Quarterly Journal of Quantitative Economics(JQE) **(2024) 21(1) 63-85**

Shahid Chamran University of Ahvaz

Quarterly Journal of Quantitative Economics

Journal Homepage: www.jqe.scu.ac.ir
Print ISSN: 2008-5850
Online ISSN: 2717-4271

The Effect of Economic Policy Uncertainty on Oil Prices (Case Study: OPEC Countries)

Parvaneh Pordel*, Marziyeh Esfandiari **

**Ph.D Candidate, Department of Economics, University of Sistan and Baluchestan, Zahedan, Iran.*
***Associate Professor, Department of Economics, University of Sistan and Baluchestan, Zahedan, Iran (Corresponding Author).*

ARTICLE HISTORY

Received:28 November 2021
Revision: 21 May 2022
Acceptance: 13 June 2022

JEL CLASSIFICATION:
E30, E60, C14, F02

KEYWORDS:
Oil prices, Economic Policy Uncertainty, nonparametric panel data

CORRESPONDING AUTHORS:
Email: m.esfandiari@eco.usb.ac.ir
[0000-0003-3704-6240](https://orcid.org/0000-0003-3704-6240)

Postal address:
University of Sistan and Baluchestan, Daneshgah Blvd, Zahedan, Postal Code:98167-45845, Iran

FURTHER INFORMATION:
The present article is taken from the M.A. thesis of Parvaneh Pordel with Supervisor of Marziyeh Esfandiari at the University of Sistan and Baluchestan.

ACKNOWLEDGEMENTS: All the individuals and institutions that assisted the author in conducting this research are appreciated.
CONFLICT OF INTEREST: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
FUNDING: The authors have not received any financial support for the research, authorship, and publication of this article.

ABSTRACT

In this paper, we investigate the relationship between the economic policy uncertainty (EPU) and oil prices in OPEC countries utilizing a nonparametric panel data model to allow the data to outfitter the shape of functional form. The change in oil price reflects the changes in fundamental and non-fundamental factors. Using yearly data from OPEC countries from 2003 to 2017, we find that EPU has a positive and significant effect on price. The research findings show renewable energies, oil price expectations, and EPU are the most influential factors, respectively. So policymakers should devote more attention to fundamental aspects. The planning and establishment of the necessary infrastructure for the extensive use of renewable energies will lead to a significant reduction in oil prices. Although the research findings indicate that renewable energy and oil are substitutes, oil and gas will continue to grow in the decades ahead. Also, the rise in the EPU will lead to an increase in oil prices. In this regard, policy authorities try to mitigate the adverse effects of oil price increases, which in turn reduces the success of those policies and causes an increment in economic policy uncertainty.

How to Cite:

Pordel, Parvaneh & Esfandiari, Marziyeh. (2024). The Effect of Economic Policy Uncertainty on Oil Prices (Case Study: OPEC Countries). *Quarterly Journal of Quantitative Economics(JQE)*, 21(1), 63-85.

doi 10.22055/jqe.2022.39326.2441

1- Introduction

Oil, the primary source of energy and the motor to grow economically, is an essential factor behind the process of production. The consumption of oil has increased significantly with the modernization of the economy (Basher & Sadorssky, 2006). In the field of oil and gas, current policies of the country include increasing the capacity of protected oil production in proportion to the existing reserves with more economic, security, and political power, exploiting the regional and geographical situation of the country for buying and selling, processing, refining, exchanging and transferring oil and gas to domestic and global markets, and replacing the export of oil and gas and petrochemical products with exporting crude oil and natural gas. Despite that, the components affecting the production volume and price of oil are not decided by economic policymakers, which affects the economy of Iran and oil-exporting countries. Rising oil prices increase production costs, import, oil products, and inflation, which are obstacles to GDP increases for countries that import oil (Cavalcanti & Jalles, 2013) and can reduce consumption, investment, and, consequently, the economic growth as well (Loungani, 1986). Earlier research indicates that the pricing of each commodity is determined by the market mechanism and the interaction of supply and demand of that commodity is affected by various components. Demand depends on consumer income, the price of related commodities, and price expectations in addition to the price of the commodity. Also, the amount of supply depends on commodity prices, production costs, and price expectations. Therefore, the price is affected by the factors affecting supply and demand. In general, the factors can be divided into two main groups: fundamental factors and non-fundamental factors. Oil is regarded as an asset and a commodity, so changes in fundamental and non-fundamental factors alter oil prices. Fundamental factors comprise supply and demand, while non-fundamental factors cover risks and uncertainties, psychological, political, and geopolitical factors, and stock exchange and speculation activities in oil financial markets, which cause fluctuations in oil prices. Uncertainty in an economic system can be characterized by high fluctuation among the economic variables. The interaction between oil performance and macroeconomics has been noticed by many researchers.

Comprehension of the effects brought about by oil shocks is essential to formulate a proper response to policies. These results probably are dependent on the source of the change in oil prices and vary among states. Recent studies suggested that the influences of oil shocks on the US and EU countries change impressively depending on the source and cause of oil price fluctuations (Kilian, 2009; Peersman & Van Robays, 2009b). For example, it is expected that exogenous disruptions in the supply of crude oil leading to raised oil prices will lead to lower economic activity and higher inflation in oil-importing countries. On the other hand, the rise of oil prices can be a consequence of the growing oil demand that reflects worldwide economic expansion or precautionary motives that will have potentially varied influences on output. The identification constraints can be obtained from a simple model of supply and demand in the oil market. First, a shock in the oil supply negatively correlates with oil prices and its production. For example, such shocks can result from production disruptions because of changes in production quotas set by the Organization of Petroleum Exporting Countries (OPEC) or military conflicts. After an adverse oil supply shock, world economic activity will either slow down or remain unchanged. Second, the occurrence of demand shocks will lead to a change in oil production, and oil prices will move in the same direction, as demand-driven price rises typically follow more outstanding production of oil in oil-exporting countries. Here we define such a shock as the oil demand shock, which is rooted in higher economic activity. As a result, this shock is characterized by a positive movement between world economic activity, oil prices, and oil production. Fears about the future of crude oil supply or rising oil prices based on hypothetical motivations are clear examples of it. Unlike the demand shock caused by economic activity, shocks because of oil-specific demand because of uncertainty can not have a positive outcome on economic activity globally. Therefore, the final impact on global activity can be harmful even due to rising oil prices (Baumeister, Peersman & Van Robays, 2010).

In recent years, the rapidly growing literature on nonparametric econometric methods has been a solution to the problems of parametric specification error in econometric regression models. Nonparametric regression methods do not require the researcher to assume and determine a functional form for the relationship between explanatory variables and dependent variables. Thus, the functional form is specified by the data instead of the researcher making arbitrary decisions. Therefore, in the present study, considering the role and importance of OPEC in the oil supply, demand, and oil prices and its effect on the growth and wealth in the world, factors affecting the determination of OPEC oil prices with an emphasis on EPU as a representative of non-fundamental factors affecting oil prices are investigated for a selection of OPEC member countries during 2003-2017 using non-parametric regression.

2- Review Literature

Concerns about political uncertainty have been exacerbated by the global financial crisis, the eurozone chain crisis, and partisan political divisions in the United States. For instance, the Federal Open Market Committee (2009) and the International Monetary Fund (2012, 2013) advise that uncertainty about fiscal policies, regulations, and monetary policy have contributed to a sharp economic downturn in 2008-09 and the slow improvement of the future. To examine the role of policy uncertainty (Baker, Bloom & Davis, 2016), they first developed an EPU index (EPU) for the United States and examined its evolution. This index is based on the media and shows that such uncertainty has a negative, lasting effect on economic activity. Several studies have examined the impact of EPU on employment and industrial production, unemployment rate (Caggiano, Castelnuovo & Figueres, 2014 and 2017) stock market fluctuations, and returns (Kang & Ratti, 2013a; 2013b; You, Guo, Zhu & Tang, 2017). Another branch of studies in this field examined the relationship between EPU and asset prices

(Brogaard & Detzel, 2015) and the growth of bank lending (Bordo, Duca & Koch, 2016). Evidence shows that EPU has a negative relationship with business cycles and exacerbates the effects of the recession by postponing firms' decisions to invest and hire (Bloom, 2014). The impact that oil prices have on EPU is considered and evaluated in various studies. Hamilton (1983) proved that oil price shocks affect stock returns, inflation, and GDP. Recent studies have concentrated on the channel of the business cycle through negative oil shocks and their impact on macroeconomics. Hamilton (2003) shows that oil prices fall in the event of a recession in the United States. Barrero, Bloom & Wright (2017) based on the study showed that oil price fluctuations have a short-term effect on uncertainty. Also, Baker et al. (2016) show that EPU affects oil prices. So that the uncertainty of economic policies can be affected through the media, showing that according to this index, the international financial crisis has intensified EPU. Bloom (2014: 28 (2)) relies on the effectiveness of economic policy with business cycles. The results of the research show that uncertainty with delay in investment decisions has a negative impact on the employment of firms and exacerbates the recession. It shows that this uncertainty has the effect of recession through delay in investment decisions and employment of enterprises and increases it by weakening economic policies. Antonakakis, Chatziantoniou & Filis (2014) examined the dynamic relationship between changes in oil prices and the EPU index; they showed that EPU (oil price shocks) negatively responds to increased demand for oil prices (fixed economic policy shocks). Rehman (2018) examines whether oil shocks predict EPU, and concludes that the economic uncertainties of India, Spain, and Japan respond to global oil price shocks. Seifollahi(2018) investigates the effect of oil price uncertainty on economic growth using the (GMM) method between 1961-2015 in oil exporting and oil importers countries. The esults show that oil prices uncertainty have a negative effect on economic growth both in the group of oil exporting countries and in the group of oil importing countries. However, demand shocks cannot trigger any change. Hailemariam, Smyth &

Zhang (2019) examined the relationship between oil prices and the EPU. Their results show that the oil price coefficient becomes negative when the demand for oil prices increases on a global scale. Also, specific non-parametric estimates in each country show that these functions and routine factors are increasing over time. Zhang & Yan (2020) investigated the possible effect of EPU (EPU) on crude oil prices. Their experimental results suggest that, first, almost all the US EPU indices and WTI returns over the sample period, are adverse. Second, in the frequency range of 1-6 months and 6-12 months, almost all the EPU indices can have significant effects on WTI returns, while in the frequency range of 12-24 months, only the uncertainties about monetary policy, National Security, and Regulation Policy may significantly affect WTI performance. The effect of the US EPUs on WTI performance seems more remarkable, particularly in the face of the global financial crisis. Darmawen et al. (2021) studied the effect of changes in world oil prices on inflation in Indonesia and they adopted a nonparametric regression approach to find that the world oil price changes affected Indonesia’s inflation less seriously. Wen et al.(2022) examined the impact of economic policy uncertainty on economic growth in Pakistan. the results of the nonlinear model show that the positive effects of economic uncertainty have a negative effect on short-term economic growth and the positive effect of economic uncertainty is more than the negative effect of economic policy uncertainty. Ansari and Rezazadeh (2023) provide important evidence on the short-run relationship between various uncertainty shocks and the Iranian macroeconomy. In the long run, the results show that economic news from the US government is the least important parameter for domestic production and Iran's macroeconomic uncertainty is the most important; Exchange rate and oil market shocks. Shocks in international financial markets have an asymmetric effect on the money supply, and a decrease in energy market uncertainty can lead to an increase in the money supply.

Given that the volume of oil reserves in OPEC member countries is almost four times that of non-oil exporting countries, OPEC decisions and policies in response to oil market realities affect oil prices. These decisions are influenced by important factors of oil demand and supply and global uncertainties. In this regard, the present study tries to examine the effect of global EPU on OPEC oil prices. This study differs from others in two ways. EPU in this study is media-based according to the method propped by Baker et al. (2016). Besides, the economic theory provided little information about the functional form of the relationship between dependent and independent variables.

3- Model and Data

The real oil price is the dependent variable, and independent variables include EPU, industry value-added index, real interest rate, oil rents, renewable energy, and oil price expectations.

Table1.Variables
Source: Resarch Result

Real price of OPEC oil (OPEC oil basket)	https://www.opec.org/opec_web/en/
Policy Uncertainty Index (Global)	https://www.policyuncertainty.com/
Oil rents	https://data.worldbank.org/
Industry value added	https://data.worldbank.org/
Real interest rate	https://data.worldbank.org/
Renewable energy	https://www.oecd.org/
Oil price expectations	https://www.eia.gov/outlooks/steo/report/prices.php

In this study, the nonparametric method is used to investigate the effect of uncertainty on the real price of OPEC oil. According to the literature, parametric models having restrictive assumptions on the functional form have been used to examine the relationship between oil prices and EPU. The downside with parametric models is because of the biased and inconsistent estimates, as a result of misspecification if there was not any prior knowledge about the functional form (Hailemariam et al, 2019).

According to the modeling strategy of Li, Chen & Gao (2011) and Silvapulle, Smyth, Zhang & Fenech (2017), the proposed econometric model linking the EPU index to the real oil price is as follows:

(1) $$Y_{it} = f_t + \beta_{t,1}UN_t + \beta_{t,2}RE_{it} + \beta_{t,3}IND_{it} + \beta_{t,4}RR_t + \beta_{t,5}OR_{it} + \beta_{t,6}OPE_t + \alpha_i + e_{it}$$

the following relation is established:
Xit = (, RE_{it} , , RR_t , , OPE_t)
This model is written as a matrix as follows

(2) $$Y_{it} = f_t + X_{it}^t\beta_t + \alpha_t + e_{it},\quad i = 1,\ldots,N, t = 1,\ldots,T$$

That Y_{it} is the real oil prices, f_t is trend functions of unknown country-specific, UN_t is the EPU index, OPE_t is oil price fluctuations, IND_{it} is industrial production index, RR_t is real interest rates, RE_{it} is renewable energy, and OR_{it} is oil rent.

α_1 shows unseen individual effects, e_{it} is an error term that is fixed and independent of regressions. $\beta_{t,j} = \beta_j(t/T)$ and $f_t = f_i(t/T)$ are variable vectors with time and trend functions; $f(0)$ and $\beta_j(0)$ are unknown smooth functions. To identify, we assume that $\sum_{i=1}^{N}\alpha_i = 0$.

To estimate the trend functions, f_t and time-varying coefficients, $\beta_{t,j}$ which measures the impacts of oil price fluctuations on the actual oil price in Equation(3), we use the LLDVE approach which was proposed by Li et al. (2011). To accurately explain the LLDVE estimator, the following symbols are introduced.

$$
\begin{aligned}
& Y = (Y_{11},...,Y_{1T}, Y_{21},...,Y_{2T},...,Y_{N1},...,Y_{Nt})^{\mathrm{T}}, \\
& \vec{B}(X, \beta) = (X_{11}^{\mathrm{T}}\beta_1,...,X_{1\mathrm{T}}^{\mathrm{T}}\beta_{\mathrm{T}},...,X_{N1}^{\mathrm{T}}\beta_1,...,X_{NT}^{\mathrm{T}}\beta_T)^{\mathrm{T}}, \\
& \vec{e} = (e_{11},...,e_{1T}, e_{21},...,e_{2T},...,e_{N1},...,e_{Nt})^{\mathrm{T}}, \\
& \vec{f} = \bar{I}_N \otimes (f_1,...,f_T)^T = \bar{I} \otimes f, \\
& \alpha = (\alpha_2,...,\alpha_N)^T, \\
& D = (-I_{N-1}, I_{N-1})^T \otimes \bar{I}_T,
\end{aligned}
\tag{3}
$$

Where $\bar{I}_K$ is a vector $K \times 1$ and $\otimes$ is the Kronecker product.

For estimating the coefficients and functions of the variable using the LLDVE approach, here the variable vector can be defined with added time as $\beta_*(\tau) = [f(\tau), \beta_1(\tau),..., \beta_d(\tau)]^t$ and assume that β_* has first- and second-order derivatives. After Taylor's expansion, the following relationship is established:

$$
\beta_*(t/T) \approx \beta_*(\tau) + \beta_*'(\tau)(t/T - \tau) \tag{4}
$$

Where $\beta_*'(\tau)$ is the first derivative of $\beta_*(\tau)$ and the following relation is obtained:

$$
\vec{f} + \vec{B}(x, \beta) \approx \vec{M}(\tau)\left[\beta_*^{\mathrm{T}}(\tau)(\beta_*'(\tau))^{\mathrm{T}}\right]^{\mathrm{T}}
$$

Hence the following relationship is established:

(5)

$$\tilde{M}^{T}(\tau)=\left[M_{1}^{\mathrm{T}}(\tau),M_{2}^{\mathrm{T}}(\tau),\ldots,M_{N}^{\mathrm{T}}(\tau)\right]^{\mathrm{T}}$$

$$M_{i}(\tau)=\begin{pmatrix} 1 & X_{i1}^{\mathrm{T}} & \dfrac{1-\tau\mathrm{T}}{\mathrm{T}h} & \dfrac{1-\tau\mathrm{T}}{\mathrm{T}h}X_{i1}^{\mathrm{T}} \\ . & . & . & . \\ . & . & . & . \\ 1 & X_{iT}^{T} & \dfrac{T-\tau T}{\mathrm{T}h} & \dfrac{T-\tau T}{\mathrm{T}h}X_{iT}^{\mathrm{T}} \end{pmatrix},$$

$i=1,2,\ldots,N$

The parameters are estimated by minimizing the weighted squares in equation (6) concerning α and $\left[\beta_{*}(\tau),h\beta_{*}^{'}(\tau)\right]^{T}$. Therefore, the following relation is established:

(6) $$\min[\tilde{Y}-\tilde{M}(\tau)\left[\beta_{*}(\tau),h\beta_{*}^{'}(\tau)\right]^{T}-D\alpha]^{T}\tilde{W}(\tau)[\tilde{Y}-\tilde{M}(\tau)\left[\beta_{*}(\tau),h\beta_{*}^{'}(\tau)\right]^{T}-D\alpha]$$

Where $\tilde{W}(\tau)=I_{N}\otimes W(\tau)$ the core weight matrix is as follows:

(7)

$$W(\tau)=diag\left\{\frac{1}{h}k\left(\frac{1-\tau T}{Th}\right),\ldots,\frac{1}{h}k\left(\frac{1-\tau T}{Th}\right)\right\}$$

K(0) is the function of the kernel and h is the bandwidth.

Given the first-order condition (6) concerning α, we obtain the following relation:

(8) $$\hat{\alpha}_{\tau}=d\left[\tilde{D}^{\mathrm{T}}\tilde{W}(\tau)\tilde{D}\right]^{-1}\tilde{D}^{T}\tilde{W}(\tau)\left[\tilde{Y}-\tilde{M}(\tau)\left[\beta_{*}^{\mathrm{T}}(\tau),h(\beta_{*}^{'}(\tau))^{\mathrm{T}}\right]^{\mathrm{T}}\right]$$

By substituting α with $\hat{\alpha}$ in Equation (6) and minimizing concerns to $\left[\beta_*^T(\tau), h\left[\beta_*'(\tau) \right]^T \right]^T$ and estimating the LLDVE, $\tilde{\beta}_*(\tau)$, $\beta_*(\tau)$ is as follows:

(9) $$\hat{\beta}_*(\tau) = (I_{d+1}, 0_{d+1})(\tilde{M}^{\mathrm{T}}(\tau)\tilde{W}^*(\tau))\tilde{M}(\tau))\tilde{M}^{\mathrm{T}}(\tau)\tilde{W}^*(\tau)\tilde{Y})$$

Where $I_{d\times1}$ is the identity matrix of $(d+1)\times(d+1)$, $0_{d\times1}$ is matrix 0 of the relation $(d+1)\times(d+1)$, $\hat{\beta}_*(\tau) = \left[\hat{f}(\tau), \hat{\beta}_1(\tau), \ldots, \hat{\beta}_d(\tau)\right]^{\mathrm{T}}$, $\tilde{W}^*(\tau) = \tilde{K}^{\mathrm{T}}(\tau)\tilde{W}(\tau)\tilde{K}(\tau)$ and $\tilde{K}(\tau) = I_{NT} - D(D^{\mathrm{T}}\tilde{W}(\tau)D)^{-1}D\tilde{W}(\tau)$.

Note that for each τ, $\tilde{K}(\tau)D\alpha = 0$.

In this study, the specific trend functions can be estimated from the residuals.

(10) $$\hat{e}_{it} = Y_{it} - \hat{f}(t/T) - X_{it}^{\mathrm{T}}\hat{\beta}_t - \hat{\alpha}_i$$

In particular, for the cross-section i^{th}, the trend function, $\hat{m}_i(t/T)$ can be calculated by using a local linear regression of $\hat{e}_{it}$ at $\tau = t/T$.

(11) $$\hat{e}_{it} = m(t/T) + \varepsilon_{it}$$

Where ε_{it} in $t = 1, 2, \ldots, T$ are independent errors with zero mean.

Following the findings of Sun, Carroll & Li (2009) and Silvapulle et al. (2017), we use cross-validation to select bandwidth. This method automatically selects the optimal bandwidth. We use the bootstrap approach to create non-parametric confidence bands for time-varying trends and coefficient functions according to the findings of Mammen (1993) and Silvapulle et al. (2017). The first step is obtaining the remainder of the detrending of (5), $\varepsilon_{it} = \widehat{e}_{it} - \widehat{m}_i(\tau;b)$ where for $i = 1,2,\ldots,N$, the relation $i = 1,2,\ldots,N$ is established. In the next step, we re-sample the remaining detrending $\widehat{\varepsilon}_t^* = \widehat{\varepsilon}_k$ where k is randomly selected from $\{1,\ldots,T\}$ by replacing and creating a bootstrap sample of Y_{it} through the following equation:

$$Y_{it}^* = \widehat{f}(1/T) + X_{it}^T \widehat{\beta}_t + \widehat{\alpha}_i + \widehat{m}_i(\tau;b) + \widehat{\varepsilon}_t^*$$

Using the bootstrap sample $\{Y_{it}^*, X_{it}\}$, we estimate the usual time-varying trend functions $\widehat{f}(t/T)$, coefficient functions $\widehat{\beta}_t^*$, and proprietary trend functions using the LLDVE method. The last step is repeating the above method 1000 times and obtaining a 90% confidence band to estimate the usual trends and coefficient functions.

4- Research findings

This section provides the results of nonparametric tests including the Kolmogorov-Smirnov and Kruscal-Wallis tests and The Kernel regression[1](Local linear estimator) results.

The Kolmogorov-Smirnov test compares a known hypothetical probability distribution (e.g. the normal distribution) with the distribution generated by the data. As can be seen in Table 1, the P-VALUE is less than 5% and it can be concluded that the data used in the present study do not have a normal distribution. So, the estimation with parametric models can be biased and inconsistent, as a result of misspecifications if there were not any prior knowledge of the functional form**.**

---

[1] Epanechnikov type of kernel functions is used in this study

Table2. Kolmogorov-smirnov test
Source: Resarch Result

One-Sample Kolmogorov-Smirnov Test										
			id	op	un	Ope	ind	or	rr	re
N			354	354	354	354	354	354	354	354
Normal Parameters[a,b]	3.50		72.78	116.52	24.51	3.86	22.50	9223.37	27.76	27.76
	1.71		30.01	45.12	8.57	9.79	15.18	9223.37	30.60	30.60
Most Extreme Differences	0.14		0.14	0.15	0.11	0.18	0.07	0.41	0.30	0.30
	0.14		0.10	0.15	0.11	0.18	0.07	0.41	0.30	0.30
	-0.14		-0.14	-0.10	-0.11	-0.16	-0.07	-0.26	-0.18	-0.18
Test Statistic			0.14	0.14	0.15	0.11	0.18	0.07	0.41	0.30
Asymp. Sig. (2-tailed)			.000c	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Monte Carlo Sig. (2-tailed)	.000d		0.00	0.00	0.00	.000d	0.04	0.00	0.00	0.00
	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	.000
	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	.000

The Kruskal-Wallis H is a nonparametric test based on rank, which can be used to determine whether there exist statistically significant differences between two or more groups of independent variables on a continuous or dependent one. Given the concept of the Kruskal-Wallis test, we want to answer the question of whether the effect of different factors on oil prices is the same in OPEC countries. According to Table 3, oil rent, real interest rate, oil price expectations, and industry value added have different effects on oil prices in OPEC member countries. The mean of the variables and the corresponding ranking of countries are given in Table 4. Nigeria is the highest in renewable energy. Iraq has the highest rank in oil rent, real interest rate, and industry value added.

Table3. Kruskal-Wallis test
Source: Resarch Result

			op	un	ope	Ind	or	rr	re
Kruskal-Wallis H			.0	.0	.0	47.7	266.9	251.3	329.9
Df			5	5	5	5	5	5	5
Asymp. Sig.			1.0	1.0	1.0	.000	.000	.000	.000
Monte Carlo Sig.	Sig.		1.0	1.0	1.0	.000	.000	.000	.000
	95% Confidence Interval	Lower Bound	1.0	1.0	1.0	.000	.000	.000	.000
		Upper Bound	1.0	1.0	1.0	.000	.000	.000	.000

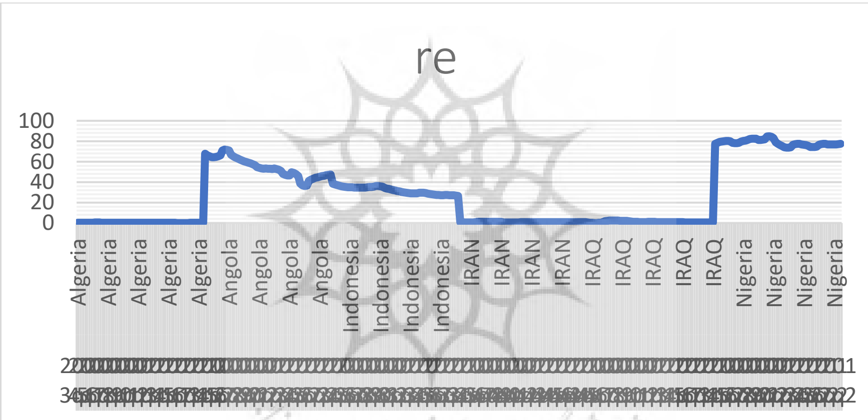

Figure1. Kruskal-Wallis test
Source: Resarch Result

Table4. Kruskal-Wallis test for renewable energy index for 6 OPEC countries in the period 2003: q1 to 2017: q3
Source: Resarch Result

Number of observations	country	Renewable energies(Mean)	real interest rate(Mean)		Oil rent(Mean)		Industry value added(Mean)		
			Mean		Mean		Mean		
59	Algeria	33.56	91.64		188.00		122.07		
59	Angola	265.83	133.97		245.88		198.63		
59	Indonesia	207.17	117.05		34.07		202.56		
59	Iran	114.39	266.22		188.27		169.85		
59	Iraq	119.05	324.78		305.54		231.32		
59	Nigeria	325.00	131.34		103.24		140.58		

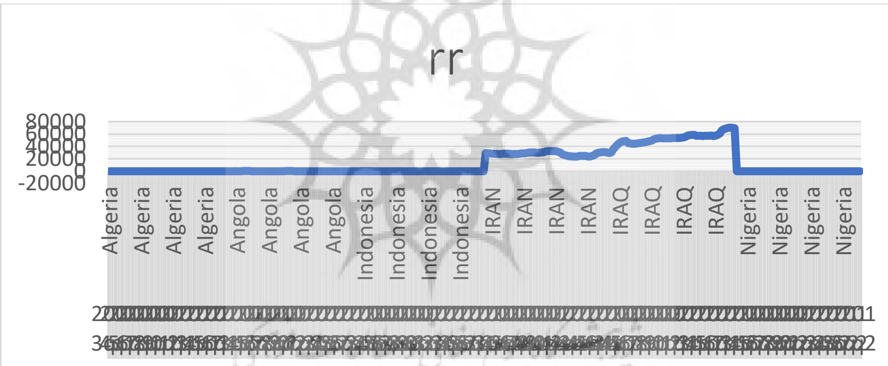

Figure2. Kruskal-Wallis test for real interest rate
Source: Resarch Result

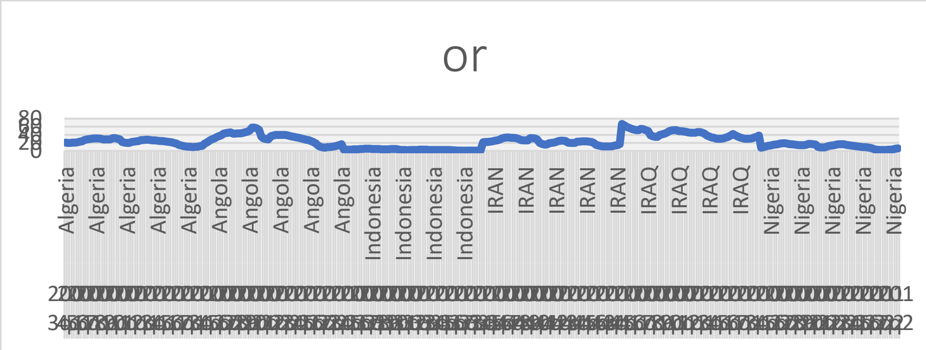

Figure3. Kruskal-Wallis test for oil Rent
Source: Resarch Result

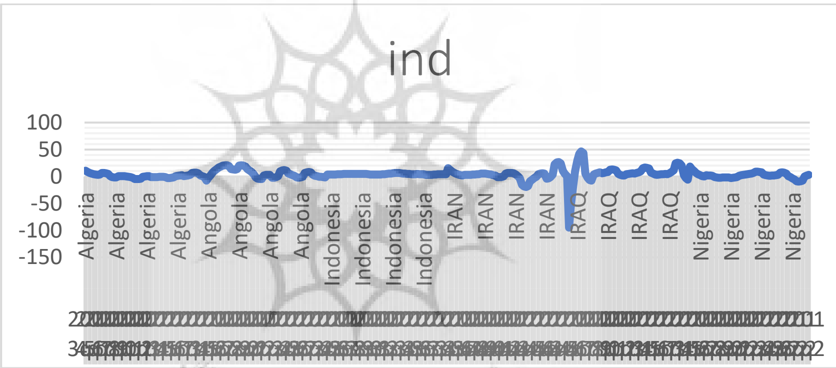

Figure4. Kruskal-Wallis test for industry index
Source: Resarch Result

Using the kernel local linear regression estimator, the extent and direction of the effect of global EPU on oil prices are estimated. There are two hypotheses are examined as follows:
Global EPU has a positive impact on oil prices.

Among the explanatory variables, EPU is the most influential factor.

Table5. Core regression: Local linear estimator
Source: Resarch Result

Local-linear regression Kernel: epanechnikov Bandwidth: cross validation	Number of obs = 327 R-squared = 0.9678	
Log op	Estimate	Z(P>|Z|)
Mean Log op	4.210966	
Effect Log un	0.3522596	2.6(0.0000)
Ope	0.420129	49.0(0.0000)
L rr	-0.0003032	-0.1(0.9000)
Or	0.0209778	0.8(0.4000)
L ind	0.0169741	2.2(0.0000)
L re	-1.228478	-3.2(.0000)

Based on Table 5, the results show that there is a positive and significant relationship between oil prices and EPU. According to the findings, it can be concluded that for oa one percent change in the EPU index, the variable of oil price will change by 0.35 percent. For one unit change in the oil price expectations index, oil prices increase by 42%. Real interest rate and oil rent index do not have any significant effect on oil prices. One percent increase in the industrial value-added elevates the oil price by 1.6 percent; also, renewable energies reduce the oil prices by 12 percent.

The fundamental factors of oil supply and demand and non-fundamental factors comprising of financial market conditions, speculation, and geopolitics have significant impacts. On the other hand, factors such as the industrial value-added in each country, alternative energy sources, oil rents, and oil price expectations are among the fundamental factors, and the US Federal Reserve real interest rate and EPU are among the non-fundamental factors.

Estimation of the model by nonparametric method shows that renewable energy has the greatest effect on oil prices. As the quota of renewable energy in the energy supply increases, OPEC oil prices fall due to declining demand. The industrial value-added has a positive and significant effect on oil prices because, with more industrial activities, the oil demand has increased, which elevates oil prices. Oil rents have a positive and significant effect on oil prices as the difference between oil income and oil extraction costs. Due to the determination of oil quotas and oil prices in OPEC member countries, the oil industry profit rises by reducing oil extraction costs. Oil price expectations, like market expectations for any commodity, affect prices. Expectations of rising oil prices will lead to higher oil prices due to increased precautionary oil demand. According to the research findings, an increase in the Federal Reserve's real interest rate will lead to lower oil prices. On the one hand, raising interest rates increases the cost of maintaining oil on board, and on the other hand, it reduces the net present value of future profits, hence increasing the oil supply. Rising interest rates on the Federal Reserve will reduce the price of savings bonds, treasury bills, and stocks. Thus, the profitability of speculative activities in the savings bond market leads to the transfer of cash flow from commodity exchanges such as oil and its derivatives and agricultural products to the savings bond and treasury markets. As a result, oil prices fall. The emergence and spread of EPU will lead to higher oil prices. Since oil has assets in addition to physical and commodity aspects, with the increase of EPU, the possibility of restricting the future supply of oil, as well as increasing precautionary demand and speculation of oil, increases oil prices. Therefore, the unique situation of OPEC member countries means that the uncertainty of global economic policies is not a significant factor affecting oil prices, and the development of alternative energies has a significant effect on oil prices. This necessitates a change in policy and precise planning in oil-rich countries to use alternative fuels and produce oil products instead of selling crude oil.

5- Concluding Remarks

The present study aimed to investigate the impact of EPU on oil prices in selected OPEC countries. We have examined the effect of fundamental and nonfundamental factors on oil prices in the selected OPEC countries using a nonparametric panel data model. This technique allows determining the shape of the function using the data instead of imposing assumptions. The results show that among the fundamental factors, renewable energies and oil price expectations are the most influential factors. Also, EPU has a positive and significant impact on oil prices. However, the impact of renewable energy is more effective than EPU as a non-fundamental factor. The results align with (Gudazi Faahani & Abbasinejad,2023), (Hamidi et al.,2019) and (Jang & Yan,2020).

The emergence and expansion of the economic policy led to an increase in oil prices. Since oil is an asset in addition to its physical aspects, oil prices are likely to rise with higher EPU, the limitation of future oil supply as well as increasing discretionary demand and oil speculation. Therefore, the unique conditions of OPEC member states make it incumbent on the global economic policy as the most important factor affecting oil price, and the rise of alternative goods has had more effect on the oil price, which requires the necessity of changing politics in oil-rich countries towards producing oil products.

Reference

Abebe H., Russell S. & Xibin Z. (2019), Oil prices and EPU: Evidence from a nonparametric panel data mode. *Energy Economics*,*83*, 40–51.

Ansari, F., Rezazadeh, A. (2023), The effects of external uncertainty shocks on Iran's macroeconomy. *Quarterly Journal of Quantitative Economics (JQE)*, Articles in Press, Accepted Manuscript, Available Online from 02 March 2023, https://doi.org/10.22055/jqe.2023.40809.2483

Antonakakis, N., Chatziantoniou, I. & Filis, G. (2014), Dynamic spillovers of oil price shocks and EPU. *Energy Economics*, *44*, 433–447.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, *131*(4), 1593-1636.

Barrero, J. M., Bloom, N., & Wright, I. (2017). *Short and long-run uncertainty* (No. w23676). National Bureau of Economic Research.

Basher, S. A., & Sadorsky, P. (2006). Oil price risk and emerging stock markets. *Global finance journal*, *17*(2), 224-251.

Baumeister, C., Peersman, G., Van Robays, I. (2010), The Economic Consequences of Oil Shocks: Differences across Countries and Time, *RBA Annual Conference Volume* (Discontinued), in Renée Fry & Callum Jones & Christopher Kent (ed.), Inflation in an Era of Relative Price Shocks, Reserve Bank of Australia.

Baumeister, C., Kilian, L.(2016), A General Approach to Recovering Market Expectations from Futures Prices With an Application to Crude Oil, CESifo Working Paper Series 5782, CESifo.

Blinder, A.S., Rudd, J.B. (2008), The Supply-Shock Explanation of the Great Stagflation Revisited, NBER Working Paper No 14563.

Bloom, N. (2014), Fluctuations in uncertainty, *Journal of Economic Perspectives*, Vol. 28, No. 2, pp. 153–176.

Bordo, M.D., Duca, J.V., Koch, C. (2016), EPU and the credit channel: aggregate and bank-level US evidence over several decades. *Journal of Financial Stability*, Vol. 26, pp. 90–106.

Brogaard, J., Detzel, A. (2015), The asset-pricing implications of government EPU, *Management Science*, Vol. 61, No. 1, pp. 3–18.

Caggiano, G., Castelnuovo, E., Figueres, J.M. (2017), EPU and unemployment in the United States: a nonlinear approach, *Economics Letters*, Vol. 151, pp. 31–34.

Caggiano, G., Castelnuovo, E., Groshenny, N. (2014), Uncertainty shocks and unemployment dynamics in US recessions, *Journal of Monetary Economics*, Vol. 67, pp. 78–92.

Cavalcanti, T., Jalles, J.T. (2013), Macroeconomic effects of oil price shocks in Brazil and the United States, *Applied Energy*, Elsevier, Vol. 104, No. C, pp. 475-486.

Darmawan, I., Siregar, H., Hakim, D.B., & Manurung, A.H.. (2021). World Oil Price Changes and Inflation in

Indonesia: A Nonparametric Regression Approach. Signifikan: Jurnal Ilmu Ekonomi, 10(1), 161 - 176. https://doi.

org/10.15408/sjie.v10i1.19010

Federal Open Market Committee, 2009. Minutes of the December 2009 Meeting, http://www.federalreserve.gov/monetarypolicy/fomcminutes20091216.htm

Gudarzi Farahani Y., Abbasinejad. H.(2023). Measuring the impact of economic uncertainty impulse on macroeconomic variables: A Dynamic Stochastic General Equilibrium Approach. *Stable Economy Journal*, 4(3), 106-133. DOI: 10.22111/SEDJ.2023.44255.1277

Hailemariam, A., Smyth, R., & Zhang, X. (2019). Oil prices and economic policy uncertainty: Evidence from a nonparametric panel data model. *Energy economics*, *83*, 40-51.

Hamilton, J. D. (1983). Oil and the macroeconomy since World War II. *Journal of Political Economy*, *91*(2), 228-248.

Hamilton, J. D. (2003). What is an oil shock? *Journal of Econometrics*, *113*(2), 363-398.

imf. (2012). *World economic outlook: Coping with high debt and sluggish growth*, IMF Press.

imf. (2013). *World Economic Outlook: Hopes, Realities, Risks*. Economic outlook, IMF Press.

Kang, W., & Ratti, R. A. (2013a). Oil shocks, policy uncertainty, and stock market return. *Journal of International Financial Markets, Institutions and Money*, *26*, 305-318.

Kang, W., & Ratti, R. A. (2013b). Structural oil price shocks and policy uncertainty. *Economic Modelling*, *35*, 314-319.

Kilian, L. (2009). Not all oil price shocks are alike: Disentangling demand and supply shocks in the crude oil market. *American Economic Review*, *99*(3), 1053-69.

Li, D., Chen, J., & Gao, J. (2011). Non parametric time varying coefficient panel data models with fixed effects. *The Econometrics Journal*, *14*(3), 387-408.

Loungani, P. (1986). Oil price shocks and the dispersion hypothesis. *The Review of Economics and Statistics*, *68*, 536-539.

Mammen, E. (1993), Bootstrap and wild bootstrap for high dimensional linear models. *The Annals of Statistics*, pp. 255-285.

Peersman, G., & Van Robays, I. (2009). Oil and the Euro area economy. *Economic Policy*, *24*(60), 603-651.

Rehman, M. U. (2018). Do oil shocks predict economic policy uncertainty? *Physica A: Statistical mechanics and its applications*, *498*, 123-136.

Seifollahi N. (2018). Investigating the Asymmetric Uncertainty Impact of Oil on Economic Growth by GMM. *Quarterly Journal of Quantitative Economics (JQE)*, 15(3), 1-20.

Silvapulle, P., Smyth, R., Zhang, X., & Fenech, J. P. (2017). Nonparametric panel data model for crude oil and stock market prices in net oil importing countries. *Energy Economics*, *67*, 255-267.

Sun, Y., Carroll, R. J., & Li, D. (2009). Semiparametric estimation of fixed-effects panel data varying coefficient models. In *Nonparametric econometric methods*. Emerald Group Publishing Limited.

Yu, W., Guo, Y., Zhu, H., & Tang, Y. (2017). Oil price shocks, economic policy uncertainty and industry stock returns in China: Asymmetric effects with quantile regression. *Energy Economics*, *68*, 1-18.

Wen, J., Khalid, S., Mahmood, H., & Yang, X. (2022). Economic policy uncertainty and growth nexus in Pakistan: a new evidence using NARDL model. Economic Change and Restructuring, 1-15.

Zhang, Y. J., & Yan, X. X. (2020). The impact of US economic policy uncertainty on WTI crude oil returns in different time and frequency domains. *International Review of Economics & Finance*, *69*, 750-768.