

Kumari, Reenu; Singh, Sunil Kumar; Vig, Shinu

## Article

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# Analyzing the association between crude oil price volatility and economic growth in OECD economies

Reenu Kumari<sup>a</sup> , Sunil Kumar Singh<sup>b</sup>  and Shinu Vig<sup>c,d</sup> 

<sup>a</sup>School of Management, Krishna Institute of Engineering and Technology Group of Institutions, Ghaziabad, India;

<sup>b</sup>Department of Computer Science and Information Technology, Mahatma Gandhi Central University, Motihari, India;

<sup>c</sup>Symbiosis Centre for Management Studies, Noida, India; <sup>d</sup>Symbiosis International (Deemed) University, Pune, India

## ABSTRACT

This research has sought to determine how the crude oil price volatility (COPV) relates to economic growth (EG) using the case of the OECD countries between 2000 and 2022. Therefore, this article employs various panel data estimation strategies: random effect regression, fixed effect regression, dynamic panel data estimation, one-step system GMM and dynamic panel data estimation; two-step system GMM. The chosen time domain consists of oil-producing and consuming major countries within the OECD. The key findings of the study suggest that COPV has adverse effects on the growth of OECD economies. This would consequently mean that the knowledge of how volatility in crude oil prices (COPs) could affect very influential economic performance is of paramount importance and might bring out certain vital challenges that could be brought up by oil market volatility. The article ends with a few policy suggestions that may assist in mitigating the adverse impact of exogenous, unpredictable fluctuations in oil prices on the EG of the countries of the OECD.

## IMPACT STATEMENT

This research provides critical insights into the relationship between crude oil price volatility (COPV) and economic growth (EG) within OECD countries, offering significant contributions to macroeconomic theory and policy formulation. By employing robust panel data estimation techniques, including dynamic panel data analysis and system GMM, the study examines the adverse effects of COPV on the economic performance of both oil-exporting and oil-importing nations over a 23-year period. The findings are particularly relevant for policymakers in oil-dependent economies, where economic stability is more vulnerable to oil price fluctuations. The research challenges traditional economic models by highlighting the asymmetric and nuanced nature of oil price effects, emphasizing the need for tailored risk management strategies and macroeconomic policies to mitigate the unpredictable impacts of COPV on growth. The theoretical advancements made in understanding the complex interplay between oil prices, COPV, and economic growth extends the existing knowledge in macroeconomics, international trade, and econometrics. These insights can be leveraged to enhance economic resilience in the face of volatile global oil markets.

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Economics; Business, Management and Accounting; Economics and Development

## 1. Introduction

The current wave of interest in volatility in crude oil prices (COPV) and their impact on economic growth (EG) has been driven by a critical role. Crude oil is an internationally traded commodity accounting for approximately 33% of global energy consumption, with almost all of it – about 94% – being devoted to transportation (Wachtmeister et al., 2018). It also shows that the prices of crude oil and other risky assets are associated with uncertainties (Mehra & Oskoui, 2007). Moreover, the price movements in Plourde and Watkins (1998) view are more important for the economy as compared to minerals.

**CONTACT** Shinu Vig  [shinu.vig@scmsnoida.ac.in](mailto:shinu.vig@scmsnoida.ac.in), [shinu17@gmail.com](mailto:shinu17@gmail.com)  Symbiosis Centre for Management Studies, Plot No. 47 and 48, Block A, Sector 62, Noida, Uttar Pradesh 201301, India

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Henry (1977) asserts that increases in oil prices within exporting countries can enhance EG due to increased earnings and income, although they can bring negative effects, such as delayed investments and lower output when they occur in importing nations. Hamilton's analysis on imported economies indicates that higher oil costs lead to expenditure delays, postponed capital outlays and rising concerns. Similarly, COPV was positively related with unemployment according to his earlier works (Hamilton, 1983, 1996). A number of studies like Hooker (1996), however, could not establish any direct relationship between macroeconomic variables and changes in crude oil prices (COPs) whereas others, such as Ferderer (1996), Lardic and Mignon (2006, 2008) and Mork (1989), oil prices and EG have a non-linear association. Thus, developing countries that heavily rely on oil income will be affected directly by a rise in oil prices because of the associated increase in funds for developmental projects, which are also likely to influence macroeconomic policies. In summary, this study finds that COPV has a complex relationship with EG, implying that there are many different effects of oil price changes on various countries depending on whether they are net importers or exporters of energy.

In the twenty-first century, petroleum has become one of the most essential resources for global economies and it influenced by several factors, such as supply-demand dynamics, petroleum trade activities (imports and exports) and speculative transactions. This has increased vulnerability to crude-oil price volatility brought about by occurrence of wars; OPEC production pricing; shocks in petroleum stocks; weather events and other market vagaries (Fesharaki & Hoffman, 1985). They assert that oil price changes can make it difficult to predict output levels even though they may not have much impact on total production especially in economies like Canada.

Given the crucial role that oscillations in COPs play in the macroeconomic performance of both oil importers and exporters, these impacts need to be examined as well as each country's Gross Domestic Product (GDP) responsiveness to such changes. It is relevant to note that the relationship between oil prices and EG varies depending on where the economy stands, and what is happening to oil prices (Das et al., 2018; Kilian & Vigfusson, 2011). This variability points out why it is important for policy makers to analyze complex interrelationships between oil prices and economic indicators before making decisions of general interest.

The key area of focus in prior researches by Cuñado and Pérez de Gracia (2003) and Jiménez-Rodríguez (2008) has been on this line. Nevertheless, these studies are limited because they have employed techniques from time-series analysis, used data from a single nation or at least one advanced country for historical reasons over certain periods. To bridge this gap, this article examined how variations in COPV impact the EG of OECD countries while outlining price movements of crude oil (COP) within those countries and explaining its effects on EG. Panel data analysis was employed in this study to consider heterogeneity, spillover effects and time-dependent adjustments, offering a comprehensive examination of the topic. The study consists of 26 OECD-country sample during 23 years from 2000 to 2022. For the analysis of these data and fulfillment of this study's objective, various econometric methodologies were employed, including the random effect regression model; fixed effect least squares dummy variables (LSDV) by its acronym; and one- and two-step Generalized Methods of Moments. These research methodologies have been selected to deal with the complexity of the research questions and seek robust answers regarding the relationship of COPV, changes in COP and EG in the OECD nations. With the purpose of fulfilling the objectives of this article, we have attempted to get answers to the following research questions:

*R.Q.1: What is the predicted severe impact of COPV on OECD nations?*

*R.Q.2: What effects do fluctuating oil prices have on the OECD countries?*

*R.Q.3: How much fluctuating COP and COPV should be considered when projecting OECD countries' EG?*

*R.Q.4: Is there a need for more forecasting methods to assess COP so that companies can make the right decisions in oil production?*

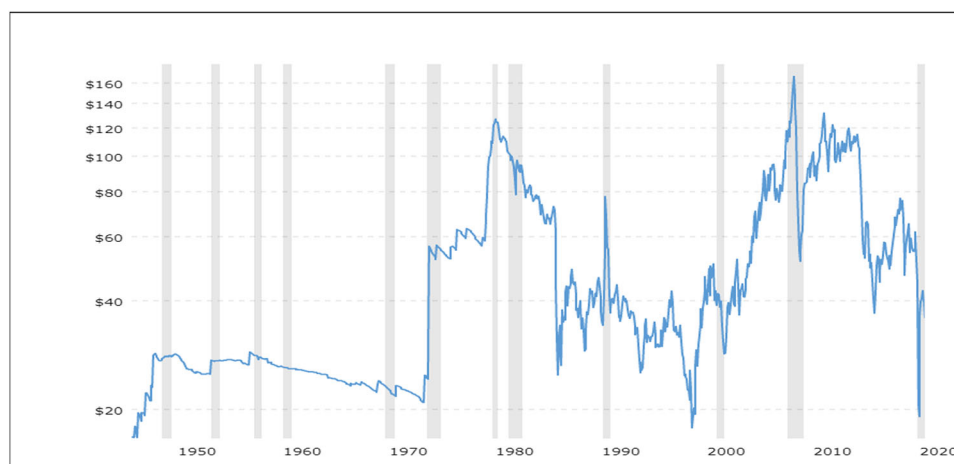
This study makes significant research contributions in multiple dimensions. First, it looks into the extensive consequences of crude oil price volatility (COPV) on economic growth (EG), by considering various macroeconomic variables for countries that are both oil consumers and producers. This problem has never been addressed before, which shows its novelty and significance. Second, this study

investigates the asymmetric nature of oil prices effects in order to ascertain the importance of both oil prices and COPV while assessing or predicting EG. The analysis employs a robust methodology such as random effect regression, fixed effect regression, one-step GMM models and two-step GMM models among others. It reveals that while changes in COPV have limited positive influence on EG; fluctuations in oil price significantly impact on economic development thus revealing how things work out intricately. Additionally, forecasting COPV is important for businesses since it helps them to predict and respond to changes in COPs thereby allowing them to prepare for any uncertainties that may arise from such movements within their respective markets. Furthermore, separate analyses for oil-consuming and oil-producing countries indicate that volatility tends to negatively affect nations reliant on oil imports while benefiting those engaged in oil exports, underscoring the diverse effects across different economies. These findings provide valuable insights into the complex relationship between COPV, oil prices and EG, offering practical implications for policymakers and businesses alike.

The sections of the study are ordered as follows: [Section 2](#) reveals trends in COPV in OECD countries (1950–2020). [Section 3](#) reveals previous studies. [Section 4](#) discusses the outcomes and their interpretation. Finally, [Section 5](#) concludes the study by offering conclusions with suggestions and limitations.

## 2. Crude oil price volatility in OECD countries (1950–2020)

[Figure 1](#) shows a detailed look at how oil trade has evolved among OECD countries from 1950 to 2020, highlighting trends in oil imports and exports. In 2015, buying countries spent 25% (which amounts to USD 841.6 billion) of oil costs. After that, oil imports dropped by 12.1% from USD 1.201 trillion in 2018. The Asia-Pacific region spent the most on imported oil in 2019, making up 54.2% of the total, followed by Europe at 28.2% and North America at 13.9%. Notable increases in oil imports were seen in China (77.7%), India (41.4%), the UK (33.2%) and Singapore (33.1%), showing big growth in these markets. On the flip side, import costs in the US fell slightly by –0.2% in the last five years. On a global scale, oil exports hit about US\$1.004 trillion in 2019, showing a 30.9% jump from 2015. Middle Eastern countries were at the forefront of oil sales, bringing in \$383.6 billion, which accounted for 38.2% of worldwide merchandise sales. In terms of geography, Asian nations were the top importers of crude oil, making up 44.1% of total imports. The US saw a huge rise in crude oil exports by 640.5% since 2015, with Libya following at 267.9%, the United Arab Emirates at 109.4% and Brazil at 103.7%. However, Angola experienced a 26.4% drop in oil sales during the same period. The United States saw a huge 640.5% rise in crude oil exports since 2015, with Libya (267.9%), the United Arab Emirates (109.4%) and Brazil (103.7%) also experiencing significant increases. On the other hand, Angola faced a 26.4% decrease in oil sales during the same time frame. It's worth noting that while these numbers give us a glimpse into oil trading patterns, we should be careful when interpreting estimated figures for Saudi Arabia due to possible data inaccuracies.



**Figure 1.** Trend of crude oil prices volatility (1950–2020).

According to Amuda (2023), the country is the 10th largest producer of oil and gas globally, with 37 billion barrels of oil and 206 trillion cubic feet of gas. Energy exports are crucial for the country's economy. On the other hand, India is the second-largest producer of crude oil worldwide, producing 4.972 million barrels per day, which is about 5.1% of the global refining capacity. India also consumes the most crude oil in the world, accounting for 4.8% of the total global consumption, as mentioned by Kumari and Sharma (2019).

### 3. Literature review

It is worth noting that a large number of studies have investigated the link between COPV and economic activities in both developed and developing countries, following Hamilton (1983). As a result of the numerous findings, it can be seen that the increase in COP worsens economic activities in oil-producing countries, as well as those in oil-consuming countries. Through various demand and supply channels, they have been identified as investment, inflation rates, interest rates, unemployment, international trade and domestic trade as elucidated by Hamilton (1983), Gupta and Krishnamurti (2018), Sadorsky (1999), Kumari and Sharma (2018) and Kumari et al. (2021). Increased COPV has been consistently linked to reduced economic activity, thereby impacting overall GDP, as evidenced by Sadorsky (1999). Similarly, in the case of African states, Omojolaibi and Egwaikhide (2013) employed the VAR method to study the case of oil price volatility on EG, specifically in the group of oil exporters. The results indicated that OVG influences one of the key driving forces of growth, investment in the real sector. Likewise, Kocaarslan et al. (2020) employed NARDL and discovered an asymmetrical relationship between oil prices and trade openness, credit costs and unemployment. The research confirms that the costs of oil increased and prolonged the unemployment period while the low prices had no influence, which is consistent with Carruth et al. (1998) and Baumeister et al. (2010).

Akinlo and Apanisile (2015) utilized panel data analysis to investigate the impact of crude oil price (COP) differences on EG across twenty sub-Saharan African countries (SSA) from 1986 to 2012. Employing the dynamic stochastic general equilibrium (DSGE) method, their study revealed that COP differences have a positive but statistically insignificant impact on EG for non-oil-based economies, whereas crude oil-exporting economies experienced a significant positive effect. On a broader scale, de Cavalcanti et al. (2015) conducted an analysis spanning 118 countries from 1970 to 2007. Using the Generalized Method of Moments (GMM) technique, they discovered that commodity price volatility exerts a negative influence on EG, affecting total productivity, human capital and physical capital. In contrast, Plante and Traum (2012) affirmed that heightened oil price instability leads to increased investment across various sectors, positively impacting real GDP, as highlighted by Kumari and Sharma (2017). Further exploring the relationship between COP and economic variables, Abid and Alotaibi (2020) analyzed personal financial commitment in Saudi Arabia from 1980 to 2016, considering additional determinants, such as gross savings, financial sector development, public sector investment, economic globalization and EG. They concluded that COP has a positive and significant impact on private investment in Saudi Arabia. Shifting focus to global implications, Mohaddes and Pesaran (2016) as well as Mohaddes and Pesaran (2017) examined the effects of real output, oil prices, interest rates and real assets on the EG of 27 economies. Their findings indicated that shocks to oil supply from Saudi Arabia have severe negative consequences for the international economy, with real GDP decreasing in both developed and developing nations and real equity prices falling sharply globally. Similarly, Lorusso and Pieroni (2017) delved into the macroeconomics of the UK concerning shifts in oil prices globally. They observed that the type of oil shock experienced determined the effect of oil price variations on UK macroeconomic aggregates. While the short-term performance of the UK economy was not materially impacted by rises in aggregate and oil market-specific demand, disruptions in crude oil supply led to a sharp decline in GDP growth, accompanied by an increase in inflation following rises in real oil prices. The study done by Mohaddes and Raissi (2017) and Mohaddes and Pesaran (2017) highlighted the dynamic relationship between oil prices and the macroeconomic effects of declining oil prices as a result of the oil revolution in the USA. This is in light of the changing economic landscape. They used the global VAR model to analyze 38 regions and discovered significant differences between the responses of various nations to the US supply-driven COPV, with real GDP rising in both developed and developing



oil-consuming markets while falling in emerging markets, the inflation rate falling and equity prices rising globally. Similar to this, Mohaddes and Pesaran (2017) assessed how the United States and the rest of the world may be impacted by short-term drops in oil prices using the GVAR method. These studies frequently focused on the investigation of the direct effects of oil price shocks as well as the indirect effects of oil price changes through secondary and tertiary channels.

In a recent study by Zhang et al. (2024), a long-term causal relationship between EG and natural resources in China was confirmed. Evans (2023) further contributed to this understanding by revealing that increasing oil prices, through substitution effects, result in heightened investment in renewable energy transition (RET) in both the short and long run. Conversely, declining oil prices lead to reduced RET investment over time. Bilal et al. (2024) employed a range of analytical techniques, including fuzzy time series, the ARIMA model and support vector machines, to explore the interaction between financial and commodity markets. Their investigation aimed to identify the most effective method for assessing this relationship, culminating in a prediction of a forthcoming decline in WTI COPs. This anticipated trend carries positive implications for the global economy. In parallel, Salisu et al. (2024) and Salisu et al. (2017) delved into the connection between global technology shocks and the crude oil market, spanning from 1880 to 2018. Their analysis underscored the unpredictable nature of this relationship, notably highlighting observations following the 'Great Depression' of the 1930s. This collective research effort has significantly advanced our understanding of the complex interplay between oil price fluctuations and the economy, elucidating the diverse effects of oil price shocks across different countries and regions.

The extensive review of existing literature on the impact of crude oil price volatility (COPV) on economic activity reveals a wealth of insights. However, several notable research gaps and areas for future exploration emerge from this review. By addressing these research gaps and embracing interdisciplinary approaches, future studies can contribute significantly to advancing our knowledge of the complex interplay between oil price volatility and economic outcomes, ultimately informing more effective policy measures and strategic decision-making.

#### 4. Data collection and method adopted

The article is based on secondary data that are publicly available. Crude oil data have been obtained from <https://fred.stlouisfed.org/series/WTISPLC> and data for all other variables has been extracted from World Bank available at <https://data.worldbank.org/>.

##### 4.1. Crude oil price volatility (dependent variable)

The bulk of empirical research analyzing COPV employs the standard deviation (SD) of the moving average of the logarithm of the dependent variable (crude oil volatility), despite the fact that COPV calculation is a contentious topic. The realized volatility (RV) method, which was also employed by Andersen et al. (2004) to calculate OLV in the international power market, was applied in this study. The price-cost process is represented by this method as a stochastic difference equation:

$$dY_t = \mu Y_t dt + \sigma Y_t dW_t \quad (1)$$

The predicted drift term with a constrained variance is represented as  $\mu t$  where  $t$  represents volatility.  $W_t$  displays the continuously compounded price change in the unit interval, or  $rt$ , which is denoted as follows:

$$n \equiv \log \pi t - \log \pi t - 1 = \int_{t-1}^t u_t du + \int_{t-1}^t \sigma t dW_\mu \quad (2)$$

The average and variance are determined in cases where it is assumed that  $du$  and  $dW_\mu$  are uncorrelated. In addition, where  $t-1 \leq \mu \leq t$  changes in the conventional Brownian motion are distributed based on the

$W_t - W_s \sim N(0, t-s)$  for  $0 \leq s \leq t$ , therefore the average  $\int_{t-1}^t u_t du$

#### 4.2. The econometric model

This study investigates how COPV affects EG in OECD countries, including the top oil consuming and producing countries. The Barro (1998) model which is frequently cited in the EG literature, provides the basis for our estimated model. COPV is the primary variable of interest in this study. The following equations are estimated using various panel data econometric approaches to investigate the relationship:

$$GDPPC_{it} = \beta_0 + \beta_1 GDPPC_{it} + \beta_2 Oil_{it} + \beta_3 Infla_{it} + \beta_4 FD_{it} + \beta_5 GE_{it} + \beta_6 CF_{it} + \beta_7 TO_{it} + \beta_8 PG_{it} + \beta_9 EX_{it} + \beta_{10} crisis + u_1 + \epsilon_{it} \quad (3)$$

where *DPPC* was considered as a predicted variable and represents GDP per capita.

*Oil price* was considered as the annualized real COP instability (Per Barrel US\$).

*Infla* equals the inflation rate.

*Fd* denotes financial development.

*ge* represents government expenditure.

*Cf* represents gross capital formation.

*represents trade* openness (total exports and imports divided by GDP per capita).

*Pg* considered the population growth rate.

*Ex* considered as a real effective exchange rate.

*Crisis* is used for the dummy variables (financial crises).

For the above three models, we have framed same time period (2000 – 2022).

GDP per capita (GDPPC) serves as the predictor variable in our regression analysis, with nine independent variables under consideration. However, our model primarily focuses on assessing the impact of COPV, inflation rates and real exchange rates on EG. The control variables encompass gross capital formation, trade openness, government expenditure, financial development, population growth rate and a dummy variable indicating systemic financial crisis. Notably, Asia underwent a severe financial crisis, particularly in 2007 and 2008, prompting the inclusion of a dummy variable that takes the value of 1 during these crisis years and 0 otherwise to mitigate these effects.

Our dataset prompted the application of various estimators to address diverse econometric challenges and ensure robust results. These estimators include the random effects (RE) regression model, least squares dummy variables (LSDV), and one and two-step GMM methods (Arellano & Bover, 1995). Given the informative variables and inherent endogeneity, controlled *via* Instrumental variables (IV), the LSDV model emerged as more suitable than the RE estimator (Anderson & Hsiao, 1981). A pivotal factor in this decision is Hausman's (1978) test, which detects endogeneity even after removing the lagged predictor variable from the equation. Considering factors like government consumption as a share of GDP, debt-to-investment ratio and inflation rates are integrated into our analysis, we anticipate a level of economic

**Table 1.** Summary of data collection, proxy, definition and data sources.

Dependent variable and independent variable	Proxy	Description	Data source
Growth Real GDP	<i>gdppc</i>	GDP per capita.	<i>World development indicators (WDI)</i>
Real oil price (annually)	<i>oil</i>	Crude oil (in U.S. dollars per barrel) West Texas Intermediate (WTI) oil price	<i>Global financial database</i>
Inflation rate	<i>Infla</i>	Inflation, consumer prices (annual %)	<i>WDI</i>
Financial development	<i>fd</i>	Domestic credit to the private sector (% of GDP)	<i>WDI</i>
Government expenditure	<i>ge</i>	General government final consumption expenditure (annual % growth)	<i>WDI</i>
Trade openness	<i>to</i>	Total exports and imports divided by GDP per capita	<i>WDI</i>
Population growth rate	<i>pg</i>	Total population	<i>WDI</i>
Real effective exchange rate	<i>ex</i>	Real effective exchange rate index (2010 = 100)	<i>WDI</i>
Dummy for global financial crises	<i>crisejst</i>	Dummy variable	– ( <i>Own estimation</i> )

Source: Own estimation.



endogeneity in the relationship. The LSDV model effectively addresses this issue by incorporating a country-specific intercept term, accounting for heterogeneity across countries.

### 4.3. Collection of data

The analysis encompasses 26 OECD countries, comprising both oil consumer and producer nations, as listed in [Appendix 1](#). This study focuses on three equations and employs panel data covering the period from 2000 to 2022. Data for this analysis were sourced from multiple reputable outlets, including the *Global Financial Database* annual oil price volatility figures, and the World Development Indicators (World Bank) for other relevant variables. [Table 1](#) provides a concise summary of the data collection process, proxies used, definitions applied and respective data sources for clarity and reference.

## 5. Results and discussion

### 5.1. Descriptive analysis

[Table 2](#) shows the real EG rate recorded for 26 OECD countries from 2000 to 2022, which was 1.501. [Table 1](#) shows the GDPPC mean of 1.501 and the following having the lowest mean *crises*: *CoCr*, *Popg*, *ge* and *inflrate* are 0.045, 0.091, 0.069, 2.003 and 2.317, respectively, and *FD* have the highest mean, which are 108.222.

[Table 3](#) shows that dependent and explanatory variables have pairwise correlations, and it also demonstrated that *infla*, *ge*, *gc* and *to* are all statistically positive and connected to *gdppc*. We discovered that *oil*, *fd* and *ex* had a detrimental and statistically significant link to *gdppc*.

[Table 4](#) presents the results from various regression models aimed at assessing the relationship between GDPPC and ten distinct independent variables. The table includes four estimation methodologies: RE regression (within), dynamic panel-data estimation (one-step system GMM) and dynamic panel-data estimation (two-step system GMM). The Hausman test results in [Table 5](#) show that the null hypothesis of no correlation between the explanatory variables and the error term (no endogeneity) is rejected

**Table 2.** Descriptive summary.

Variable	Obs	Mean	Std. Dev	Min	Max
GDPPC	572	1.501	3.114	−11.758	23.201
oil	571	62.49	29.208	−5.151	117.78
infla	572	2.317	4.226	−4.478	54.915
fd	572	108.222	43.831	12.869	216.335
ge	572	2.003	2.361	−6.955	10.151
gc	572	23.378	4.158	11.902	46.018
to	572	83.732	41.383	19.798	239.837
PopG	571	0.069	0.771	−0.87	10.4
ex	572	97.949	12.352	55.627	175.134
crises	572	0.045	0.208	0	1
CoCr	572	0.091	0.288	0	1

Sources: Authors estimation.

**Table 3.** Pair-wise correlation.

Variables	1	2	3	4	5	6	7	8	9	10	11
(1) GDPPC	1										
(2) oil	−0.046	1									
(3) infla	0.09	−0.014	1								
(4) fd	−0.294	0.035	−0.262	1							
(5) ge	0.266	−0.184	0.17	−0.157	1						
(6) gc	0.321	−0.058	0.119	−0.138	0.445	1					
(7) to	0.18	0.083	−0.098	−0.401	−0.008	0.181	1				
(8) PopG	0.063	−0.072	−0.003	−0.044	0.07	−0.027	−0.076	1			
(9) ex	−0.084	0.055	−0.265	0.281	0.028	−0.049	−0.055	0.034	1		
(10) crises	−0.097	0.226	0.08	0.039	0.06	0.092	0.008	−0.017	0.071	1	
(11) CoCr	−0.302	−0.109	−0.058	0.028	0.033	0.007	0.057	−0.026	−0.068	−0.069	1

Source: Authors calculation.

**Table 4.** Results of random effect regression (GLS), fixed effect (within) regression, dynamic panel-data estimation, one-step system GMM and two-step system GMM.

Variables	(i) Random effect regression (GLS)	(ii) Fixed effect (within) regression	(iii) Dynamic panel data estimation, one-step system GMM	(iv) Dynamic panel data estimation, two-step system GMM
Dependent variable: <i>gr</i>				
L.GDPPC	–	–	–0.015 (–0.049)	0.011 (0.055)
oil	–0.002 (0.004)**	–0.013 (0.005)**	–0.086 (0.003)**	–0.071 (0.004)***
infra	–0.015 (–0.029)	–0.045 (–0.034)	–0.004 (–0.037)	–0.028 (–0.084)
fd	–0.013 (0.003)***	–0.037 (0.006)***	–0.009 (–0.006)	–0.008 (–0.01)
ge	0.207 (0.055)***	0.068 (–0.058)	0.166 (0.093)***	0.137 (–0.107)
gc	0.171 (0.031)***	0.28 (0.04)***	0.255 (0.077)***	0.284 (0.138)***
to	0.007 (0.003)**	0.051 (0.01)***	0.007 (–0.005)	0.008 (–0.007)
PopG	0.19 (–0.145)	0.143 (–0.136)	–1.103 (2.421)**	–1.262 (6.303)**
ex	–0.01 (–0.01)	–0.017 (–0.011)	–0.018 (–0.014)	–0.004 (–0.04)
crises	–2.057 (0.551)***	–1.88 (0.521)***	–1.23 (0.384)***	–1.304 (0.765)***
CoCr	–3.482 (0.39)***	–3.769 (0.372)***	–3.443 (0.269)***	–3.176 (0.387)***
Constant	–0.611 (–1.23)	–3.002 (–1.9)	–1.927 (–2.31)	–4.187 (–7.676)
AB (1)	Overall $R^2 = 0.298$	Overall $R$ square = 0.335	Pr > $z = 0.000$	Pr > $z = 0.000$
AB (2)	Within = 0.267	Akaike Crit. (AIC) = 2614.057	Pr > $z = 0.919$	Pr > $z = 0.966$
Sargan	Between = 0.135	BayestanCrit. (BIC) = 2331.878	Prob > $\chi^2 = 0.00$	Prob > $\chi^2 = 0.00$
Hansen			Prob > $\chi^2 = 0.330$	Prob > $\chi^2 = 0.339$

Notes: SD in italics, \*\*\* $p < 0.01$  and \*\* $p < 0.05$ .**Table 5.** Hausman test.

Null hypothesis	Dynamic model	Static model
$H_0: E(X_{it} u_{it}) = 0$	$m_3(8) = 23.70$	$m_3(7) = 20.96$
Decision	Reject $H_0$ as $p$ value < 0.00	Reject $H_0$ as $p$ value < 0.00

Notes: Dismissal of invalid means model misspecification/endogeneity.

for both the dynamic and static models, suggesting potential model misspecification or endogeneity issues.

Comparing the results (in Table 4) across Columns I, II, III and IV, it becomes evident that the impact of oil prices and the severity of the COVID crisis are more pronounced in the dynamic specifications, aligning with findings from previous studies (Blanchard and Gali, 2010; Nakov & Pescatori, 2010; Bjørnland et al., 2018; Sánchez García & Cruz Rambaud, 2023; Faisal et al., 2024). Specifically, Column II presents the estimated coefficients for the growth equation, indicating that the lagged GDPPC variable (GDPPC-1) significantly influences the current growth rate of GDPPC. The coefficient suggests that a 1% increase in the previous year's GDPPC corresponds to a 0.011% increase in the current GDPPC, supporting Faisal et al. (2024).

However, the one-step system GMM dynamic panel data estimation in Column III shows a different relationship: a 1% increase in the previous year's GDPPC results in a 0.015% decrease in the current GDPPC. This divergence highlights the sensitivity of the growth rate to past economic performance under different estimation techniques.

Across all columns (I–IV), the coefficients consistently show that a 1% increase in oil prices (COP) leads to a decrease in EG by 0.002%, 0.013%, 0.086% and 0.071%, respectively. Additionally, inflation, financial development, population growth, crises and the COVID crisis are all negatively correlated with GDPPC, with coefficients of –0.028%, –0.008%, –1.262%, –1.304% and –3.176%, respectively. These findings are consistent with Nakov and Pescatori (2010) and Bjørnland et al. (2018), reinforcing the adverse effects of these factors on EG.

It just so follows from our findings that the volatility of COPs is statistically significantly and negatively related to EG in OECD countries. In conclusion, it follows that our findings are similar to Nakov and Pescatori (2010), who arrived at a conclusion that oil price volatility deterred GDP growth due to increased uncertainty affecting investment decisions. In return, Bjørnland et al. (2018) discovered that due to oil price shocks, employment and EG decrease, especially in the case of those economies that

are heavily dependent on oil imports because shocks increase production costs and reduce the purchasing power of consumers.

The impact of the exchange rate is particularly notable, as an increase in the exchange rate negatively affects the domestic currency, leading to higher import prices and discouraging production processes dependent on imported inputs. This observation aligns with established economic theories on currency depreciation and its implications for domestic production.

The model's fit is robust, with Model (2)'s likelihood ratio (LR) Chi-square statistic showing a value of 97213.9 and a  $p$  value of 0.0000, indicating that the chosen independent variables effectively explain new ideas related to the environment. The validity of the moment conditions is confirmed, as the null hypothesis at order 2 was not rejected, evidenced by  $p$  values of 0.919 and 0.966 from our test for serial correlation in the first-differenced errors.

The analysis underscores the complex interplay between various economic factors and GDPPC, highlighting the significant role of oil prices, crises and macroeconomic conditions in shaping EG. These results are consistent with similar studies, reinforcing the need for targeted policies to mitigate negative externalities and enhance economic resilience.

However, our research goes contrary to the argument put forward by Blanchard and Gali (2009), to the effect that exogenous influence of oil price volatility on EG has overtime waned due to the improvement of monetary policies, coupled with efficiency gains with regard to energy/OECD Countries consumption. While it is true for our analysis to recognize the mitigation factors put in place, it comes out that there is evidence of a significant negative effect of oil price volatility on GDP growth from the data. This could be because of the varying time periods and econometric methodologies that the studies utilized.

Our results align with those of Blanchard and Galí (2009) and Sánchez García and Cruz Rambaud (2023), who assert that oil price volatility has detrimental effects on EG and stability. They argue that increased volatility raises costs for businesses and consumers, thereby reducing economic activity. Our study supports this view, demonstrating that oil price volatility consistently diminishes EG across various estimation models.

However, some studies indicate that this relationship is not straightforward, with factors, such as the structural characteristics of an economy and the monetary policy response influencing the outcome. For instance, Hamilton (2003) highlights the complexity of this relationship. Our study contributes to this literature by using a dynamic panel-data method, finding that lagged GDP is a significant determinant of current growth rates and that oil price volatility exacerbates negative growth trends in the short run. These results are in line with previous studies by Mory (1993) and Hamilton (1983, 2003, 2009).

Additionally, COPV poses a significant growth risk for OECD economies. While some studies suggest that adaptation measures may mitigate these impacts, our analysis confirms the importance of oil price stability for sustaining robust EG. This underscores the need for OECD countries to implement measures to cushion the effects of oil price volatility, such as diversifying energy sources, improving energy efficiency and maintaining sound monetary and fiscal policies.

Our findings are consistent with much of the existing literature (Akinsola & Odhiambo, 2020; Ghalayini, 2011; Odhiambo, 2020) which shows that EG is adversely affected by oil price volatility. However, our results also highlight the persistence of this relationship despite significant advancements in policy and technology. Future research should explore how structural shifts, alongside a greater emphasis on renewable energy sources, can further shield economies from the volatility of oil prices in the long term.

## 6. Implications

This study has several important implications for development and understanding of theory, for businesses and for policymakers.

### 6.1. Theoretical implications

The study helps in understanding the impact of COPV on EG. By examining the extensive consequences of COPV on EG and considering various macroeconomic variables, it contributes to a deeper understanding of the complex relationship between oil price volatility and EG. This contributes to economic theory

by shedding light on the mechanisms through which COPV affects EG in both oil-consuming and oil-producing countries. Also, the use of robust methodologies, such as random effect regression, fixed effect regression, one-step GMM models, and two-step GMM models contributes to methodological advancements in econometric analysis. These approaches enhance the validity and reliability of our findings, providing a solid foundation for theoretical implications derived from the results. The separate analyses for oil-consuming and oil-producing countries reveal divergent effects of COPV, with negative impacts on nations reliant on oil imports and benefits for those engaged in oil exports. This contributes to theories of international trade and economic development by highlighting the heterogeneous nature of COPV effects across different economies.

## 6.2. Practical implications

In times when the oil market is all over the place, governments in these countries have to stay ready to step up and do what it takes to keep things stable. It's important to remember that countries that both buy and sell oil do not usually get hit as hard by ups and downs in the market. This matches up with what experts have found in their studies, which shows that even though the oil market might calm down someday, having strong financial rules in place can help protect us from the wild swings in prices.

The models we use to predict how well an economy is doing usually take into account how the oil market affects things. So, it's important to keep an eye on the oil market and make plans to deal with its ups and downs. Policymakers should focus on finding ways to make the oil market more predictable as part of a bigger plan to grow our economies and make them stronger. Given the global nature of oil markets, addressing oil price volatility may require international cooperation and coordination among OECD member states and other major oil-producing nations. Collaborative efforts could focus on market regulation, information sharing and collective action to stabilize oil prices and promote EG.

## 7. Conclusion

This study examines the impacts of trade openness, inflation rates and COPV on EG across the most industrialized OECD nations spanning 23 years from 2000 to 2022. Four analytical methods were utilized: RE regression, fixed effect (inside) regression, dynamic panel data estimation (one-step system GMM) and dynamic panel-data estimation (two-step system GMM). The dynamic panel data analysis revealed a negative correlation between COPV and overall economic activity and growth within a broad data framework. Notably, specific coefficients for actual oil price volatility are significantly higher for countries like Norway and Canada than for others, highlighting their heightened vulnerability to oil price uncertainties due to their reliance on oil earnings. Conversely, countries importing oil are less affected by oil price fluctuations. For example, Norway exhibits a sensitivity measure about twice as high as that of the United States, underscoring the substantial impact of oil price volatility on EG, particularly for nations heavily reliant on oil exports.

This study investigates the asymmetric nature of oil price effects which adds nuance to existing economic theories. By demonstrating that changes in COPV have limited positive influence on EG while fluctuations in oil price significantly impact economic development, this study highlights the importance of considering both oil prices and COPV when assessing or predicting EG. This challenges traditional economic models that may overlook the distinct effects of COPV. The article advances theoretical understanding in the fields of macroeconomics, international trade, risk management and econometrics by examining the complex relationship between COPV, oil prices and EG, and providing insights into the diverse effects and implications for policymakers and businesses.

## 8. Limitations of the study and future scope

This study's main focus on crude oil volatility and how it affects macroeconomic factors has some limitations. In the future, researchers could really benefit from looking at electricity as another important part of energy markets. Studying how macroeconomic factors influence electricity consumption in both emerging and developed nations would give us a more complete understanding of how energy markets

work. To make their research even stronger, researchers could consider using a mix of cross-sectional and time-series data analysis methods. This would allow them to dig deeper into the connections between different economic variables and how they affect energy consumption patterns over time and in different regions.

### Author contribution statement

Reenu Kumari conceived the idea of the research, designed the initial research framework and prepared the initial draft of the article.

Sunil Kumar Singh conducted the analysis and interpretation of the data.

Shinu Vig critically revised the intellectual content of this article.

All authors agree to be accountable for all aspects of this work.

### Disclosure statement

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### About the authors

**Reenu Kumari** is working with Krishna School of Management, Krishna Group of Institutions, Ghaziabad, India. She received Ph.D from Indian Institute of Technology, Roorkee. She has fifteen years of experience in teaching and research. Her area of specialization is Finance & Accounting and areas of interest are FDI, Education, Economic Growth, Digitalization and Trade Openness.

**Sunil Kumar Singh** is working as an Assistant Professor in the Department of Computer Science & Information Technology, Mahatma Gandhi Central University, Bihar, India. His research interest lies in the area of Mobile Computing, Parallel Computing, Machine Learning, Internet of Things, and Blockchain Technology.

**Shinu Vig** is an academican and researcher with expertise in corporate governance, business sustainability, and corporate social responsibility. She is a Company Secretary and a law and commerce graduate, having an experience of more than fourteen years in corporate and academics. She has been awarded her Ph.D. at TERI School of Advanced Studies, India.

### ORCID

Reenu Kumari  <http://orcid.org/0000-0002-0910-9155>

Sunil Kumar Singh  <http://orcid.org/0000-0001-8954-6648>

Shinu Vig  <http://orcid.org/0000-0002-0063-0470>

### Data availability statement

The authors agree to the 'Share Upon Reasonable Request' policy followed by the journal. The data that support the findings of this study are available from the first author, upon reasonable request.

### References

- Abid, M., & Alotaibi, M. N. (2020). Crude oil prices and the private sector of Saudi Arabia: Do globalization and financial development matter? New evidence from combined cointegration test. *Resources Policy*, 69, 101774. <https://doi.org/10.1016/j.resourpol.2020.101774>
- Akinsola, M. O., & Odhiambo, N. M. (2020). Asymmetric effect of oil price on economic growth: Panel analysis of low-income oil-importing countries. *Energy Reports*, 6, 1057–1066. <https://doi.org/10.1016/j.egy.2020.04.023>
- Amuda, Y. J. (2023). Islamic financial surplus for energy and gas investment: Towards financial inclusion for improving living condition of needy and poor in Nigeria. *International Journal of Energy Economics and Policy*, 13(5), 394–406. [10.32479/ijeep.14514](https://doi.org/10.32479/ijeep.14514)

- Akinlo, T., & Apanisile, O. (2015). The impact of volatility of oil price on the economic growth in sub-Saharan Africa. *British Journal of Economics, Management & Trade*, 5(3), 338–349. <https://doi.org/10.9734/BJEMT/2015/12921>
- Anderson, T. W., & Hsiao, C. (1981). Estimation of dynamic models with error components. *Journal of the American Statistical Association*, 76(375), 598–606. <https://doi.org/10.1080/01621459.1981.10477691>
- Andersen, T. G., Bollerslev, T., & Meddahi, N. (2004). analytical evaluation of volatility forecasts\*. *International Economic Review*, 45(4), 1079–1110. <https://doi.org/10.1111/j.0020-6598.2004.00298.x>
- Arellano, M., & Bover, O. (1995). Another look at the instrumental variables estimation of error component models. *Journal of Econometrics*, 68(1), 29–51. [https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/10.1016/0304-4076(94)01642-D)
- Barro, R. J. (1998). *Human capital and growth in cross-country regressions* (pp. 1–56). Harvard University.
- Baumeister, C., Peersman, G., & Van Robays, I. (2010). The economic consequences of oil shocks: Differences across countries and time. *Inflation in an era of relative price shocks, reserve bank of Australia* (pp. 91–128). Ghent University.
- Bilal, M., Aamir, M., Abdullah, S., & Khan, F. (2024). Impacts of crude oil market on global economy: Evidence from the Ukraine-Russia conflict via fuzzy models. *Heliyon*, 10(1), e23874. <https://doi.org/10.1016/J.HELIYON.2023.E23874>
- Bjørnland, H. C., Larsen, V. H., & Måih, J. (2018). Oil and macroeconomic (in)stability. *American Economic Journal: Macroeconomics*, 10(4), 128–151. <https://doi.org/10.1257/mac.20150171>
- Blanchard, O., & Galí, J. (2009). The Macroeconomic Effects of Oil Price Shocks. *International Dimensions of Monetary Policy*, 373.
- Blanchard, O. J., & Galí, J. (2010). The macroeconomic effects of oil price shocks: Why are the 2000s so different from the 1970s? In J. Galí, & M. Gertler (Eds.), *International dimensions of monetary policy*. Chicago Scholarship Online. <https://doi.org/10.7208/chicago/9780226278872.003.0008>, accessed 20 June 2024.
- Carruth, A. A., Hooker, M. A., & Oswald, A. J. (1998). Unemployment equilibria and input prices: Theory and evidence from the United States. *Review of Economics and Statistics*, 80(4), 621–628. [10.1162/003465398557708](https://doi.org/10.1162/003465398557708)
- Cuñado, J., & Pérez de Gracia, F. (2003). Do oil price shocks matter? Evidence for some European countries. *Energy Economics*, 25(2), 137–154. [https://doi.org/10.1016/S0140-9883\(02\)00099-3](https://doi.org/10.1016/S0140-9883(02)00099-3)
- Das, D., Kumar, S. B., Tiwari, A. K., Shahbaz, M., & Hasim, H. M. (2018). On the relationship of gold, crude oil, stocks with financial stress: A causality-in-quantiles approach. *Finance Research Letters*, 27, 169–174. <https://doi.org/10.1016/j.frl.2018.02.030>
- de Cavalcanti, T. V., Mohaddes, K., & Raissi, M. (2015). Commodity price volatility and the sources of growth. *Journal of Applied Econometrics*, 30(6), 857–873. <https://doi.org/10.1002/jae.2407>
- Evans, O. (2023). The investment dynamics in renewable energy transition in Africa: The asymmetric role of oil prices, economic growth and ICT. *International Journal of Energy Sector Management*, 18(2), 229–247. <https://doi.org/10.1108/IJESM-03-2022-0002>
- Faisal, S. M., Salari, T. E., & Adibian, M. S. (2024). What is the effect of the 2008 economic crisis and the Covid-19 pandemic crisis on oil consumption in selected OECD countries? *Energy Policy*, 188, 114055. <https://doi.org/10.1016/j.enpol.2024.114055>
- Federer, J. P. (1996). Oil price volatility and the macroeconomy. *Journal of Macroeconomics*, 18(1), 1–26. [https://doi.org/10.1016/S0164-0704\(96\)80001-2](https://doi.org/10.1016/S0164-0704(96)80001-2)
- Fesharaki, F., & Hoffman, S. L. (1985). OPEC and the structural changes in the oil market: The outlook after the counter-revolution. *Energy*, 10(3–4), 505–516. [https://doi.org/10.1016/0360-5442\(85\)90065-9](https://doi.org/10.1016/0360-5442(85)90065-9)
- Ghalayini, L. (2011). The interaction between oil price and economic growth. *Middle Eastern Finance and Economics*, 13(21), 127–141. [https://www.researchgate.net/publication/235939209\\_The\\_Interaction\\_between\\_Oil\\_Price\\_and\\_Economic\\_Growth?enrichId=rgreq-515ed745-3bd2-4fba-9256-bb9d74c01097&enrichSource=Y292ZXJQYWdloZlNTkzOTlwOTtBUzoxMDUwMDY4OTlwNjA2NzZAMTQwMjA0NzAwMzExMw%3D%3D&el=1\\_x\\_2](https://www.researchgate.net/publication/235939209_The_Interaction_between_Oil_Price_and_Economic_Growth?enrichId=rgreq-515ed745-3bd2-4fba-9256-bb9d74c01097&enrichSource=Y292ZXJQYWdloZlNTkzOTlwOTtBUzoxMDUwMDY4OTlwNjA2NzZAMTQwMjA0NzAwMzExMw%3D%3D&el=1_x_2)
- Gupta, K., & Krishnamurti, C. (2018). Do macroeconomic conditions and oil prices influence corporate risk-taking?. *Journal of Corporate Finance*, 53, 65–86. <https://doi.org/10.1016/j.jcorpfin.2018.10.003>
- Hamilton, J. D. (1983). Oil and the macroeconomy since world war II. *Journal of Political Economy*, 91(2), 228–248. <https://doi.org/10.1086/261140>
- Hamilton, J. D. (1996). This is what happened to the oil price-macroeconomy relationship. *Journal of Monetary Economics*, 38(2), 215–220. [https://doi.org/10.1016/S0304-3932\(96\)01282-2](https://doi.org/10.1016/S0304-3932(96)01282-2)
- Hamilton, J. D. (2003). What is an oil shock? *Journal of Econometrics*, 113(2), 363–398. [https://doi.org/10.1016/S0304-4076\(02\)00207-5](https://doi.org/10.1016/S0304-4076(02)00207-5)
- Hamilton, J. D. (2009). Causes and Consequences of the Oil Shock of 2007–08 (No. w15002). National Bureau of Economic Research.
- Hausman, J. A. (1978). Specification tests in econometrics. *Econometrica*, 46(6), 1251–1271. <https://doi.org/10.2307/1913827>
- Henry, J. D. (1977, February). The effect of oil price policy on tertiary oil recovery. In SPE Hydrocarbon Economics and Evaluation Symposium (pp. SPE-6354). SPE.
- Hooker, M. A. (1996). What happened to the oil price-macroeconomy relationship? *Journal of Monetary Economics*, 38(2), 195–213. [https://doi.org/10.1016/S0304-3932\(96\)01281-0](https://doi.org/10.1016/S0304-3932(96)01281-0)
- Jiménez-Rodríguez, R. (2008). The impact of oil price shocks: Evidence from the industries of six OECD countries. *Energy Economics*, 30(6), 3095–3108. <https://doi.org/10.1016/j.eneco.2008.06.002>



- Kilian, L., & Vigfusson, R. J. (2011). Nonlinearities in the oil price–output relationship. *Macroeconomic Dynamics*, 15(53), 337–363. <https://doi.org/10.1017/S1365100511000186>
- Kocaarslan, B., Soytaş, M. A., & Soytaş, U. (2020). The asymmetric impact of oil prices, interest rates and oil price uncertainty on unemployment in the US. *Energy Economics*, 86, 104625. <https://doi.org/10.1016/j.eneco.2019.104625>
- Kumari, R., & Sharma, A. K. (2017). Determinants of foreign direct investment in developing countries: A panel data study. *International Journal of Emerging Markets*, 12(4), 658–682. <https://doi.org/10.1108/IJoEM-10-2014-0169>
- Kumari, R., & Sharma, A. K. (2019). Why India still fighting for first FDI receipt country. *International Journal of Business and Globalisation*, 23(4), 549. <https://doi.org/10.1504/IJBG.2019.104834>
- Kumari, R., Shabbir, M. S., Saleem, S., Khan, G. Y., Abbasi, B. A., & Lopez, L. B. (2021). An empirical analysis among foreign direct investment, trade openness and economic growth: Evidence from the Indian economy. *South Asian Journal of Business Studies*, 12(1), 127–149. <https://doi.org/10.1108/SAJBS-06-2020-0199>
- Kumari, R., & Sharma, A. K. (2018). Long-term relationship between population health, FDI and economic growth: New empirical evidence. *International Journal of Business and Globalisation*, 20(3), 371–393. <https://doi.org/10.1504/IJBG.2018.091512>
- Lardic, S., & Mignon, V. (2006). The impact of oil prices on GDP in European countries: An empirical investigation based on asymmetric cointegration. *Energy Policy*, 34(18), 3910–3915. <https://doi.org/10.1016/j.enpol.2005.09.019>
- Lardic, S., & Mignon, V. (2008). Oil prices and economic activity: An asymmetric cointegration approach. *Energy Economics*, 30(3), 847–855. <https://doi.org/10.1016/j.eneco.2006.10.010>
- Lorusso, M., & Pieroni, L. (2017). The effects of military and non-military government expenditures on private consumption. *Journal of Peace Research*, 54(3), 442–456. <https://doi.org/10.1177/0022343316687017>
- Mehrara, M., & Oskoui, K. N. (2007). The sources of macroeconomic fluctuations in oil exporting countries: A comparative study. *Economic Modelling*, 24(3), 365–379. <https://doi.org/10.1016/j.econmod.2006.08.005>
- Mohaddes, K., & Pesaran, M. H. (2016). Country-specific oil supply shocks and the global economy: A counterfactual analysis. *Energy Economics*, 59, 382–399. <https://doi.org/10.1016/j.eneco.2016.08.007>
- Mohaddes, K., & Pesaran, M. H. (2017). Oil prices and the global economy: Is it different this time around? *Energy Economics*, 65, 315–325. <https://doi.org/10.1016/j.eneco.2017.05.011>
- Mohaddes, K., & Raissi, M. (2017). Do sovereign wealth funds dampen the negative effects of commodity price volatility? *Journal of Commodity Markets*, 8, 18–27. <https://doi.org/10.1016/j.jcomm.2017.08.004>
- Mork, K. A. (1989). Oil and the macroeconomy when prices go up and down: An extension of Hamilton's results. *Journal of Political Economy*, 97(3), 740–744. <https://doi.org/10.1086/261625>
- Mory, J. F. (1993). Oil prices and economic activity: Is the relationship symmetric? *The Energy Journal*, 14(4), 151–161. <https://doi.org/10.5547/ISSN0195-6574-EJ-Vol14-No4-10>
- Nakov, A., & Pescatori, A. (2010). Oil and the great moderation. *The Economic Journal*, 120(543), 131–156. <https://doi.org/10.1111/j.1468-0297.2009.02302.x>
- Odhiambo, N. (2020). Oil price and economic growth of oil-importing countries: A review of international literature. *Applied Econometrics and International Development*, 20, 1–23. <https://www.usc.es/economet/reviews/aeid2019.pdf>
- Omojolaibi, J. A., & Egwaikhide, F. O. (2013). A panel analysis of oil price dynamics, fiscal stance and macroeconomic effects: The case of some selected African countries. *Economic and Financial Review*, 51(1), 4. <https://dc.cbn.gov.ng/efr/vol51/iss1/4/>
- Plante, M., & Traum, N. (2012). Time-varying oil price volatility and macroeconomic aggregates. Center for Applied Economics and Policy Research Working Paper No. 2012-002. Available at SSRN: <https://ssrn.com/abstract=2005312> or <http://dx.doi.org/10.2139/ssrn.2005312>
- Plourde, A., & Watkins, G. C. (1998). Crude oil prices between 1985 and 1994: How volatile in relation to other commodities? *Resource and Energy Economics*, 20(3), 245–262. [https://doi.org/10.1016/S0928-7655\(97\)00027-4](https://doi.org/10.1016/S0928-7655(97)00027-4)
- Sadorsky, P. (1999). Oil price shocks and stock market activity. *Energy Economics*, 21(5), 449–469. [https://doi.org/10.1016/S0140-9883\(99\)00020-1](https://doi.org/10.1016/S0140-9883(99)00020-1)
- Salisu, A. A., Isah, K. O., Oyewole, O. J., & Akanni, L. O. (2017). Modelling oil price-inflation nexus: The role of asymmetries. *Energy*, 125, 97–106. <https://doi.org/10.1016/j.energy.2017.02.128>
- Salisu, A. A., Isah, K., & Oloko, T. O. (2024). Technology shocks and crude oil market connection: The role of climate change. *Energy Economics*, 130, 107325. <https://doi.org/10.1016/j.eneco.2024.107325>
- Sánchez García, J., & Cruz Rambaud, S. (2023). Volatility spillovers between oil and financial markets during economic and financial crises: A dynamic approach. *Journal of Economics and Finance*, 47(4), 1018–1040. <https://doi.org/10.1007/s12197-023-09634-x>
- Wachtmeister, H., Henke, P., & Höök, M. (2018). Oil projections in retrospect: Revisions, accuracy and current uncertainty. *Applied Energy*, 220, 138–153. <https://doi.org/10.1016/j.apenergy.2018.03.013>
- Zhang, R., Zhao, W., & Wang, Y. (2024). Is there a relationship between economic growth and natural resource commodity price volatility? Evidence from China. *Resources Policy*, 88, 104391. <https://doi.org/10.1016/j.resourpol.2023.104391>

## Appendix 1. List of sample countries

Country code	Country name	Full name
4	AUS	Australia
5	AUT	Austria
9	BEL	Belgium
13	CAN	Canada
20	CHE	Switzerland
21	DEU	Germany
24	DNK	Denmark
25	ESP	Spain
27	FIN	Finland
29	FRA	France
35	GBR	Great Britain
38	GRC	Greece
39	IRE	Ireland
40	ISL	Iceland
51	ITA	Italy
53	JPN	Japan
55	KOR	South Korea
58	LUX	Luxemburg
59	MEX	Mexico
68	NLD	Netherlands
70	NOR	Norway
73	NZL	New Zealand
74	PRT	Portugal
79	SWE	Sweden
80	TUR	Turkey
81	USA	United States