



## Economic and Environmental Consequences of Internal and External Shocks in Net Oil-importing and Exporting Economies: A Structural VAR

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### Abstract

The main aim of our research is to use a structural vector autoregressive (SVAR) analysis to examine the effects of various shocks (oil price, exchange rate, money supply, and interest rate) on inflation and economic growth in selected net oil-exporting (NOE) and net-oil importing (NOI) countries. It also explores the implications of these shocks for efforts to reduce carbon emissions. The study finds that supply shocks, such as oil price fluctuations, significantly affect inflation and economic growth in most NOE and NOI countries. In contrast, demand shocks primarily affect inflation fluctuations and contribute to output fluctuations in most of these countries. Additionally, it is observed that in most NOE and NOI countries, except Morocco and Jordan, inflation rates respond positively and significantly to global oil price shocks, while GDP reacts negatively to positive exchange rate and pollution shocks. On the other hand, domestic inflation reacts negatively to exchange rate shocks in NOE and NOI countries. Our research contributes to a better understanding of the macroeconomic effects of external and internal shocks (oil price, exchange rate, money supply, and interest rate) in NOE and NOI countries. Moreover, the research highlights the implications of these shocks for efforts to reduce carbon emissions in these countries, emphasizing the importance of understanding their macroeconomic effects.

**Keywords:** corporate carbon emissions, net-oil exporter, net-oil importer, oil price.

**JEL Classification:** O1, O4, O5.

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## **Introduction**

The differences between net oil-exporting (NOE) and net oil-importing (NOI) economies are evident in their dependence on oil-related income, economic performance, and various socioeconomic factors. At a time when environmental issues have become a central focus, the importance of decarbonization and carbon sequestration strategies has increased markedly. These approaches are designed to reduce carbon emissions while promoting economic development (Mahmood and Furqan, 2021; Sayadi and Rajabzadeh, 2021; Balcilar et al., 2020; Hossain et al., 2021; Abubakar and Dano, 2020; Yoshizaki et al., 2012).

Interestingly, the use of crude oil results in carbon emissions, environmental difficulties, and economic consequences. Over the last thirty years, diverse economic paths have emerged across countries. Iran, a significant oil producer, has experienced strong economic growth and rising inflation (Mahmood and Furqan, 2021). In contrast, Egypt, a notable oil-importing country, has witnessed moderate economic expansion and relatively stable inflation rates, as noted by Hossain et al. (2021). These differences can be linked to a range of factors, such as fiscal policies, housing market dynamics, labor market inflexibility, and food imports (van der Ploeg, 2020).

Although NOE and NOI countries share some similarities, such as trade-dependent economies and currencies pegged to the US dollar, as highlighted by Yoshizaki et al. (2012), this trade dependency makes them susceptible to fluctuations in oil supply and demand. Consequently, it is essential to examine the impact of these market shocks on economic growth and inflation (Balcilar et al., 2020; Amiri et al., 2021).

Price disturbances in the oil market, whether arising from supply disruptions or demand fluctuations, give rise to a range of economic outcomes. These consequences include reductions in output, surges in inflation, changes in interest rates, and adjustment costs for numerous industries, as indicated by Mahmood and Furqan (2021), van der Ploeg (2020), Sayadi and Khoshkalam Khosroshahi (2020), and Abubakar and Dano (2020).

In this context, it is crucial to understand the definitions of essential terms. A supply shock denotes a sudden and substantial interruption in the availability of a vital resource, such as oil. Such interruptions are often caused by unforeseen events like geopolitical conflicts or natural disasters (Kilian, 2009). Conversely, a demand shock involves sudden and significant shifts in consumer or industry

demand for a specific product or service. These shifts can be influenced by factors such as economic downturns or changes in consumer preferences, as described by Kilian (2009). Furthermore, climate change refers to the long-term transformation of temperature and typical weather patterns, often leading to more frequent and severe weather events due to the accumulation of greenhouse gases in the Earth's atmosphere (Pielke Jr, 2004).

In summary, despite the stark contrasts between NOE and NOI countries in terms of their dependence on oil revenues and economic performance, they share a common susceptibility to oil market supply and demand shocks, which can exert profound effects on economic activity and inflation. This underscores the importance of crafting policies that reduce oil dependency and encourage low-carbon economic growth.

The objective of this paper is to analyze the impacts of supply and demand shocks on economic growth and inflation in both NOE and NOI countries. Additionally, it aims to explore the carbon footprint of businesses and examine the relationship between oil price volatility and carbon emissions (Mahmood and Furqan, 2021; van der Ploeg, 2020; Balcilar et al., 2020; Sayadi and Rajabzadeh, 2021; Abubakar and Dano, 2020; Yoshizaki et al., 2012).

This section has introduced the article's topic and defined key concepts. The next section presents a detailed literature review of the effects of supply- and demand-side shocks on economic growth and inflation. It examines previous research in this area, highlights key distinctions, and provides a comprehensive overview. It is important to note that the economic landscape is multifaceted, and understanding the complexities of supply and demand shocks is crucial for policy formulation and economic management.

Supply and demand shocks can disrupt economic stability and influence critical macroeconomic variables. Accordingly, the literature review examines the extensive research conducted in this field, shedding light on the diverse responses of economies to these shocks. The global economic landscape is characterized by volatility and uncertainty, and studying how different countries navigate these challenges contributes to the broader literature in economics and policymaking.

The methodological framework of the structural vector autoregressive (SVAR) model is then presented, providing a robust analytical foundation for the study. The choice of variables and dataset is of paramount importance. The research methodology plays a crucial role in ensuring the reliability and validity of the results and forms the basis for a comprehensive empirical analysis.

The subsequent sections present a detailed analysis of the empirical findings and the outcomes derived from the model. These findings are not only academically significant but also have practical implications for policymakers and stakeholders. Understanding the real-world impact of supply and demand shocks on economic growth and inflation is vital for crafting effective policies that promote economic stability and sustainable development.

Finally, the study concludes with a synthesis of the results and policy recommendations. These proposals are grounded in the empirical evidence and are intended to help governments and institutions respond to economic shocks. A detailed list of references is also provided to ensure transparency and support further research. In summary, this research offers a comprehensive examination of the interplay between supply and demand shocks, economic growth, and inflation.

The remainder of the article is organized as follows: the literature review is presented in Section 2; the research method is introduced in Section 3; Section 4 presents the empirical results and discussion; and the conclusion is provided in Section 5.

### **Literature Review**

The empirical literature has attempted to investigate the relationship between oil price fluctuations and the business cycle. Scholars such as Hamilton (1983) and Darby (1982) have examined the impact of oil price increases on real income in the US and other developed economies. While Hamilton found significant relationships between oil price changes and real GNP growth in the US economy during the periods 1948–1972 and 1973–1980, Darby was not satisfied with the ability of the variables used to explain the recession that hit the US. The negative correlation between oil price fluctuations and economic growth suggests a causal relationship from oil prices to aggregate economic activity. Other studies, such as Gisser and Goodwin (1986), have investigated the growth rate of the nominal price of crude oil through St. Louis-type equations that incorporate four macroeconomic variables, namely real GDP, general price level, unemployment rate, and real investment.

Some economists have suggested that monetary policy may play a role in the response of aggregate economic activity to oil price shocks. Jiménez-Rodríguez and Sánchez (2005) investigated the impact of world oil production shocks on the

economic performance of most industrialized countries. Similarly, Dungey (1994) found that adverse economic effects in the US and Japan had an impact on the Australian economy, which is closely linked to the US as a dominant trading partner. However, the effect was less pronounced when the model included only the impact of US shocks. Cushman and Zha (1997) analyzed the impact of foreign shocks on the US policy interest rate, world commodity prices, US income, and US inflation on the domestic output of the Canadian economy. They found that monetary policy shocks had little impact on output. Dungey and Pagan (2000) likewise found that domestic monetary policy had a limited effect on the Australian economy as an internal factor but helped stabilize economic activity. Similarly, Kim and Roubini (2000) concluded that external factors such as oil prices and US monetary policy were more important than domestic monetary policy in explaining output fluctuations in the G7 countries.

However, there is a dearth of comparative studies on the effects of selected supply and demand shocks on inflation and economic growth between NOE and the three NOI countries. Samimi and Shahryar (2009) found that long-term oil price shocks had a positive effect on real production growth for all countries except Kuwait, while demand shocks accounted for more inflation than supply shocks in all countries. Mehrara and Oskoui (2007) used an SVAR method for OPEC countries and found that oil price shocks were the main source of output fluctuations for Iran and Saudi Arabia, but not for Kuwait and Indonesia. Furthermore, oil price shocks were the main source of inflation for Saudi Arabia, while nominal shocks affected inflation in all countries in the short run. Kandil and Morsy (2011) used an error-correction model for the six GCC countries and found that oil revenue caused inflationary pressures in these countries. Hasan and Alogeel (2008) used an error-correction model for Kuwait and Saudi Arabia and found that exchange rates, inflation in trading-partner economies, and oil prices were the main drivers of inflation in these countries. Kia (2006) used a monetary model of inflation for the Iranian economy and found that a higher exchange rate led to higher prices, with fiscal policy being effective in combating inflation. In the short run, both external (foreign interest rates and sanctions) and internal factors (fiscal policy) were major sources of inflation in Iran, while internal factors played a major role in the long run. These findings are consistent with the literature on net oil-importing (MENA) countries. Similarly, Tawadros (2007) implemented a monetary model of inflation for Morocco, Egypt, and Jordan and found that money supply affected inflation in these countries but had no impact on real income.

Recently, Berument et al. (2010) employed VAR methodology to study the MENA region and found that changes in oil prices had a significant impact on production in the majority of oil-importing countries, including Algeria, Iran, Iraq, Kuwait, Libya, Oman, Qatar, Syria, and the United Arab Emirates. Interestingly, oil price shocks did not affect production in other Middle Eastern and North African countries, such as Bahrain, Djibouti, Egypt, Israel, Jordan, Morocco, and Tunisia.

Choi et al. (2018) conducted a study on the impact of global oil prices on domestic inflation using a sample of 72 advanced and developing economies. They found that a 10% increase in global oil prices, on average, affects domestic inflation by about 0.4 percentage points, with this effect disappearing after two years. These results were consistent for both advanced and developing economies.

Živkov et al. (2019) examined the effects of oil price changes on consumer price inflation in eleven Central and Eastern European countries using a wavelet-based Markov switching approach to distinguish between the effects at different time horizons. They found that the transmission of oil price changes to inflation was relatively low in these countries, with a 100% increase in oil prices leading to a rise in inflation of 1–6 percentage points. The strongest impact of rising oil prices on inflation occurred at longer time horizons in most countries, indicating that the indirect spillover effect is more intensive than the direct one. Additionally, the results suggested that the exchange rate was not a significant factor in the transmission of oil shocks to inflation, except in cases of high depreciation.

Neto et al. (2019) developed a three-equation model that linked environmental variables with traditional macroeconomic variables, assuming that economic agents are forward-looking. In the New Keynesian Environmental Canonic Model, environmental protection is seen as compatible with economic growth and price stability, while pollution shocks cause inflation and a decline in aggregate output due to the scarcity of environmental assets.

Sayadi and Khoshkalam Khosroshahi (2020) investigated the impact of oil shocks on macroeconomic variables. They employed a New Keynesian DSGE model to examine four scenarios, including an alternative fiscal rule known as the modified “Bird in the Hand” (MBIH), which considers both infrastructure development and the needs of future generations, and compared the results with those of the base fiscal rule. The simulation results indicated that the oil revenue

shock caused private sector production, consumption, total investment, and non-oil GDP to increase more under the MBIH scenario.

Ilyas et al. (2021) studied the combined effects of oil price uncertainty and economic policy uncertainty and found that both factors had a more pronounced negative effect in oil-producing countries. Oil price fluctuations generally harm corporate investment and may affect corporate financing decisions and firm value through various channels, such as leverage ratios and financing schemes (Fan et al., 2021).

Baek (2021) found that the responses of OPEC currencies to oil price shocks differ in timing and direction. The study also suggests that the effects of the three oil shocks are temporary for OPEC currencies.

The existing body of research has endeavored to explore the nexus between oil price fluctuations and their repercussions on various dimensions of the economy. Previous investigations have yielded several significant insights:

1. **Impact on Economic Growth:** Academics such as Hamilton (1983) and Darby (1982) have explored the effects of increasing oil prices on real income in the United States and other advanced economies. Their research has revealed a noticeable negative connection between oil price changes and economic growth, suggesting a causal relationship between oil prices and overall economic performance.
2. **Role of Monetary Policy:** Several researchers, including Kilian (2009) and Dungey (1994), have postulated the potential influence of monetary policy on how aggregate economic activity responds to oil price shocks.
3. **Effects on Inflation:** Studies by Samimi and Shahryar (2009), Mehrara and Oskoui (2007), and Berument et al. (2010) have examined the consequences of oil price shocks on inflation and identified diverse outcomes in various national settings.
4. **Environmental Considerations:** Scholars such as Neto et al. (2019) have developed models that establish links between environmental factors and traditional macroeconomic metrics. They underscore the crucial role of environmental preservation in promoting economic advancement and ensuring price stability.
5. **Comparative Studies:** While literature exists on the subject, there is a noticeable lack of studies that conduct comparative examinations of the effects of supply and demand shocks on both inflation and economic

growth in both Net Oil Exporting (NOE) and Net Oil Importing (NOI) countries.

Based on the literature reviewed, our research aims to provide a unique contribution by conducting a comparative analysis of how NOE and NOI countries respond to both demand and supply shocks. We will examine the differences in the effects of these shocks on their respective economies. This comparative approach adds an innovative dimension to the field, as it allows for a deeper understanding of the unique dynamics and consequences of oil price shocks in different economic contexts.

Our proposed hypothesis, H1, suggests that oil price volatility will have a significant negative impact on corporate carbon emissions. This underscores the growing importance of environmental sustainability in the context of economic activities associated with the oil industry.

## Methods and Materials

### The Econometric Framework Structural VAR Analysis

As per convention, a VAR is considered a reduced-form model, and interpreting its results can often be challenging without linking the reduced-form VAR to an economic model. When economic theory is employed to establish the correlation between forecast errors and fundamental shocks, we refer to the resulting model as an SVAR.

We established a structural VAR model to characterize the dynamic relationship among the macroeconomic variables. Our model begins by taking into account the following equations, involving  $N$  variables:

$$Ax_t = \alpha + (b_1p + b_2p^2 + \dots + b_np^n)x_t + \varepsilon_t \quad (1)$$

where  $A$  is matrix of variables in our analysis,  $x_t$  describes a vector of economic variables,  $\alpha$  is a vector of deterministic variables, and order matrix polynomial is  $b p$ . The structural shock (innovation) in this equation is  $b\varepsilon_t$  with constant variance  $E(\varepsilon_t\varepsilon_t)'$  and zero mean and covariance. The next step is to estimate a VAR model by multiplying  $A$  matrix in the reduced form of SVAR model, using the pre – multiplying Equation (1):

$$x_t = A^{-1}\alpha + A^{-1}(b_1p + b_2p^2 + \dots + b_np^n)x_t + A^{-1}\varepsilon_t \quad (2)$$

The reduced form VAR model describes each endogenous variable as function that was predetermined. The reduced form VAR residual is  $e_t = A^{-1}\varepsilon_t = C_{\varepsilon_t}$  has zero mean and variance  $\sigma^2$  and covariance  $\partial$ . The residuals of VAR relate

to the structural shocks  $\varepsilon_t$ . For the analysis of the effects of structural shocks on the variables, we have to improve the  $N^2$  elements of  $A^{-1}$ . we identified a set of restrictions based on economic theory. We apply Equation 2 to show:

$$\sum_{\delta} = E(\varepsilon_t \varepsilon_t)' = E(Ae_t e_t' A)' = AE(e_t e_t)'A' = A \sum_e A' \quad (3)$$

$$\sum_e = AA' \quad (4)$$

This explains that the structural shocks are uncorrelated with unit variance. Without further restrictions,  $N \times N$  matrix  $A$  is not unique in equation (3) and (4).  $\sum_e = AA'$  Only identifies  $(K^2 + k)/2$  as independent equation. We need  $(K - 1)/2$  additional restrictions to describe the unique arrangement of the  $N^2$  elements of  $A$ .

### The Theoretical Model and Identification of SVAR Models

In this section, we provide a concise derivation of a simple theoretical macroeconomic model. The model, as specified by Kim and Roubini (2000), takes into account the following set of variables:

$$x_t = (w_{o_t}, f_{i_t}, y_t, p_t, m_t, i_t, ex_t) \quad (5)$$

where  $w_{o_t}$  is a world oil price index in current US dollars (Kim and Roubini, 2000).

$f_{i_t}$ : the federal Funds rate (Cushman and Zha, 1997); (Kim and Roubini, 2000); (Dungey and Pagan, 2000),  $y_t$ : the domestic output (Tang, 2006) and (Ibrahim, 2006),  $p_t$ : the domestic price level (Sek et al., 2015),  $m_t$ : a narrow monetary aggregate (Thoma, 1994),  $i_t$ : domestic policy interest rate (Sims, 1992) and (Walsh, 2003), (Tang, 2006) and  $ex_t$  exchange rate expressed in US dollars (Kim, 1998). All variables except interest rates are expressed in logarithms.

To account for forward-looking monetary policy, these models require one variable. Because interest rates rise in anticipation of measured inflation, these models predict that a shock to monetary policy leads to a rise in the price level, which means that the price puzzle is resolved under this condition by the oil price index. The federal funds rate is included in the model to control for the response of domestic monetary policy to US financial variables. The other variables are standard variables in open-economy monetary business cycle models, including output, prices, money, interest rates, and exchange rates. However, the focus on US interest rates and the USD exchange rate indicates that the US serves as a

proxy for the international economy. Although this may not be ideal for all purposes, it has the advantage of being simple (Dungey and Pagan, 1998).

We can present the Kim and Roubini model, which restricts the elements of the  $B_0$  matrix as follows:

$$B_0 x_t =$$

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -b_{21}^0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ -b_{31}^0 & 0 & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ -b_{41}^0 & 0 & -b_{43}^0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & -b_{52}^0 & -b_{53}^0 & -b_{54}^0 & 1 & 0 & 0 & -b_{58}^0 & 0 \\ -b_{61}^0 & 0 & 0 & 0 & 0 & 1 & 0 & 0 & 0 \\ -b_{71}^0 & -b_{72}^0 & -b_{73}^0 & -b_{74}^0 & -b_{75}^0 & -b_{76}^0 & 1 & 0 & 0 \\ -b_{81}^0 & 0 & 0 & 0 & 0 & -b_{86}^0 & -b_{87}^0 & 1 & -b_{89}^0 \\ -b_{91}^0 & -b_{92}^0 & -b_{93}^0 & -b_{94}^0 & -b_{95}^0 & -b_{96}^0 & -b_{97}^0 & -b_{98}^0 & 1 \end{bmatrix} \begin{bmatrix} wo_t \\ wc_t \\ fy_t \\ fi_t \\ y_t \\ p_t \\ m_t \\ i_t \\ ex_t \end{bmatrix} \quad (6)$$

The model is overidentified. There are five more restrictions than required to just identify the model. The model is largely recursive, with the exception of the relationship between the domestic interest rate, the monetary aggregate, and the nominal exchange rate<sup>1</sup>. Two variables are exogenous variables that are unaffected by contemporaneous movements in all domestic variables. First, the federal funds rate depends contemporaneously on the oil price variable, reflecting the role this variable plays as a proxy for anticipated inflation. Domestic output is assumed to respond immediately to changes in oil prices, as are domestic prices. This is based on the hypothesis that oil prices are an important determinant of production and pricing decisions, and firms respond quickly to any changes. The interest rate equation is interpreted as the policy reaction function of the central bank. The central bank's policy reaction function depends contemporaneously on three variables: the oil price variable, the domestic monetary aggregate, and the nominal exchange rate. The oil price variable is included as a proxy for anticipated inflation. The monetary aggregate equation is specified as a standard money

<sup>1</sup>. We order the model differently to Kim and Roubini. We do so to identify the features of the model which make it differ from the more standard recursive ordering. For example, this model is very similar to the recursive model in Eichenbaum and Evans's (1995) study for the US which documents evidence of the exchange rate and forward discount puzzle.

demand equation, depending on output, prices, and interest rates. We use a measure of M1, consistent with KR. For simplicity, we follow KR and leave the contemporaneous and dynamic relationships unrestricted, with a possible loss of efficiency. Moreover, we develop the KR model with three variables.

An important omission from the policy reaction function is the US interest rate. Kim and Roubini justify this by arguing that, for domestic monetary authorities, the information in changes to the federal funds rate, whether expected or unexpected, is dominated by the information in movements of the nominal exchange rate. The exchange rate is treated as dependent on all shocks in the model, reflecting the fact that the exchange rate is a financial variable and reacts quickly to all information. The central bank's policy reaction function depends contemporaneously on three variables: the oil price variable, the domestic monetary aggregate, and the nominal exchange rate.

#### The EIO-LCA Method

In this paper, the EIO-LCA method used adopts the practical experience of Trappey et al. (2013) and Virtanen et al. (2011). We extend the EIO-LCA approach to evaluate the carbon footprint at the corporate level, combining the approaches of Clabeaux et al. (2020) and Liu et al. (2020). The companies' carbon footprint is based on financial data at the enterprise level and combined with industry data, referring to Liu et al. (2020):

$$E_m = F_m * \frac{O_m}{O_{i,m}} \quad (7)$$

$E_m$  is the carbon footprint of company  $m$ ;  $F_m$  is the total carbon footprint of the industry  $i$  that company  $m$  belongs to  $o_m$  is the cost of the central business; and  $o_{i,m}$  is the total cost of the main business of the industry  $i$ .

The carbon emissions from energy actives and carbon emissions from industrial production process, including cement and ferrous metals).

$$B = R(I - A)^{-1}Y \quad (8)$$

where  $B$  is the carbon emission matrix of each department;  $R$  is the direct emission coefficients of each sector; and  $(I - A)^{-1}$  represents the intermediate input-output structure of the economy is the final usage of products and services of each sector. The carbon emission from fossil fuel combustion ( $C_e$ ) refers to the carbon emission from the burst of fossil energy directly input in production or service provision, and its calculation formula is as follows:

$$C_e = \sum_{k=1}^n A_{i,k} \times C_k \quad (9)$$

where  $A_{i,k}$  is the consumption of energy  $k$  of industry  $I$  and  $C_k$  is the carbon emission coefficient of energy  $k$ . and specific formula for carbon emission of the industrial production process of various sectors refers to (Wei et al., 2022) is as follows :

$$C_e = \sum P_{i,j} \times K_{i,j} \times \frac{12}{44} \quad (10)$$

where  $P_{i,j}$  is the output of  $j$  industrial products of the  $i$  production sector and  $K_{i,j}$  is the carbon emission coefficient of the production process of industrial product  $j$  of  $i$  production sector .the sum of the direct and indirect carbon footprints is the industry's carbon footprint (Wei et al., 2022).

The model refers to the traditional EKC test method of Doğan et al. (2019) and Zhang et al. (2019).

We use the company's total assets to represent the company's development scale and then verify the existence of the EKC inverted U-shaped curve by including its squared term. The large gap between the company's asset scale (ASSET), the company's carbon emissions (E), and other variables. Following Wang et al. (2018) and Liu and Lai (2021), we choose a time-series regression model, and the formula is as follows:

$$LNE_{i,t} = \alpha_0 + \alpha_0 ov_t + \alpha_2 lnasset_{i,t} + \alpha_3 lnasset_{i,t}^2 + \alpha_i z_{i,t} + \sigma_f + \mu_{i,t} \quad (11)$$

where  $LNE_{i,t}$  and  $OV_t$  are the company's carbon emissions and volatility of WTI crude oil price ;the  $LNASSET_{i,t}$  is the natural logarithm of the size of a company's total assets;  $Z_{i,t}$  is the set of control variables at the corporate level; the  $\sigma_f$  represents the fixed effects ; and the  $\mu_{i,t}$  is the error term.

### Data and Description Variables

The first block consists of four foreign variables: real commodity prices, food prices, oil prices, and the US interest rate. The US is chosen to represent foreign sectors not only because it is the major trading partner of Egypt, Jordan, Nigeria, and Saudi Arabia, and Japan is the leading trading partner of Iran and the United Arab Emirates, while France is Morocco's primary trading partner, but also because these are three important countries that have affected many other countries economically and financially.

The second block contains the domestic variables: real GDP, the relative price inflation rate, the interest rate (INT), money supply, and the real effective exchange rate. All variables, except the inflation rate and the interest rate, are transformed by taking logarithms. The interest rate is in nominal terms and is the

policy variable used by the central bank. The inflation rate is calculated as the year-over-year percentage change in the consumer price index (CPI).

To enhance comprehension of the research variables, we provide their definitions and measurement indices below:

**Real commodity prices:** These represent the prices of commodities (such as oil, metals, and agricultural products) after adjusting for inflation. Real prices are used to account for changes in the general price level, providing a more accurate measure of price trends (Cashin and McDermott, 2002).

**Food price:** This variable measures the price level of food products, including both raw agricultural products and processed foods. It is typically used to gauge changes in food costs (Bellemare, 2015).

**Oil price:** Refers to the price of crude oil, a critical global commodity used for energy production, transportation, and various industrial processes. Changes in oil prices can have significant economic implications (IEA)<sup>1</sup>.

**US interest rate:** This is the nominal interest rate set by the United States. Nominal interest rates are the rates before adjusting for inflation. They play a vital role in shaping borrowing costs, investment decisions, and overall economic activity (Mishkijn, 1982).

**Real GDP:** Real Gross Domestic Product represents the total economic output of a country after adjusting for inflation. It is a key indicator of an economy's performance and is used to assess economic growth or contraction (Landefeld et al., 2008).

**Relative Price Inflation Rate:** This variable quantifies the inflation rate by measuring the percentage change in the general price level over time. It's often expressed relative to a base year or index (Domberger, 1987).

**Interest Rate (INT):** This is typically the nominal interest rate, which reflects the cost of borrowing or the return on savings or investments. In economic analysis, it can be a crucial determinant of consumer and business behavior (Blanchard, 2023).

**Money Supply:** Money supply refers to the total amount of money circulating in an economy, including cash, demand deposits, and other liquid assets. Changes in money supply can affect inflation and economic activity (Meltzer, 1969).

**Real Effective Exchange Rate:** The real effective exchange rate is a measure that takes into account changes in exchange rates and adjusts for differences in

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<sup>1</sup>. International Energy Agency

price levels between countries. It is used to evaluate a country's international competitiveness (Chinn, 2006).

**Inflation Rate (CPI):** The inflation rate, calculated as the year-on-year percentage change in the Consumer Price Index (CPI), measures the average price change for a basket of consumer goods and services. It's a crucial indicator for assessing changes in the cost of living (Huang and Liu, 2005).

Data are collected from various issues of Enerdata and the International Financial Statistics (IFS) online database. The data are succinctly presented in Table 1, outlined below:

**Table 1.** Variables Definition and Source

Variable	Definitions	Sources
RCP	Adjusted real price of commodity	IFS
FPR	Food price index	FAO
OPR	Oil price USD Per Barrel	Enerdata
RGDP	Real GDP per capita constant USD at 2015	WDI
INT	Interest rate	IFS
MON	Money supply	IFS
REER	Real effective exchange rate	IFS
CPI	Consumer price index	IFS

**Source:** Research finding.

To provide a more comprehensive overview of the countries examined in this research, the details are consolidated in Table 2.

**Table 2.** Categorization of Countries Based on Their Oil Import and Export Activities

	Net Oil Exporter (NOE)	Net Oil Importer (NOI)
1	Iran	Egypt
2	Saudi Arabia	Jordan
3	Nigeria	Morocco
4	United Arab emirate	

**Source:** Research finding.

The sample period covers 1980 to 2021, taking into account the effects of the Asian financial crisis in 1997-1998, the global financial crisis of 2007-2008 and the period of exchange control implemented by the government (as well as the earlier period of economic liberalization and deregulation). In this study, the measurement of oil price volatility ( $ov_t$ ) refers to the latest research of (Phan et

al., 2021) and (Maghyereh and Abdoh, 2020) .the standard deviation of daily returns of oil prices is adopted as the calculation basis of oil price uncertainty. The equation is as follows:

$$ov_t = \sqrt{\frac{1}{N-1} \sum_{T=1}^N (r_t(E(r_t)))^2} \times \sqrt{N} \quad (12)$$

where  $r_t$  is the daily WTI oil price return define as  $r_t = \ln(-p_{t-1})$  ,  $p_t$  denotes the WTI crude oil price and  $E(r_t)$  is the mean value of  $r_t$  .the  $N$  is the number of trading days. The data used in the carbon emission calculation process and GDP data are basically from various statistical yearbooks (Wei et al., 2022).

In this section, we define the nature of variables as real or nominal to underpin the foundation of our analysis. Additionally, we acknowledge the significance of official and unofficial exchange rates in our study.

### **Real Variables**

**Real GDP (Gross Domestic Product):** This is considered a real variable because it measures a country's economic output after adjusting for inflation. It reflects the actual production of goods and services and is used to analyze a nation's real economic growth.

**Real effective exchange rate:** This is categorized as a real variable because it adjusts exchange rates for inflation differentials between countries. It provides a more accurate representation of changes in a country's international competitiveness.

### **Nominal Variables**

**Nominal interest rate (policy interest rate):** The interest rate is considered nominal because it is set by the central bank in nominal terms. It does not account for inflation and is used as a policy tool to influence economic conditions.

**Nominal exchange rate:** The exchange rate is also classified as nominal. It represents the exchange rate without adjusting for inflation. It is an essential factor in determining the competitiveness of a country's exports.

Regarding the official or unofficial rate, it is worth mentioning that we primarily use official rates when available. Official exchange rates are provided by government authorities and are used for most economic and financial transactions. They are considered the standard exchange rates for international trade and financial markets. However, we acknowledge that in certain situations or regions, unofficial or parallel exchange rates might exist and be significant,

particularly in informal economies or when official rates are subject to distortions or controls. In such cases, it is essential to consider the impact of unofficial rates when assessing economic dynamics, and these factors should be taken into account for a more comprehensive analysis.

By categorizing variables as real or nominal and using official rates as the primary basis, our analysis aims to provide a structured and meaningful evaluation of the economic relationships under study.

## **Empirical Results**

### **Stationary Test**

The first step of this study is to test whether the data are stationary. It is essential to determine whether the variables tend to return to their long-term trend following a shock (stationary) or whether they follow a random walk (contain a unit root). It is well known that if variables follow a random walk after a shock, the regression results between variables are spurious, and the series do not have finite variance.

The results of the Augmented Dickey-Fuller (ADF) unit root test show that, for the full sample, only inflation (INF) is stationary at the 10 percent significance level, and at the 5 percent and 1 percent significance levels in the constant and trend specification; the other variables are stationary at first difference. For Saudi Arabia, the ADF test shows that the inflation rate is stationary at level at the 5 percent significance level in the constant and trend specification, and real GDP is stationary at first difference at the 5 percent significance level in the constant and trend specification, while the other variables are stationary at the 5 percent significance level in the constant and trend specification. For Nigeria, all variables are stationary at first difference at the 10 percent significance level in the constant and trend specification, except the policy interest rate, which is stationary at level at the 10 percent and 5 percent significance levels in the constant and trend specification. For Jordan, all variables are stationary at first difference at the 10 percent and 5 percent significance levels in the constant and trend specification, except the inflation rate, which is stationary at level at the 5 percent and 1 percent significance levels. For Morocco and Egypt, all variables are stationary at first difference at the 10 percent and 5 percent significance levels in the constant and trend specification, except the inflation rate, which is stationary at level at the 10 percent, 5 percent, and 1 percent significance levels in the constant and trend specification. For the United Arab Emirates, the inflation rate and policy interest

rate are stationary at level at the 10 percent significance level, real GDP is stationary at the second difference level in the constant and trend specification, and the other variables are stationary at first difference at the 10 percent, 5 percent, and 1 percent significance levels in the constant and trend specification. Therefore, we can conclude that all variables in this study are stationary.

### **Choice of Lag Length**

The number of lags in the SVAR model for Iran and the United Arab Emirates indicates that each equation in the system is free of serial correlation at the 5 percent significance level for either a lag length of two or four, and both the AIC and SBC select four lags for the SVAR model.

The results indicate that each equation in the system is free of serial correlation for Saudi Arabia at the 5 percent significance level for either a lag length of three or four, and both the AIC and SBC select four lags for the SVAR model.

The number of lags in the SVAR model for Nigeria indicates that each equation in the system is free of serial correlation at the 5 percent significance level for either a lag length of three or four, and both the AIC and SBC select four lags for the SVAR model.

The results indicate that each equation in the system is free of serial correlation for Egypt and Jordan at the 5 percent significance level for either a lag length of two or four, and both the AIC and SBC select two lags for the SVAR model.

### **Stability Test**

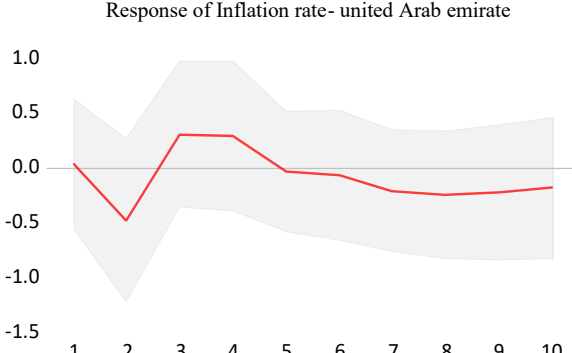
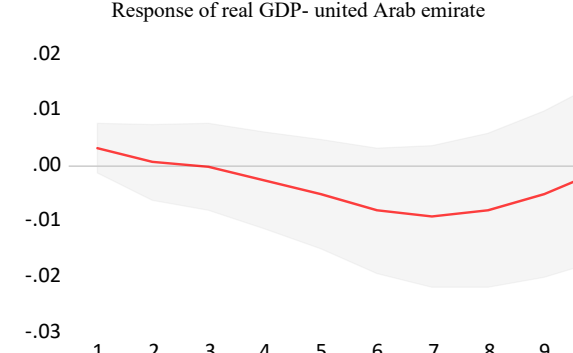
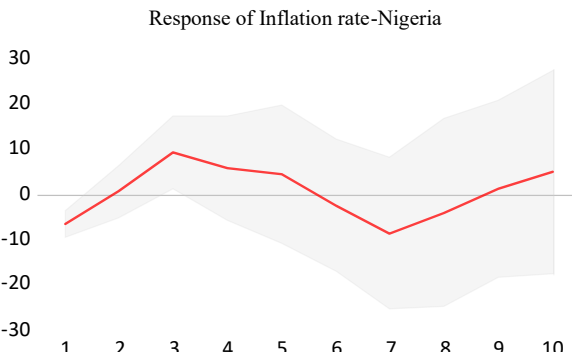
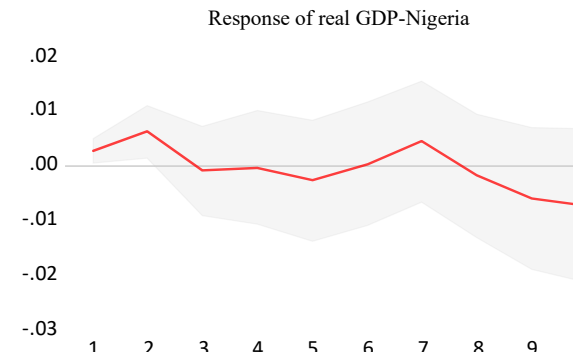
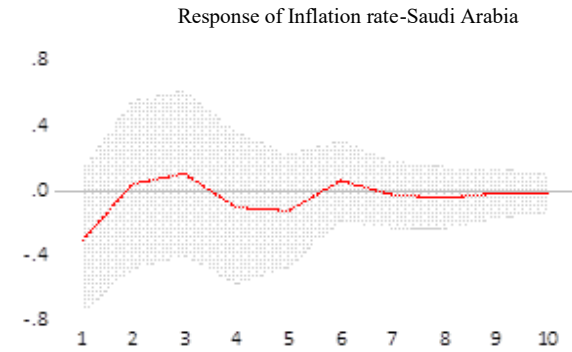
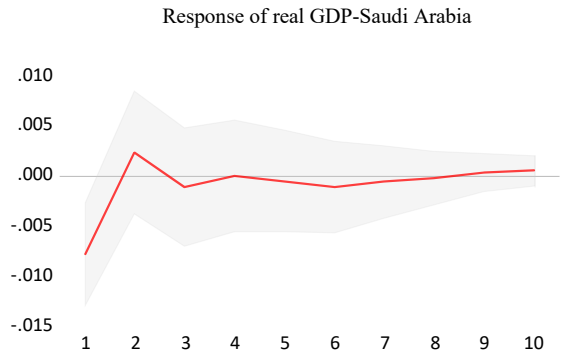
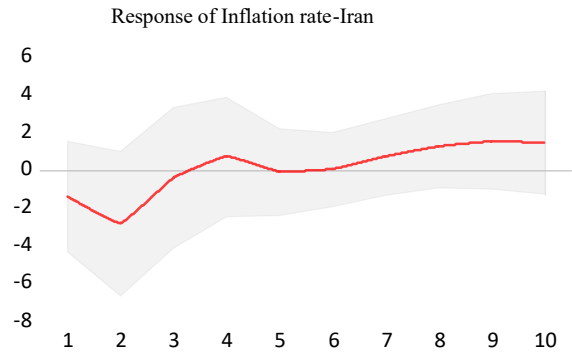
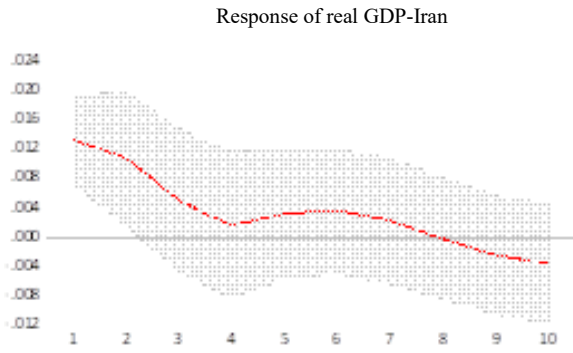
We compute the absolute values of the eigenvalues of the VAR companion matrix for all models of the selected oil-importing and oil-exporting countries. The results show that they are all less than unity; this provides some evidence that the estimated VAR model is stationary for all selected oil-importing and oil-exporting countries.

### **Impulse Responses analysis**

#### **Supply Shocks: Oil Price (Wo)**

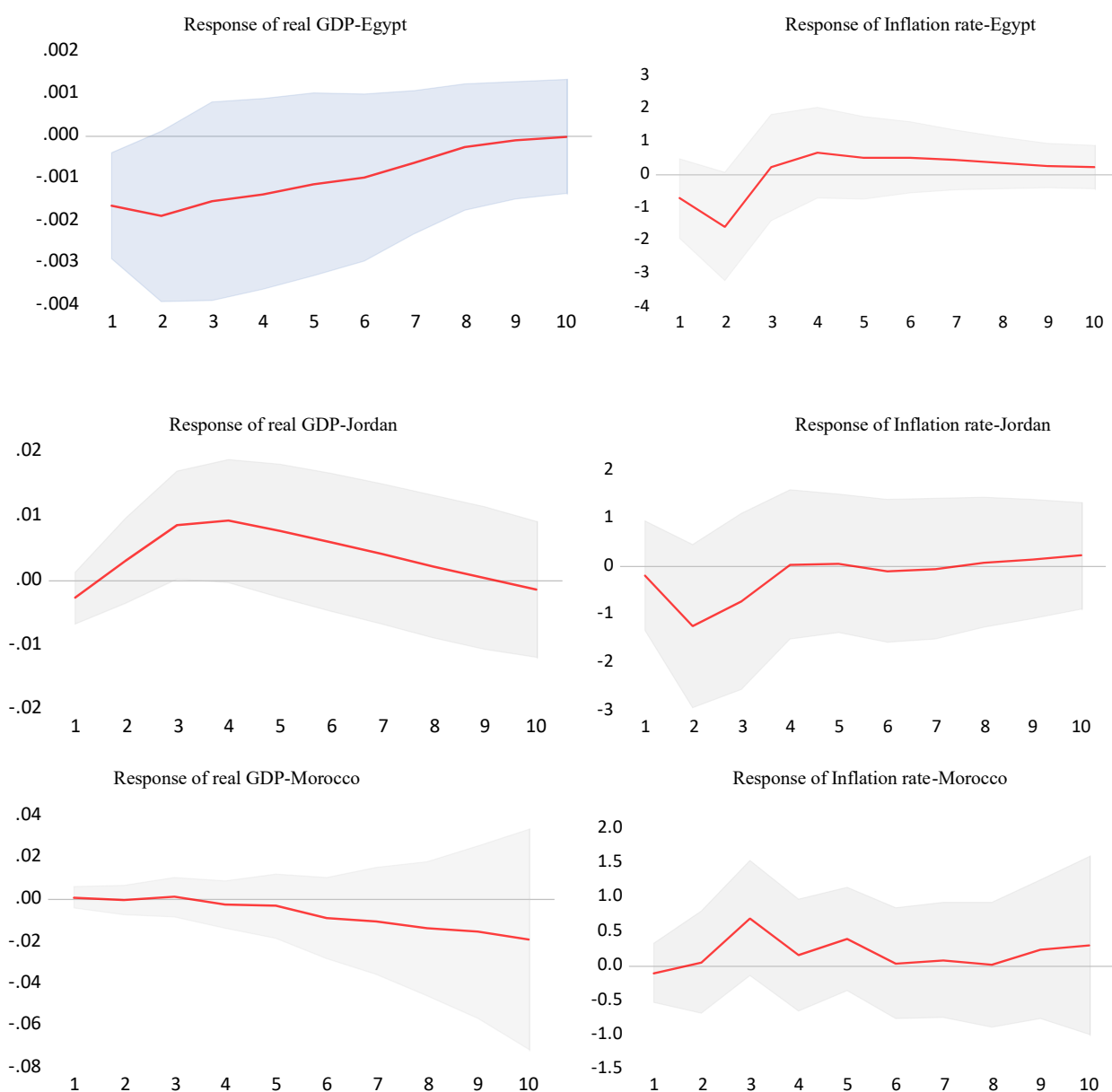
Oil price shocks significantly and positively affect output in the NOE and NOI countries, except in Egypt. This effect is probably due to the structure of these countries' exports and imports. The main export of Iran, Saudi Arabia, the United Arab Emirates, and Nigeria is crude oil. The demand for crude oil is likely to be sensitive to income growth in net-oil-exporting countries. Meanwhile, Jordan and

Morocco are increasingly becoming major oil-importing countries. In contrast, the inflation rate in the NOE and NOI countries, except Morocco, responded positively and significantly to world oil price shocks. Similar results were reported by Mehrara and Oskoui (2007), Samimi and Shahryar (2009), and Berument et al. (2010) for the OPEC countries.



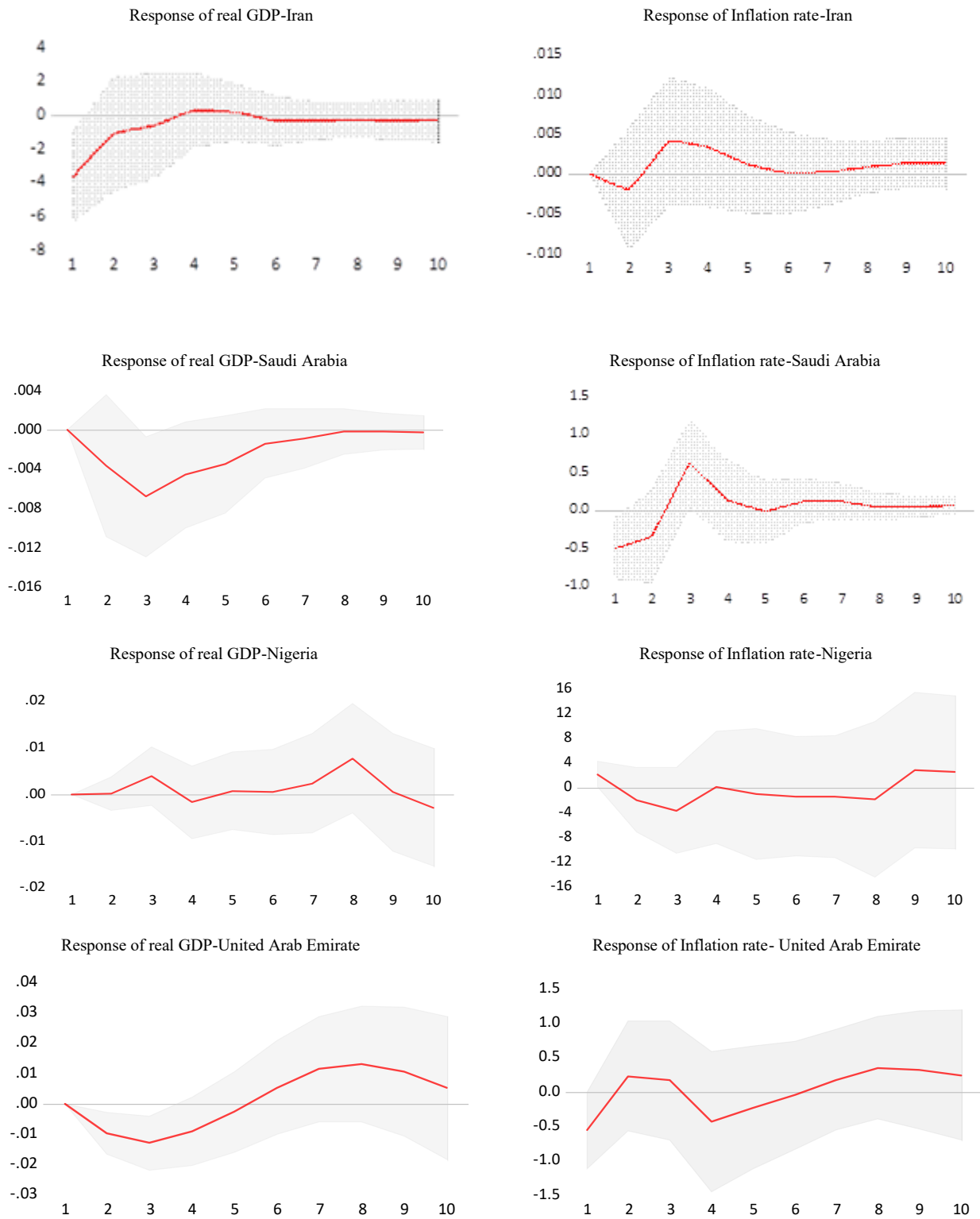
**Figure 1.** Impulse Response to an Oil Price Shock, Impulse Response to an Oil Price Shock- Net-Oil Exporting (NOE) Countries during 1980-2021

**Source:** Research finding.



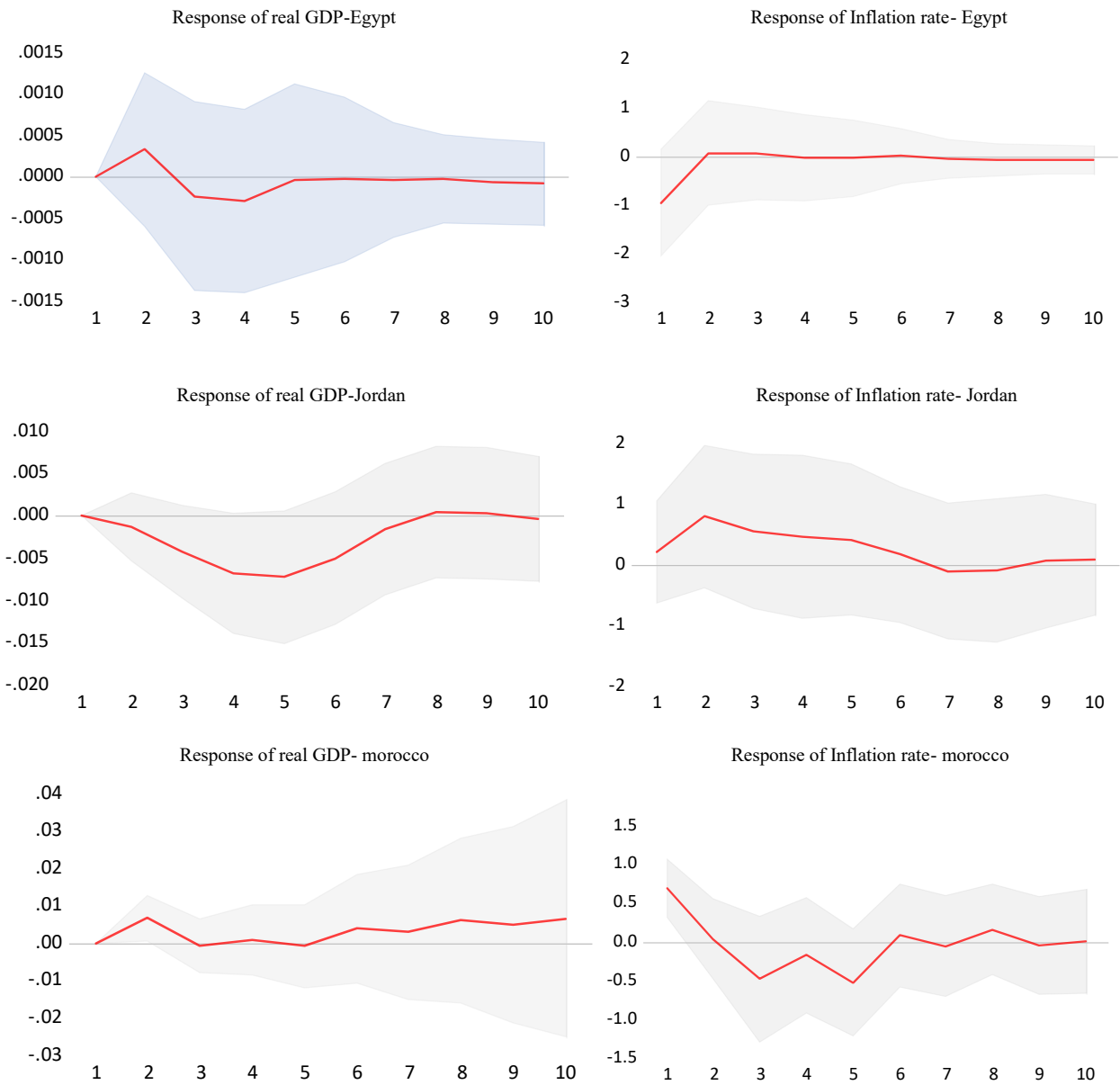
**Figure 2.** Impulse Response to an Oil Price Shock, Impulse Response to an Oil Price Shock- Net-Oil Importing (NOI) Countries during 1980-2021

**Source:** Research finding.



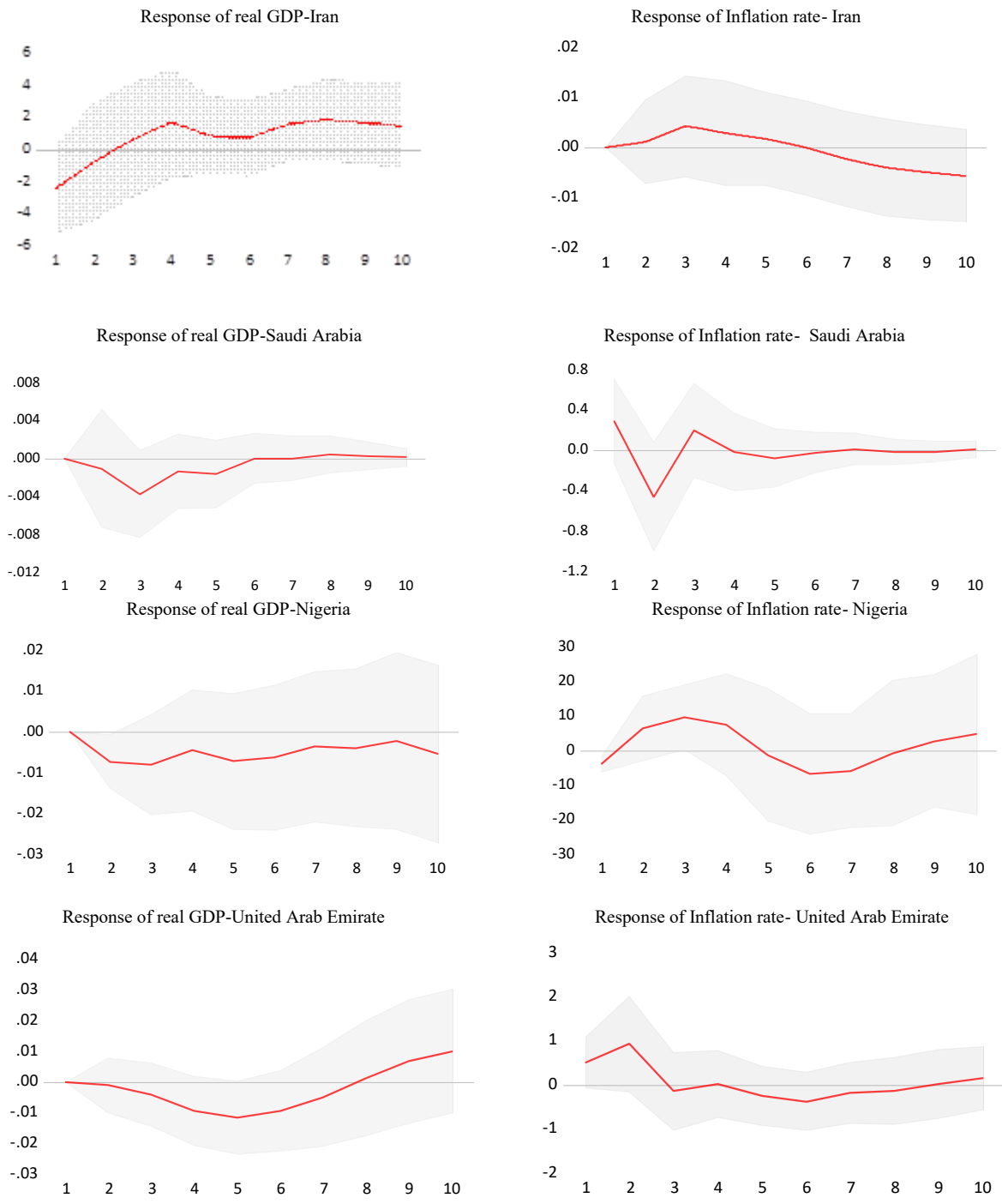
**Figure 3.** Impulse Response to an Interest Rate, Money Supply, Exchange Rate Shocks, Impulse Response to an Interest Rate Shock - Net-Oil Exporting (NOE) Countries during 1980-2021

**Source:** Research finding.

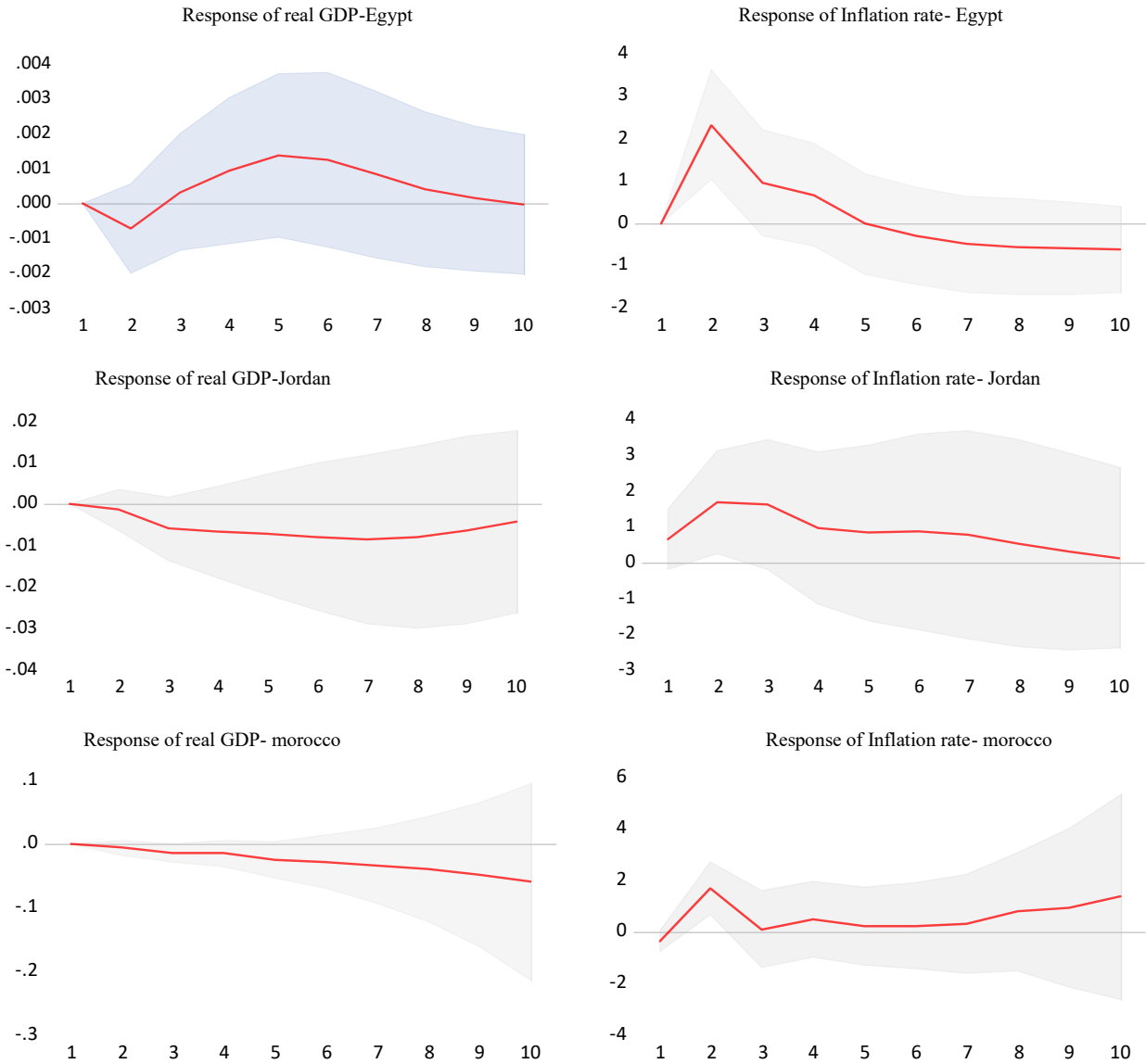


**Figure 4.** Impulse response to an interest rate, money supply, exchange rate shocks, Impulse response to an interest rate shock- Net-Oil Importing (NOI) Countries during 1980-2021

**Source:** Research finding.

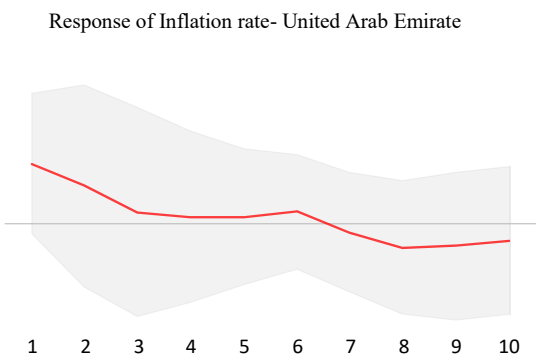
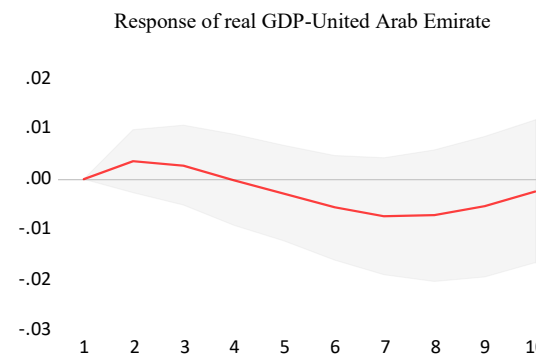
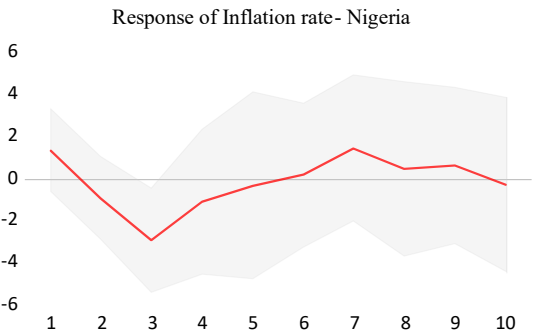
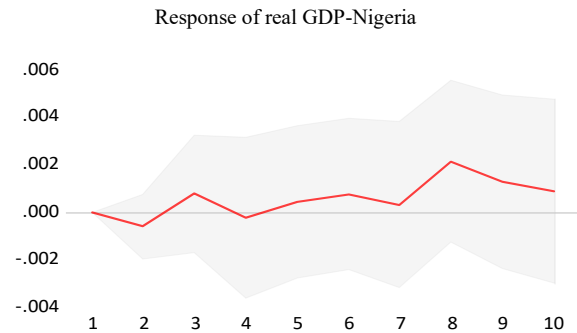
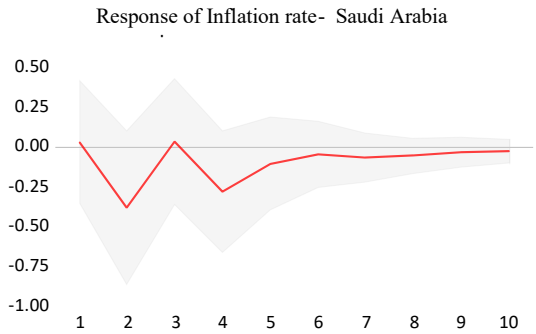
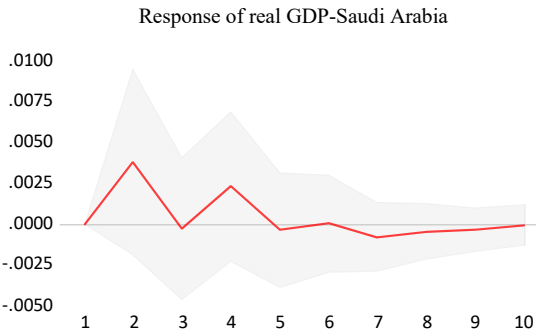
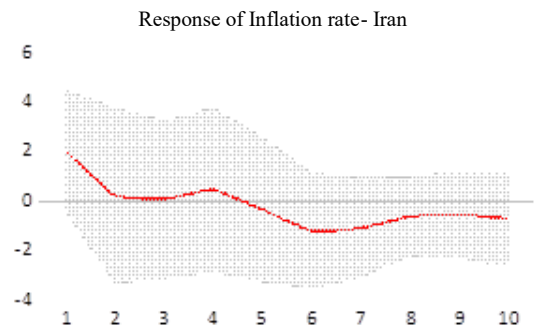
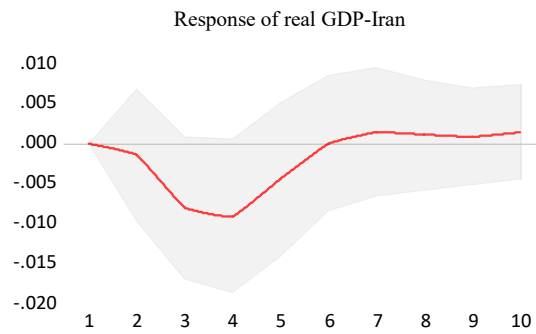


**Figure 5.** Impulse response to an interest rate, money supply, exchange rate shocks, Impulse response to an money supply shock - Net-Oil Exporting (NOE) Countries during 1980-2021  
**Source:** Research finding.



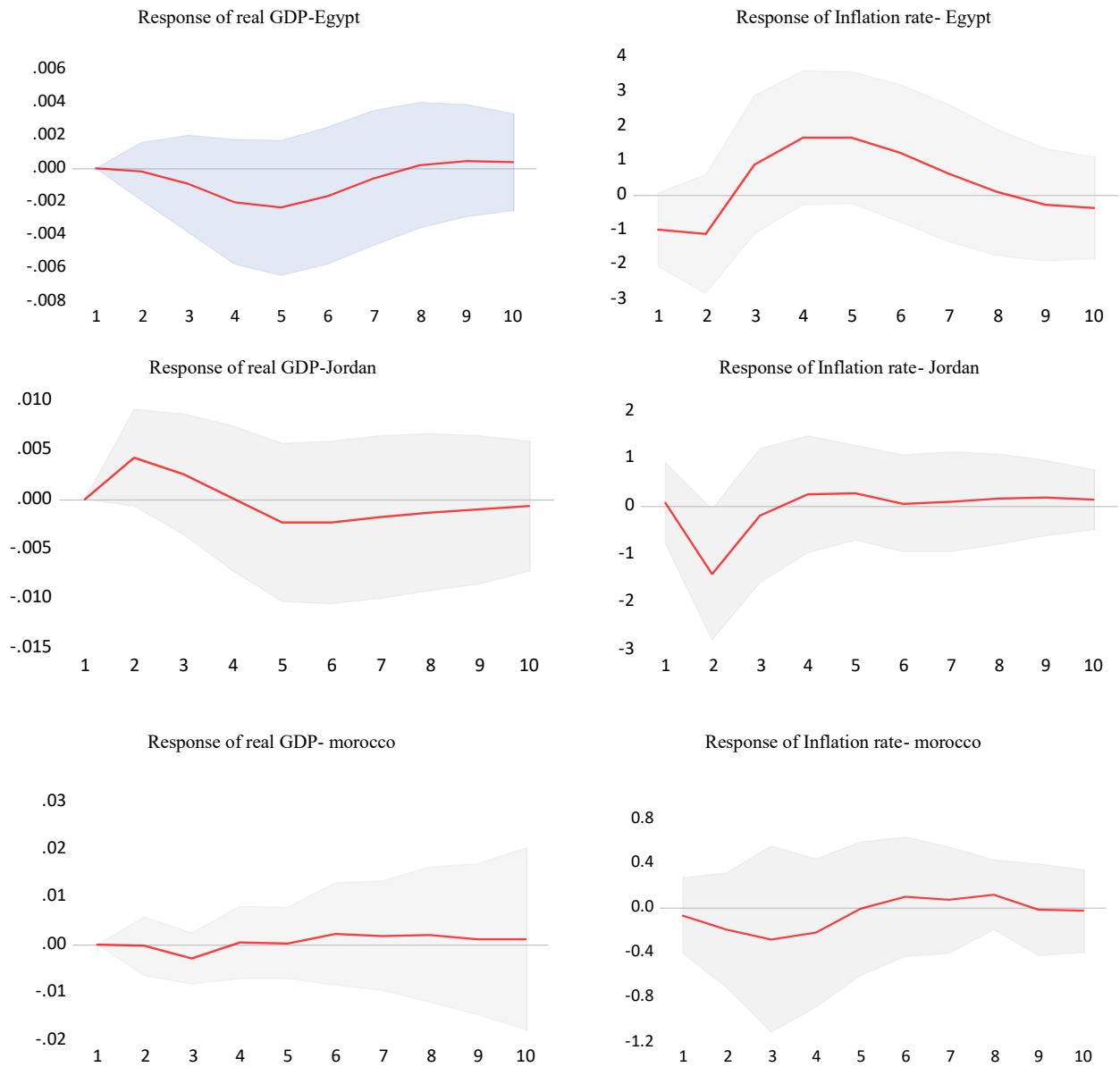
**Figure 6.** Impulse Response to an Interest Rate, Money Supply, Exchange Rate Shocks, Impulse Response to an Money Supply Shock - Net-Oil Importing (NOI) Countries during 1980-2021

**Source:** Research finding.



**Figure 7.** Impulse response to an interest rate, money supply, exchange rate shocks, Impulse response to an exchange rate shock - Net-Oil Exporting (NOE) Countries during 1980-2021

**Source:** Research finding.



**Figure 8.** Impulse response to an interest rate, money supply, exchange rate shocks, Impulse response to an exchange rate shock - Net-Oil Importing (NOI) Countries during 1980-2021

**Source:** Research finding.

**Demand Shocks: interest rate (ir), money supply (m), exchange rate (ex)**

Figure 2 displays the dynamic responses of inflation and economic growth in the three net-oil-importing and four NOE countries to different demand shocks. Economic growth in countries such as Morocco and Iran showed positive responses to domestic money supply shocks. In most countries, except Iran and the United Arab Emirates, the response of inflation to money supply shocks is positive. Demand-side shocks, that is, interest rates, have negative effects on output for up to ten periods in six of the NOE and NOI countries, except Iran. Similar effects were evident in the impact of interest rates on inflation in Jordan, Saudi Arabia, and the United Arab Emirates. The response of the inflation rate and output to exchange rate shocks was negative in some of the NOE and NOI countries. For instance, output decreased by between 1 percent and 2 percent by the second to tenth year in four NOE member countries and Jordan, while domestic inflation responded negatively to exchange rate shocks in the NOE-4 and three NOI countries, except Egypt and Nigeria.

**Variance Decomposition**

Variance decompositions are presented in Table 1. Variance decomposition shows the proportion of a variable's forecast error variance attributable to its own shocks and to shocks in other variables. Table 1 displays the results of the variance decomposition of demand and supply variables for horizons  $k = 1$ ,  $k = 2$  (8 years after the shocks),  $k = 5$  (20 years after the shocks), and  $k = 10$  (40 years after the shocks). Each table corresponds to a different measure of the supply-side and demand-side variables. The final two columns of each table indicate the relative importance of the supply sector vis-à-vis the demand sector in contributing to the forecast error variance of each domestic variable. Supply shock (SS) corresponds to supply-side factors and is the sum of the proportions of the forecast error variance of the given domestic variable explained by one supply-side variable, world oil price (Wo). Demand shock (DS) corresponds to demand-side factors and is the sum of the proportions of the forecast error variance of a given domestic variable explained by three demand-side variables (M, ex, and Pir). As shown in Table 1, the effects of demand-side shocks on output are greater than those of supply-side shocks in the NOE and NOI countries, except Iran, the United Arab Emirates, Nigeria, and Egypt. Demand-side shocks account for more of the variation in inflation in the NOE-4 and three NOI countries. Demand-side shocks are represented by exchange rate, interest rate, and money supply shocks, which are major sources of fluctuations in inflation and economic growth in the NOE-4 and three NOI countries.

**Table 1.** The results of variance decomposition of inflation and real GDP for NOE and NOI countries during 1980-2021

period	(1) Iran :Variance Decomposition of lreal gdp						(2)Saudi Arabia :Variance Decomposition of ly					
	Wo	Pir	M	Ex	SS	DS	Wo	Pir	M	Ex	SS	DS
1	14.337	13.974	11.079	2.450	14.337	5.117	15.338	7.972	15.484	7.061	15.338	9.204
2	15.621	12.432	10.514	5.452	15.621	7.649	15.311	10.201	18.196	9.510	15.311	7.599
3	16.465	13.675	10.427	4.467	16.465	6.235	14.500	8.746	19.108	10.539	14.500	6.565
4	17.844	15.990	7.948	5.675	17.844	6.293	14.762	9.865	20.365	12.140	14.762	6.834
5	18.784	16.059	8.980	4.421	18.784	6.168	13.507	10.753	20.082	11.646	13.507	5.724
6	20.402	18.146	9.127	4.886	20.402	6.681	13.648	10.942	21.384	11.211	13.648	6.045
7	20.837	16.019	8.422	4.450	20.837	6.960	14.718	10.628	20.781	10.829	14.718	6.789
8	20.654	18.979	8.782	5.446	20.654	8.590	14.988	11.677	21.190	12.694	14.988	6.894
9	21.800	17.370	7.929	5.298	21.800	8.841	14.888	13.112	21.054	12.822	14.888	6.577
10	20.587	19.182	8.415	5.935	20.587	8.137	15.906	12.189	21.429	13.026	15.906	6.881
period	Variance Decomposition of Inflation						Variance Decomposition of Inflation					
	Wo	pir	M	Ex	SS	DS	Wo	pir	M	Ex	SS	DS
1	13.567	12.617	7.291	2.371	13.567	3.401	13.236	10.779	17.939	10.322	13.236	7.285
2	13.411	13.454	9.963	3.858	13.411	4.872	12.737	11.181	23.769	13.373	12.737	6.880
3	16.386	14.841	11.028	4.514	16.386	4.109	14.087	13.595	23.148	13.787	14.087	7.015
4	18.545	17.293	10.608	3.930	18.545	6.656	15.753	14.810	22.854	14.226	15.753	7.446
5	19.652	17.989	11.062	3.462	19.652	6.719	15.547	15.187	22.848	13.726	15.547	6.906
6	20.886	17.823	10.473	4.555	20.886	7.156	15.012	15.328	22.777	14.206	15.012	6.364
7	20.962	16.852	11.982	4.387	20.962	5.551	15.148	14.995	22.390	12.969	15.148	6.356
8	21.102	19.322	11.227	4.425	21.102	6.322	14.687	15.009	22.079	11.866	14.687	6.632
9	21.348	19.265	10.333	5.147	21.348	4.613	15.003	15.260	21.874	12.676	15.003	6.458
10	21.731	20.494	10.003	4.950	21.731	6.383	14.706	15.265	21.766	14.135	14.706	6.443
period	(3) Nigeria :Decomposition of Variance for Series lrealgdp						(4) United Arab Emarat :Decomposition of Variance for Series lreal gdp					
	wo	pir	M	Ex	SS	DS	wo	pir	M	Ex	SS	DS
1	18.612	2.392	17.791	0.910	18.612	13.816	12.678	10.227	10.423	2.223	12.678	12.503
2	16.064	3.636	17.915	1.243	16.064	14.058	15.299	13.587	13.404	2.473	15.299	11.298
3	16.421	3.545	17.224	1.669	16.421	13.265	13.693	13.811	14.387	2.508	13.693	9.504
4	15.707	3.218	18.019	1.868	15.707	11.871	14.390	12.894	12.165	3.672	14.390	8.635
5	14.595	3.639	18.607	1.745	14.595	12.048	13.137	13.474	11.757	3.529	13.137	8.830
6	13.825	4.527	18.855	1.841	13.825	11.079	15.154	14.402	12.946	3.663	15.154	10.325
7	14.075	5.118	18.116	2.315	14.075	11.165	14.726	15.736	13.163	3.212	14.726	11.338
8	14.648	5.064	17.636	2.289	14.648	11.128	15.476	14.889	13.046	3.407	15.476	10.700
9	14.957	5.157	17.728	2.173	14.957	11.680	15.265	15.752	12.743	3.687	15.265	10.951
10	15.899	5.310	17.858	2.363	15.899	11.241	16.325	14.293	12.308	3.774	16.325	11.341
period	Decomposition of Variance for Series inflation						Decomposition of Variance for Series inflation					
	wo	pir	M	Ex	SS	DS	wo	pir	M	Ex	SS	DS
1	13.556	6.594	14.569	4.094	13.556	9.454	9.149	7.352	10.895	6.266	9.149	10.352
2	14.456	5.125	12.729	3.121	14.456	8.016	12.295	16.076	12.958	5.204	12.295	8.425
3	14.430	4.704	13.619	2.729	14.430	8.966	14.146	18.479	13.265	3.339	14.146	9.025
4	16.277	5.411	14.190	2.746	16.277	11.302	14.605	15.927	12.162	3.717	14.605	10.366
5	15.862	6.294	13.845	3.030	15.862	11.560	13.953	16.967	13.089	3.768	13.953	10.665
6	16.146	6.353	15.417	3.111	16.146	11.044	14.300	14.867	13.468	4.135	14.300	10.693
7	16.469	6.444	16.317	3.330	16.469	11.857	14.078	15.737	11.564	4.234	14.078	10.788
8	16.736	7.056	17.342	3.485	16.736	11.685	15.515	14.817	12.718	4.212	15.515	10.783
9	17.535	7.372	17.243	3.636	17.535	11.618	15.295	15.355	12.969	4.224	15.295	10.355
10	17.691	7.216	17.573	3.683	17.691	12.381	16.032	14.917	13.778	4.278	16.032	10.981
period	(5) Egypt :Error Variance Decompositions lreal gdp						(6) Jordan: Error Variance Decompositions lreal gdp					
	wo	pir	M	Ex	SS	DS	wo	pir	M	EX	SS	DS
1	15.691	2.557	3.168	0.909	15.691	15.937	16.183	9.979	5.139	2.432	16.183	16.187
2	21.325	4.065	5.258	2.312	21.325	19.878	15.629	10.714	6.098	5.009	15.629	17.364
3	22.600	5.361	6.165	3.450	22.600	20.317	16.525	12.651	6.781	6.051	16.525	16.314
4	22.332	5.573	7.884	2.947	22.332	19.497	15.809	13.133	7.928	5.482	15.809	17.082
5	21.037	5.346	7.737	2.452	21.037	17.891	16.035	15.170	8.172	5.417	16.035	16.506
6	21.439	5.316	8.168	2.464	21.439	18.020	15.619	15.700	9.738	5.618	15.619	16.367

7	21.828	5.586	8.768	2.458	21.828	17.849	16.154	16.067	10.270	5.778	16.154	17.149
8	21.615	6.513	9.428	2.699	21.615	17.618	16.484	15.709	11.251	6.338	16.484	17.204
9	21.842	6.329	9.137	2.886	21.842	18.533	15.982	15.805	11.462	6.237	15.982	16.878
10	22.397	6.317	9.070	2.534	22.397	18.604	17.737	16.208	12.643	6.006	17.737	17.892
Error Variance Decompositions inflation						Error Variance Decompositions inflation						
<b>period</b>	<b>wo</b>	<b>pir</b>	<b>m</b>	<b>ex</b>	<b>SS</b>	<b>DS</b>	<b>wo</b>	<b>pir</b>	<b>m</b>	<b>ex</b>	<b>SS</b>	<b>DS</b>
1	18.608	8.120	10.337	18.608	1.958	9.134	16.623	13.759	5.530	2.929	16.623	13.241
2	17.757	8.146	10.127	17.757	2.904	12.081	14.298	12.734	9.220	4.384	14.298	15.643
3	17.832	9.312	9.940	17.832	3.233	11.322	15.078	13.276	8.306	6.535	15.078	14.397
4	17.073	8.057	10.547	17.073	3.393	9.403	15.045	13.573	9.199	5.930	15.045	16.572
5	17.506	8.056	10.091	17.506	2.925	11.954	16.252	15.364	11.155	7.254	16.252	17.126
6	18.087	7.899	11.180	18.087	2.923	13.283	16.677	16.216	11.668	5.766	16.677	17.615
7	19.771	8.025	10.818	19.771	3.172	14.965	16.736	16.534	12.009	7.030	16.736	17.063
8	20.404	8.764	10.037	20.404	3.187	14.317	17.235	16.866	12.205	6.305	17.235	18.189
9	21.083	9.455	12.283	21.083	3.244	14.365	17.069	16.130	12.471	7.203	17.069	16.348
10	20.318	9.121	12.181	20.318	3.335	13.819	17.706	16.335	12.415	6.813	17.706	17.205
(7) Morocco: Error Variance Decompositions real gdp						Error Variance Decompositions inflation						
<b>period</b>	<b>wo</b>	<b>pir</b>	<b>m</b>	<b>ex</b>	<b>SS</b>	<b>DS</b>	<b>wo</b>	<b>pir</b>	<b>m</b>	<b>ex</b>	<b>SS</b>	<b>DS</b>
1	9.499	4.838	16.819	8.321	9.499	14.028	9.601	12.270	20.687	11.511	9.601	10.560
2	10.436	5.929	17.147	7.737	10.436	14.718	9.249	9.344	21.014	7.703	9.249	13.158
3	11.091	6.154	18.223	8.999	11.091	15.048	9.960	10.655	21.559	8.219	9.960	14.721
4	12.087	7.755	19.738	7.011	12.087	14.044	12.661	10.377	22.455	6.603	12.661	14.954
5	11.026	8.595	20.258	6.544	11.026	14.476	14.034	8.401	22.009	6.259	14.034	16.012
6	12.256	8.552	22.065	5.365	12.256	15.493	13.900	8.387	23.606	5.715	13.900	17.164
7	13.169	9.442	21.520	4.307	13.169	15.606	13.559	9.718	23.233	5.416	13.559	16.361
8	12.932	9.364	22.535	4.704	12.932	14.353	13.194	8.960	24.177	6.132	13.194	17.298
9	12.428	9.202	22.231	3.967	12.428	16.211	12.744	8.673	24.070	6.268	12.744	17.334
10	12.163	7.673	21.519	4.867	12.163	14.451	13.769	8.462	24.358	5.521	13.769	17.638

Source: Research finding.

**Results of Oil Price Volatility**

We can see that the first column presents the main regression results under the fixed-effects model. The regression coefficient of oil price volatility (OVt) on carbon emissions (LNEt) is -0.0487, which is significant at the 1% level. It indicates that one additional unit of oil price uncertainty decreases the industry's carbon emissions by 0.051 units. That is, the more uncertain the oil price is, the less carbon companies will emit.

The second column shows the regression results after adding the squared term of assets. The regression coefficient of oil price volatility on corporate carbon emissions has changed to -0.154, but the significance level has not changed. Statistically speaking, this result shows that Hypothesis 1 is valid. Oil price fluctuations do affect firms' carbon footprints, and increasing oil price uncertainty will inhibit carbon emissions. The result is similar to that of Constantinou et al. (2019), da Rocha Lima Filho et al. (2021), Habib et al. (2021), and Madaleno and Moutinho (2018).

Table 2. Results of Oil Price Volatility

Variables	LNE <sub>t</sub>	LNE <sub>t</sub>
OV <sub>t</sub>	-0.0487*** (-7.98)	-0.0154*** (-8.98)
LNASSET <sub>t</sub>	0.312*** (7.09)	0.2800*** (6.45)
LNASSET <sub>t</sub> * LNASSET <sub>t</sub>	-	-0.0441*** (-3.95)
LEV <sub>t</sub>	0.187*** (2.83)	0.2800***
SA <sub>t</sub>	1.342***(8.98)	2.056*** (9.54)
LNGDP <sub>t</sub>	2.142*** (9.954)	0.763*** (5.05)
LNEPU <sub>t</sub>	-0.121*** (-2.90)	0.1265*** (7.87)
CF <sub>t</sub>	0.0005* (1.80)	0.0016*** (5.12)
PROFIT <sub>t</sub>	-0.0003 (-0.47)	-0.0013 (-1.56)
Constant	8.032*** (9.23)	12.876*** (11.08)
observations	10.870	10.988
R-squared	0.176	0.154
F	141.05	180.43

**Source:** Research finding.

**Note:** industries two digit ISIC Codes include: 1. food products and beverages 2. tobacco products 3. textiles 4. wearing apparel; dressing and dyeing of fur 5. tanning and dressing of leather; luggage; handbags, saddlery, harness and footwear 6. wood and products of wood and cork, except furniture; articles of straw and plaiting materials 7. Paper and paper products 8. publishing, printing and reproduction of recorded media 9. coke, refined petroleum products and nuclear fuel 10. chemicals and chemical products 11. rubber and plastic products 12. other non-metallic mineral products 13. basic metals 14. fabricated metal products, except machinery and equipment 15. machinery and equipment n.e.c. 16. office, accounting and computing machinery 17. electrical machinery and apparatus n.e.c. 18. radio, television and communication equipment and apparatus 19. medical, precision and optical instruments, watches and clocks 20. motor vehicles, trailers and semi-trailers 21. Other transport equipment 22. furniture; n.e.c. 23. Recycling

### Policy Implications

In this comprehensive study, we examine the multifaceted impact of oil price shocks and demand fluctuations on the economies of Net Oil Exporting (NOE) and Net Oil Importing (NOI) countries. Our analysis not only sheds light on the implications of these economic dynamics but also offers valuable policy recommendations to strengthen resilience, environmental sustainability, and economic stability. From diversification strategies to climate policy implications,

this research provides a valuable resource for policymakers and stakeholders navigating the complex terrain of energy market volatility and economic growth.

#### 1- Policy Implications of Oil Price Shocks:

The research reveals that oil price shocks have a significant and positive effect on output in most Net Oil Exporting (NOE) and Net Oil Importing (NOI) countries, with the notable exception of Egypt. This finding underscores the importance of crafting economic policies that account for the structural differences in these economies. Policy recommendations include diversifying economies to reduce vulnerability to oil price fluctuations, strengthening fiscal policies to improve stability, and promoting sustainable energy practices to mitigate environmental impacts. Moreover, Egypt's resilience to oil price shocks can serve as a model for other NOI countries.

#### 2- Impact of Demand Shocks on Economic Growth and Inflation:

The study demonstrates the diverse responses of NOE and NOI countries to demand shocks, including interest rates, money supply, and exchange rates. To maintain economic stability, countries need to tailor their policies to their unique economic structures. Policymakers should consider the trade-offs between stimulating economic growth and controlling inflation when adjusting monetary and fiscal policies. Additionally, focusing on exchange rate management can be vital for controlling inflation.

#### 3- Implications for Climate Policy and Economic Growth:

The analysis highlights the connection between corporate carbon emissions and oil price volatility. Policymakers should use these findings to inform climate policies that address carbon emissions in the context of economic growth. Incentives for industries to reduce their carbon footprint can contribute to a low-carbon transition. Furthermore, the inverse relationship between oil price uncertainty and carbon emissions suggests that global energy markets can play a role in achieving environmental goals while supporting economic growth.

#### 4- Balancing Supply and Demand Shocks:

The variance decomposition results indicate that both supply and demand shocks significantly affect economic growth and inflation. Policymakers need to develop adaptive economic frameworks that account for the relative importance of these shocks. For NOE countries, strategies to cope with supply-side fluctuations, including export diversification and investment in renewable energy, are essential.

On the other hand, NOI countries should focus on managing demand-side fluctuations to control inflation and foster growth.

#### 5- Recommendations for Stability and Confidence:

In light of the study's results, implementing policies to mitigate high oil price volatility is crucial. Policies that promote price stability and confidence in economic decision-making are recommended. This includes measures to build strategic reserves, promote transparency in oil markets, and invest in energy diversification to reduce dependence on oil imports. Furthermore, comprehensive infrastructure reforms targeting both the supply and demand sides can help stabilize the economy and mitigate the impact of oil price shocks.

### **Conclusion and Policy Implications**

This paper uses a structural VAR model with block exogeneity and identifying restrictions to examine two major issues related to economic growth and inflation in net-oil-exporting and net-oil-importing countries. The study is based on small open economies and data availability. The selected NOE countries are Iran, Saudi Arabia, Nigeria, and the United Arab Emirates, which are major oil producers. The net-oil-importing countries are Egypt, Jordan, and Morocco, which are oil importers.

The first issue examines the effects of supply shocks (oil price), demand shocks (money supply, interest rate, and exchange rate), and pollution shocks on inflation and economic growth. The impulse response analysis shows that demand shocks such as interest rates generally have a negative effect on economic growth in Saudi Arabia and the United Arab Emirates. The inflation rate rises in response to a positive shock in interest rates in Egypt, Nigeria, Saudi Arabia, and the United Arab Emirates. Economic growth increased in the NOE-4 and NOI countries, except in Saudi Arabia, Nigeria, and Jordan. The inflation rate increased in response to a positive shock in the money supply in the NOE-4 and NOI-3 countries. Moreover, in all the NOE and NOI countries except Morocco and Jordan, the inflation rate responded positively and significantly to world oil price shocks. Output responded negatively to positive shocks in the exchange rate and pollution shocks in the NOE-4 and NOI-3 countries. In contrast, domestic inflation responded negatively to exchange rate shocks in the OPEC and oil-importing countries, except in Egypt and Nigeria. Fourth, there is no evidence of the output puzzle or the price puzzle after 14 years. Specifically, the variance decomposition results show that demand shocks are the main source of variation

in economic growth for all of the selected net-oil-importing countries. Also, demand shocks are the main source of variation in economic growth for net-oil-exporting countries except Iran, which means that supply shocks are the main source of fluctuations in economic growth for Iran. Moreover, demand shocks contributed more to variations in the inflation rate in NOE and net-oil-importing countries, but supply shocks are the main source of variation in the inflation rate in Iran, Nigeria, and the United Arab Emirates. Supply and demand factors are dominant in both the short and the long run.

The paper investigates the dynamic relationship between corporate carbon emissions, fluctuations in international crude oil prices, and corporate asset size to accurately capture the relationship among these factors. We found that crude oil price uncertainty could significantly reduce companies' carbon emissions. A similar inverted U-shaped EKC is observed between company size and carbon emissions. Our analysis of the relationship between international crude oil price fluctuations and corporate carbon emissions provides policymakers with a new perspective for coordinating oil prices and low-carbon development and helps improve relevant policies. The results are consistent with those of Gam (2021), Mzoughi et al. (2020), and Albulescu (2020).

Based on the results of the study, the researcher offers several suggestions. According to the results, aggregate demand can be affected. These changes affect the general price level, which shows that implementing anti-inflationary policies and infrastructure reforms on both the supply and demand sides is necessary. High fluctuations on the supply side cause instability in economic decision-making, so policies that can reduce oil price volatility may help create stability and confidence and lower costs. This can help promote sustained economic welfare.

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