix} y_{1,t-1} \\ y_{2,t-1} \\ \vdots \\ y_{k,t-1} \end{pmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \cdots & \beta_{1k} \\ \beta_{21} & \beta_{22} \cdots & \beta_{2k} \\ \vdots & \vdots \ \ddots & \vdots \\ \beta_{k1} & \beta_{k2} \cdots & \beta_{kk} \end{bmatrix} (x_{1,t}, x_{2,t}, \ldots, x_{j,t}) + \begin{pmatrix} c_i \\ c_i \\ \vdots \\ c_i \end{pmatrix} + \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \vdots \\ \varepsilon_{k,t} \end{pmatrix} \quad \ldots\ldots (3)$$

In (3) we have a vector of dependent variables on the left-hand side, which are also included with a lag on the right-hand side. x_{it} is a column vector of the exogenous variables, c_i and ε_{it} are the panel fixed effects and the error term respectively. Which is simply a way to present a panel VAR model in matrix form where there are a different number of lags on the dependent variable list and a list of exogenous variables. The vector Yi,t included four (4) key macroeconomic indicators that were affected by resource-based shocks. The variables included in this model were total natural resource rents (NRR), inflation rate (INF), oil rents (ORN) exchange rate (EXR), and crude oil production (COP).

Estimation Technique

The study uses the Generalized Method of Moments (GMM) approach to estimate the Panel VAR model, as recommended by Abrigo and Love (2015). This method is necessary because using regular estimation techniques would give biased results when lagged variables appear on both sides of the equation. Belingher (2015) explains that GMM helps solve this problem by using appropriate instruments. Before estimation, researchers must determine the optimal number of lags using information criteria such as the Akaike Information Criterion (AIC) or Schwarz Bayesian Criterion (SBC) to ensure the model captures the right amount of historical influence.

Impulse Response Functions

After estimating the model, impulse response functions (IRFs) are calculated to show how macroeconomic indicators respond to resource-based shocks over time. Lennman (2016) describes IRFs as visual tools that demonstrate how a stable economic system reacts to sudden changes in any variable. For this study, IRFs will show how a shock in crude oil production or natural resource rents affects inflation, exchange rates, and other macroeconomic indicators. The mathematical representation of IRF at horizon h is:

$$IRF_h = \frac{\partial Y_{i,t+h}}{\partial \in_{i,t}} \quad \ldots\ldots (4)$$

This equation shows how future values of macroeconomic indicators change due to a one-time resource-based shock.

Forecast Error Variance Decomposition

Forecast Error Variance Decomposition (FEVD) is used to measure how much of the variation in each macroeconomic indicator can be explained by shocks in other variables. This analysis helps determine, for example, how much of the changes in inflation rates can be attributed to oil production shocks versus exchange rate changes. The FEVD calculation at horizon h for variable i due to a shock in variable j is:

$$FEVD_h = \frac{VAR(\in_{j,t})}{VAR(Y_{i,t+h})} \quad \ldots\ldots (5)$$

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This measure provides important information about which types of resource-based shocks have the strongest effects on different macroeconomic indicators in OPEC countries.

The Panel VAR approach allows researchers to understand how resource-based shocks spread through the economy and affect different macroeconomic indicators. Cakir and Kabundi (2013) explain that an increase in oil production might lead to higher government revenues, which could reduce inflation, but it might also cause the currency to become more valuable, making non-oil exports less competitive. Similarly, changes in oil prices can immediately affect interest rates as central banks adjust their policies to control inflation. These dynamic relationships are crucial for understanding how resource-based shocks influence the overall economic performance of OPEC countries.

Model Stability Testing

To ensure the Panel VAR model produces reliable results, stability tests must be conducted. Pattersson (2000) states that a VAR model is stable when all eigenvalues have a modulus less than 1. This means the model will eventually return to a balanced state after experiencing a shock. If any eigenvalue has a modulus greater than 1, the model would be unstable, and future values would continue to increase without limit, making the results unreliable. The eigenvalue stability condition is essential for ensuring that the impulse response functions and variance decomposition results are meaningful and can be used for policy recommendations.

Table 1 Measurement of Variables and Sources of Data

Variables	Variables	Measure	Sources of Data
Natural resources development	NRR	Total natural resources rents (% of GDP)	World Bank Development Indicator (WDI)
Crude oil production	COP	Annual Crude Oil Production, in thousands of barrel	U.S Energy Information Administration (EIA) Website data centre
Oil rent	ORN	Oil rents (% of GDP)	World Bank Development Indicator (WDI)
Inflation	CPI	Consumer Price Index. Country's all price index.	World Bank Development Indicator (WDI)
Exchange rate	EXR	Real Effective Exchange Rates. In country's currency units after relative price adjustments	World Bank Development Indicator (WDI)

Source: Prepared by Researcher (2025)

IV.DATA PRESENTATION, ANALYSIS AND DISCUSSIONS

Table 2 shows the descriptive statistics of five important variables: total natural resources rents (NNR), oil production (COP), oil rents (ORN), inflation (INF), and real effective exchange rate (RER).

Table 2 Descriptive Statistics

	NNR	*COP*	*ORN*	*INF*	*RER*
Mean	31.09436	1379.522	50.3668	113.5732	89.24141
Maximum	88.59235	6823.463	1453.417	23773.13	476.8674
Minimum	4.554107	0.058501	0	-16.1173	-15.6903
Std. Dev.	14.94642	1610.464	120.2316	1316.981	49.90977
Skewness	0.909465	1.893357	9.74378	17.23169	2.759686
Kurtosis	3.706529	5.941825	110.7868	308.4538	17.92725
Sum	10572.08	469037.6	17124.71	38614.89	30342.08
Observations	340	340	340	340	340
Correlation Matrix					
	NNR	LCOP	ORN	INF	RER
NNR	1	0.033018	-0.05678	-0.05003	-0.22003

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LCOP	0.033018	1	-0.08213	-0.09188	0.256646
ORN	-0.05678	-0.08213	1	0.148971	-0.13472
INF	-0.05003	-0.09188	0.148971	1	-0.09814
RER	-0.22003	0.256646	-0.13472	-0.09814	1

Source computed by the researcher using Eviews Version 12 (2025)

The average (mean) value of natural resources rents (NNR) was 31.09%, and oil production (COP) had a high average of 1,379.52 terawatt-hours, showing oil production is very important in OPEC countries. Oil rents (ORN) had a mean of 50.37%, which means oil made up a large part of national income. Inflation had a high average of 113.57%, but the maximum value (23,773.13%) shows that inflation was very unstable in some years. The exchange rate (RER) also changed a lot, with an average of 89.24.

The standard deviation values show how much each variable moved from its average. Oil production (COP), oil rents (ORN), and inflation (INF) had high standard deviations, meaning there were large changes in their values over time. The skewness and kurtosis results also show that oil rents and inflation had strange values. For example, oil rents had a skewness of 9.74 and a kurtosis of 110.79, and inflation had a kurtosis of 308.45, which means a few extreme values pulled the data far from the normal shape.

From the correlation matrix, total natural resources rents (NNR) had a small negative relationship with inflation (-0.05) and oil rents (-0.056), and a stronger negative link with the exchange rate (RER = -0.22). This may mean that when natural resource rents increase, the exchange rate value tends to go down. Oil production (LCOP) had a small positive relationship with exchange rate (0.256), but a weak negative one with inflation (-0.092). Oil rents (ORN) showed a small positive link with inflation (0.149), suggesting oil income might increase inflation in some cases.

Panel Vector Autoregression (PVAR) Analysis

The study utilizes a Panel VAR framework to examine the dynamic effects of natural resource shocks on critical economic indicators, specifically, inflation and exchange rates, across OPEC countries. The number of lags chosen in the model determined how well it captured the delayed effects of these shocks. The relationships between the variables at the same time also allowed us to see how each one may slow down the economy. This was done using impulse response functions and forecast error variance decomposition. The Panel VAR results are discussed below.

Table 3 shows the results for choosing the best lag length for the Panel VAR model. The lag is the number of past years included to study how resource-based shocks affect the economy over time. Three lags were tested.

Table 3: Order of Lag Selection Criteria Table

Lag	CD	J	J pvalue	MBIC	MAIC	MQIC
1	.9717465	132.9237	.0000434	-292.3174	-17.0763	-127.3515
2	.985063	85.20873	.0014026	-198.2853	-14.79127	-88.30808
3	.9914523	42.52024	.0157908	-99.22678	-7.47976	-44.23817
No. of obs	290					
No. of panels	10					
Ave. no. of T	29.000					

Source computed by the researcher using STATA 14 (2025).

The first lag (Lag 1) had the lowest values for MBIC, MAIC, and MQIC, which are common methods for choosing the best lag. These values suggest that Lag 1 gives the best model fit. Also, the J-statistic for Lag 1 (132.92) had a very small p-value (0.0000434), showing the model is statistically valid. As the lag increased to 2 and 3, the J-statistic

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values became smaller, and the p-values increased, meaning they fit the data less well. So, the best lag to use in the analysis is Lag 1. The model used 290 observations from 10 OPEC countries, with an average of 29 years of data per country. This supports that Lag 1 is good enough to capture the effects of resource shocks on inflation and exchange rates without making the model too large or weak.

Impulse Response Function

The PVAR impulse response table shows how different economic variables in OPEC countries react when one variable receives a shock or sudden change. This helps us understand how natural resource changes affect other parts of the economy and how these effects spread through the economic system.

Table 4 PVAR impulse response table

Response to	Response of INF	RER	NNR	LCOP	ORN
INF	-.1067376 (0.000)	-81.88163 (0.000)	-174.9837 (0.000)	-14864.01 (0.000)	-9.247738 (0.000)
RER	-.0006685 (0.000)	.563997 (0.000)	-.5603778 (0.000)	17.75956 (0.000)	.1463095 (0.000)
NNR	.0005413 (0.000)	-.0832653 (0.000)	.7910527 (0.000)	-15.48774 (0.000)	-.0305842 (0.000)
LCOP	-4.06e-06 (0.000)	.0058715 (0.000)	.0084374 (0.000)	1.129384 (0.000)	.0005029 (0.000)
ORN	-.0036219 (0.000)	.8265101 (0.000)	.2493266 (0.266)	115.9867 (0.000)	1.343353 (0.000)
Test of overidentifying restriction					
Hansen's J chi2(50)	86.870527				
P-value	0.001				

*Source computed by the researcher using STATA 14 (2025). The asterisks ***, ** and * indicate significance at 1%, 5% and 10% respectively. The figures in parenthesis () are standard errors.*

When Inflation (INF) Gets a Shock: When inflation suddenly increases, it causes negative effects on most other economic variables. The real exchange rate falls by -81.88, which means the currency becomes weaker when inflation goes up. This makes sense because high inflation usually makes a country's money worth less compared to other countries' currencies. Natural resource rents drop by -174.98, showing that inflation weakens the natural resource sector significantly. Oil production decreases dramatically by -14,864, suggesting that high inflation makes oil production less profitable or harder to manage. Oil rents also fall by -9.25, confirming that inflation generally weakens the oil sector in OPEC countries.

When Real Exchange Rate (RER) Gets a Shock: When the exchange rate experiences a sudden shift, it has mixed effects on the economy. A stronger exchange rate causes inflation to drop slightly by -0.0007, which is expected because a stronger currency makes imports cheaper and reduces price pressure. However, it reduces natural resource rents by -0.56, possibly because a stronger currency makes natural resource exports less competitive in international markets. Interestingly, oil production increases by 17.76, which might happen because a stronger currency makes it cheaper to import equipment and technology needed for oil production. Oil rents increase by 0.15, showing some positive effects on the oil sector.

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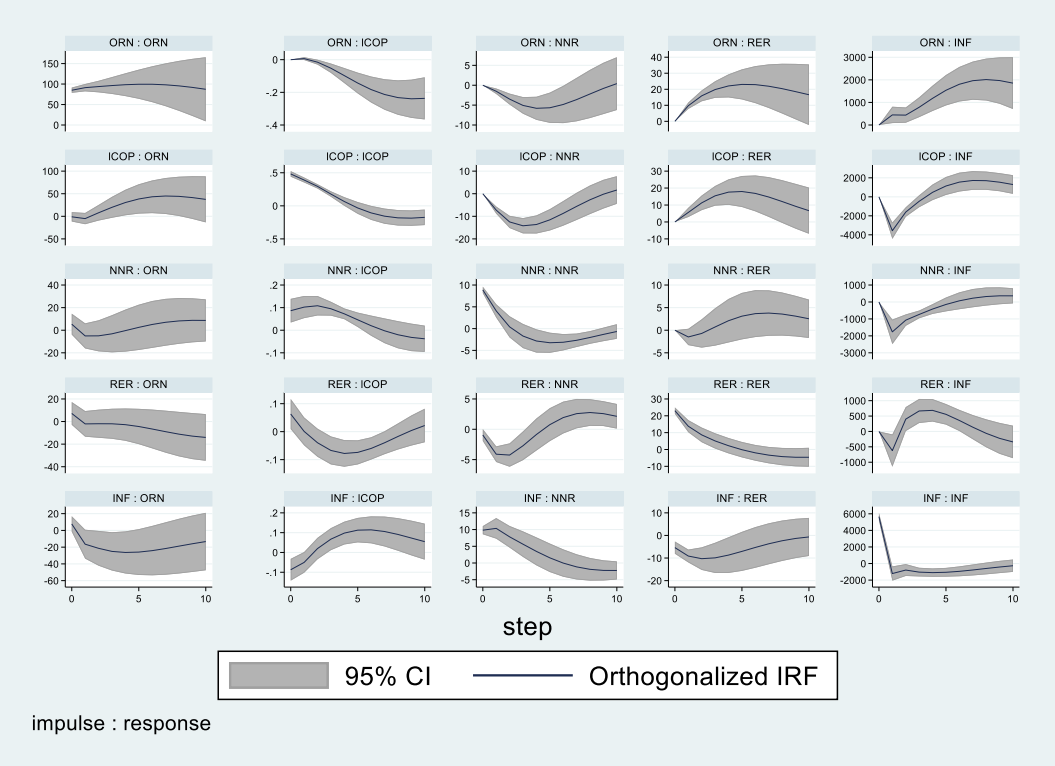

Figure 4.1: PVAR Impulse Response Graphs

Source: Generated by the Author using STATA 14 (2025)

When Natural Resource Rents (NNR) Get a Shock: When natural resource rents suddenly increase, they cause small positive effects on inflation (0.0005) and negative effects on the exchange rate (-0.083). This suggests that higher natural resource income leads to slightly higher prices and a weaker currency, which is consistent with Dutch disease theory. The effect on oil production is negative (-15.49), which seems strange since both are related to natural resources. Oil rents decrease slightly by -0.031, suggesting some competition or substitution between different types of natural resource income.

When Oil Production (COP) Gets a Shock: When oil production suddenly increases, it has very small effects on most variables. Inflation barely changes (-0.000004), and the exchange rate increases slightly (0.006). Natural resource rents increase by 0.008, which makes sense because more oil production should increase resource income. Oil rents increase by 0.0005, showing a small positive relationship between oil production and oil income.

When Oil Rents (ORN) Get a Shock: When oil rents suddenly increase, they cause inflation to drop by -0.004 and the exchange rate to strengthen by 0.83. This is interesting because it suggests that higher oil rents actually help stabilize prices and strengthen the currency, contrary to what might be expected from Dutch disease theory. Natural resource rents increase by 0.25, but this effect is not statistically significant (p-value = 0.266), meaning we cannot be sure this relationship is real. Oil production increases dramatically by 115.99, suggesting that higher oil rents encourage more oil production.

Overall Economic Relationships: The results show that inflationary shocks have the strongest and most negative effects on all other variables in OPEC economies. This suggests that controlling inflation is very important for economic stability in these countries. Exchange rate changes also have significant effects, particularly on natural resource sectors.

Contrary to conventional expectations, the interactions between different natural resource indicators exhibit mixed or even negative correlations. In some cases, increases in income from one type of natural resource are associated with declines in another, this indicates potential competition or trade-offs between resource sectors.

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Model Reliability: The Hansen's J test shows a chi-square value of 86.87 with a p-value of 0.001. Since the p-value is less than 0.05, this suggests there might be some problems with the model specification. This means we should be somewhat careful about interpreting these results, as the model may not perfectly capture all the relationships between these variables.

Policy Implications: The results suggest that OPEC countries should focus on controlling inflation since it has the most harmful effects on their economies. The mixed effects of exchange rate changes indicate that both very strong and very weak currencies can cause challenges. Countries should try to maintain stable exchange rates while managing their natural resource wealth carefully.

The fact that different types of natural resource income sometimes compete with each other suggests that countries should have coordinated policies for managing different resource sectors rather than treating them separately.

Forecast-Error Variance Decomposition

The forecast-error variance decomposition table shows how much each economic variable is influenced by shocks from other variables over different time periods. The table is divided into three time periods: P1-P3 (short term), P3-P6 (medium term), and P7-P10 (long term). This helps us understand how the effects of economic shocks change over time in OPEC countries.

Table 5 PVAR Forecast-Error Variance Decomposition

	INF				RER			NNR			LCOP			ORN	
	P_1-P_3	P_3-P_6	P_7-P_{10}	P_1-P_3	P_3-P_6	P_7-P_{10}	P_1-P_3	P_3-P_6	P_7-P_{10}	P_1-P_3	P_3-P_6	P_7-P_{10}	P_1-P_3	P_3-P_6	P_7-P_{10}
INF	0.625	0.567	0.419	0.0100	0.026	0.0209	0.0780	0.076	0.056	0.280	0.258	0.294	0.0176	0.072	0.210
RER	0.143	0.108	0.073	0.522	0.203	0.131	0.0018	0.043	0.101	0.1045	0.253	0.262	0.2288	0.432	0.524
NNR	0.428	0.231	0.211	0.058	0.034	0.046	0.154	0.084	0.092	0.461	0.557	0.552	0.0234	0.081	0.097
LCOP	0.020	0.058	0.076	0.011	0.033	0.027	0.054	0.071	0.049	0.911	0.787	0.623	0.0053	0.051	0.226
ORN	0.031	0.047	0.043	0.0023	0.015	0.0047	0.031	0.016	0.0210	0.034	0.049	0.086	0.9601	0.901	0.852

Source computed by the researcher using STATA 14 (2025)

Inflation (INF) Analysis: Inflation is mostly explained by its own shocks, especially in the short term where it accounts for 62.5% of its own variation. However, this self-influence decreases over time, dropping to 56.7% in the medium term and 41.9% in the long term. This means that other economic factors become more important for explaining inflation as time passes. Oil production (LCOP) has a significant impact on inflation, starting at 28% in the short term and staying around 25-29% throughout all periods. This shows that changes in oil production consistently affect price levels in OPEC countries. Natural resource rents (NNR) also influence inflation, contributing about 7-8% across all time periods. The real exchange rate and oil rents have smaller effects on inflation, each contributing less than 3% in most periods.

Real Exchange Rate (RER) Analysis: The real exchange rate shows interesting patterns over time. In the short term, it is mostly explained by its own shocks (52.2%), but this drops significantly to 20.3% in the medium term and 13.1% in the long term. This suggests that exchange rates become more influenced by other economic factors as time passes. Oil rents (ORN) become increasingly important for explaining exchange rate movements, starting at 22.8% in the short term and growing to 43.2% in the medium term and 52.4% in the long term. This makes sense because oil earnings are a major source of foreign currency for OPEC countries. Oil production also becomes more important over time, rising from 10.5% in the short term to 26.2% in the long term. Inflation has a moderate effect that decreases over time, from 14.3% to 7.3%.

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Natural Resource Rents (NNR) Analysis: Natural resource rents show a strong relationship with inflation, especially in the short term where inflation explains 42.8% of the variation in resource rents. However, this effect decreases over time to 23.8% in the medium term and 21.1% in the long term. Oil production (LCOP) has a significant and growing influence on natural resource rents, starting at 46.1% in the short term and increasing to 55.4-55.7% in the medium and long term. This suggests that oil production is the main driver of total natural resource income in OPEC countries. The exchange rate and oil rents have smaller effects, usually contributing less than 10% each.

Oil Production (LCOP) Analysis: Oil production is mostly explained by its own factors across all time periods, though this decreases from 91.1% in the short term to 78.7% in the medium term and 62.3% in the long term. This shows that oil production becomes more influenced by other economic variables over time. Oil rents (ORN) become increasingly important, growing from almost zero (0.05%) in the short term to 5.1% in the medium term and 22.6% in the long term. This suggests that higher oil profits eventually encourage more oil production. Natural resource rents also show growing importance over time, rising from 5.7% to 7.1% and then declining slightly to 4.9%. Inflation and exchange rates have smaller effects on oil production.

Oil Rents (ORN) Analysis: Oil rents are overwhelmingly explained by their own shocks across all time periods, starting at 96% in the short term and remaining high at 90.1% in the medium term and 85.2% in the long term. This suggests that oil rent changes are mostly driven by factors specific to the oil sector rather than by other macroeconomic variables. Oil production shows some increasing influence over time, growing from 0.3% in the short term to 4.9% in the medium term and 9.9% in the long term. The other variables have very small effects on oil rents, usually contributing less than 5% each.

Discussion of Findings and Implications

The analysis of resource-based shocks on macroeconomic indicators in OPEC nations reveals important patterns that connect with major economic theories about natural resources. The findings show both support for and challenges to established theories about how natural resources affect national economies.

The Dutch Disease theory suggests highlights how resource-driven currency appreciation can crowd out other productive sectors by eroding their international competitiveness. Our analysis provides mixed evidence for this theory in OPEC countries. The negative correlation between natural resource rents and the real exchange rate (-0.22) supports the Dutch Disease idea, showing that countries with more resource income tend to have weaker currencies rather than stronger ones. This finding goes against the typical Dutch Disease pattern where resource wealth strengthens the currency.

However, the impulse response analysis shows more evidence supporting Dutch Disease effects. When natural resource rents increase, they cause the exchange rate to weaken (-0.083) and inflation to rise slightly (0.0005). This pattern matches what Jato and Ayaga (2022) found in Nigeria, where natural resource abundance had negative effects on the balance of payments. The variance decomposition results also support Dutch Disease theory by showing that oil rents become increasingly important for explaining exchange rate movements over time, growing from 22.8% in the short term to 52.4% in the long term.

These findings align with several studies from the empirical review. Ofor and Grechyna (2021) found that oil rents had negative effects on economic growth in Sub-Saharan Africa, while Yasmeen et al. (2021) confirmed the resource curse hypothesis in Pakistan. However, our results differ from studies like Adabor et al. (2021) in Ghana, where oil resources showed positive effects on economic growth.

The Resource Curse theory argues that countries with abundant natural resources often experience slower growth than countries without them. Our analysis shows some evidence supporting this theory, particularly in the way inflationary shocks adversely affect a wide range of macroeconomic variables. When inflation increases, natural resource rents drop by (-174.98) and oil production falls by (-14,864), suggesting that economic instability can have detrimental effects on the resource sector.

The high average inflation rate of 113.57% in our descriptive statistics supports findings from studies like Forgha et al. (2016) in Cameroon, who found negative effects of natural resources on economic growth. The extreme values in

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our inflation data, reaching up to 23,773%, show that some OPEC countries experienced severe economic challenges, similar to what Hussain et al. (2021) found in their study of Thailand's environmental and economic challenges.

However, our findings also contradict the resource curse in some ways. The positive correlation between oil production and the real exchange rate (0.26) suggests that higher oil production can strengthen currencies, which would typically help economic stability. This finding aligns more with studies like Haseeb et al. (2020), who found positive effects of natural resources in most Asian economies they studied.

The variance decomposition shows that natural resource rents become less self-determined over time, which could indicate growing rent-seeking activities as more economic actors try to capture resource benefits. This pattern matches findings from Zallé (2018), who emphasized the importance of anti-corruption measures in African countries to make natural resources beneficial for economic growth.

The negative relationship between natural resource rents and oil production (-15.49 in impulse responses) is puzzling but might reflect rent-seeking behavior where focus on capturing resource rents reduces actual productive activities in the oil sector. This finding is consistent with Rahim et al. (2021), who found that natural resource rents hurt economic growth in the Next Eleven countries.

Our findings show several areas of consistency with the empirical literature reviewed earlier. The negative effects of inflation shocks on natural resource sectors align with studies like Brown and Stephen (2017) in Nigeria, who found mixed effects of natural resources on economic growth. The strong relationship between oil production and natural resource rents (55.4-55.7% in variance decomposition) matches findings from Rusiadi et al. (2024) in ASEAN countries, where natural resources significantly affected economic growth.

The growing importance of oil rents for exchange rate determination over time supports findings from Ahmed et al. (2020a) in Pakistan, who found positive relationships between natural resources and financial development. However, our results contrast with studies like Topcu et al. (2020), who found positive effects of natural resources across different income groups and rejected the resource curse hypothesis.

Several findings from our analysis differ from the empirical literature. The negative correlation between natural resource rents and exchange rates contradicts typical Dutch Disease predictions and differs from studies like Hayat et al. (2021), who found positive relationships between natural resources and economic growth in UAE and Saudi Arabia.

The small and sometimes negative effects between different natural resource variables (oil rents and natural resource rents) contrast with studies like Nasir and Redmond (2020), who found that natural resource abundance positively influences economic growth. Our finding that oil production increases when oil rents increase (115.99 in impulse responses) differs from studies like Vandana et al. (2022) in India, who found that natural resources hurt long-term economic growth.

V.CONCLUSION AND RECOMMENDATIONS

The study has shown that inflation is strongly affected by oil production and total natural resource rents in OPEC countries. Inflation reduced when there were changes in resource-based activities. The real exchange rate also responded to oil rents and oil production, showing clear reactions in all periods. Natural resource rents were mostly driven by oil production and inflationary shocks. Oil production remained a major source of change for most other variables and explained its own future changes well. Oil rents were very stable and less disturbed by other shocks but had strong effects on other indicators. In general, the results show that changes in oil and resource earnings have clear effects on key economic indicators like inflation and exchange rate in OPEC countries.

Based on the findings that inflation is affected by oil production and total natural resource rents, it is recommended that central banks and finance ministries in OPEC countries should work together to monitor and manage resource-based incomes more carefully. They should implement savings mechanisms that store excess oil revenues during booms, to be used later in times of inflation or economic stress. This can be done through stabilization funds or special government reserves. By stabilizing prices, this strategy may help maintain consumer purchasing power and the adverse effects of inflation.

Since the real exchange rate was influenced by oil rents and production, national treasury departments and foreign exchange regulators should focus on creating a balanced exchange policy. They should track oil earnings and exchange rate movements monthly and adjust monetary tools when needed. This can be achieved by setting up a monitoring system for resource income and exchange rate behavior. It may help reduce exchange rate fluctuations and promote stable trade and investment.

Because natural resource rents are mainly driven by oil production and inflation, ministries of petroleum and natural resources should work with economic planners to keep oil output stable. They should avoid sudden changes in production and apply output planning tools. This can be done by using production caps and forecast-based planning. It may help stabilize national income and reduce inflation caused by supply shocks.

Given that oil production affects most variables, OPEC governments and oil-producing companies should invest in better oil production, planning and transparency. This includes regular audits, proper oil storage systems, and real-time reporting. By introducing smart oil production tracking tools, these actors can reduce waste and improve national earnings. It may lead to better control over economic conditions and stronger long-term growth.

Lastly, since oil rents are stable and influence many other variables, economic policy makers and budget officers should use oil rent projections for long-term national planning. They can do this by setting clear budget rules that rely on realistic oil rent expectations and avoid over-spending. With this strategy, using medium-term expenditure frameworks (MTEFs) may help ensure responsible fiscal behavior and economic stability in OPEC countries.

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