Spillover connection between oil prices, energy risk exposure, and financial stability: implications for the COVID-19 pandemic

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Received: 8 March 2022 / Accepted: 22 May 2022 / Published online: 13 June 2022
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Abstract
The aim of the study is to test the nexus between oil prices, energy risk exposure, and financial stability to recommend the implications for the period of COVID-19 crises. The study findings show that a systemic macroeconomic simulation that combines with the 17% oil prices and 26% energy risk exposure at household item demand gives a rise to energy subsidies at 18.14% and it contributes to make energy financing as efficient as 38.3% in study context. By this, the oil prices and energy risk exposure repercussions caused significant connection with financial stability. Utilization of oil-importing and oil-exporting economies necessitates the use of energy. Energy and capital are complementary in manufacturing. Following the study findings, we suggested and adjusted the energy risk exposure framework to take into account. The findings show that allocating oil price-related subsidy to enterprises yields the best policy results. However, the benefit to society as a whole is quite small. Additional analysis results indicate that in a less energy-dependent sector, having no subsidies would be the best strategy. On such benefits, different policy implications are also suggested for associated individuals to sustain financial stability.

Keywords Financial stability · Oil prices · Energy risk exposure · COVID-19 crises · Green capital formation

Introduction
Oil price has fluctuated dramatically since the 1970s. In most cases, these alterations are the product of prior occurrences (Khindanova and Atakhanova 2002). World Wars I and II as well as the 2008 global financial crisis are examples of this (Allen et al. 2020). When the oil market tanked in 2014–2015, followed by the flu pandemic a few years later, the end of the preceding decade was signaled by these two events (Alodayni 2016). On Monday, April 21, 2020, the price of US unrefined oil reached negative for the first time ever; since producers were compelled to pay consumers for barrels, they could not keep due to surplus (Mensi et al. 2017). COVID-19 has a direct impact on Russia’s deal with the Organization of Petroleum Exporting Countries because of this provision (OPEC). Offices and businesses have been compelled to close because of the spread of COVID-19, lowering demand for energy and gasoline in particular (Umar et al. 2021). Thus, the motivation of the study is to test the nexus between oil prices, energy risk exposure, and financial stability in OECD economies.

Although several countries have shown energy improvements throughout the world, oil is still a major source of power (He et al. 2021). Unrefined oil is a valuable commodity on the product market. Uncertified oil prices have fluctuated widely during the preceding decade (El-Sharif et al. 2005). It is also important to note that the volatility of oil prices significantly impacts financial markets in real-time economies (Sadorsky 2001). This situation is of particular interest to many stakeholders, including oil industry insiders, legislators, and investors alike. Even greater attention is paid when prices diverge from their underlying values (Kisswani and Elian 2017). Speculators worry greatly about
oil price bubbles (Hesse and Poghosyan 2016). In the world of money, there are fundamental reasons and causes and ongoing help. In order to avoid bubbles, governments will implement pertinent regulations (Kisswani and Elian 2017). For the most part, journalists are dubious about traders’ ability to make sensible decisions in light of recent market fluctuations (Roncoroni et al. 2021). The financialization of commodity markets is blamed for this investigation’s present state of things. The fast variations in bubbles have been found in other research to explain supply and demand (Curtin et al. 2019). We found an oil market bubble assault during the COVID-19 reporting period (Moya-Martínez et al. 2014). This study explores whether the oil market functioned rationally and efficiently during the pandemic, or if a negative financial bubble accompanied the shock of lower demand. “Oil price volatility has long been seen as an important yet challenging problem (Henriques and Sadosky 2008). Not only does oil play a crucial role in the industry, but it also has a massive impact on consumer spending power. Crude’s average value movements are the primary cause of oil price fluctuations. Changes in global economic circumstances and geopolitical tensions significantly impact energy prices (Chen and Chen 2007). During the 1970s, oil prices fluctuated widely, but the 2008–2009 global financial crisis led to a significant decline in oil prices.” 2014–2015 saw a substantial change in the oil business due to the USA’ shale revolution (Basher et al. 2012). Shale oil from the USA was indeed responsible for increasing domestic oil output in 2014. Shale oil accounts for more than a third of onshore crude oil production (Backus and Crucini 2000).

It is no longer possible for OPEC leaders like Saudi Arabia to decrease output in order to raise oil prices, as they previously did (Amano and Van Norden 1998). Oil-producing nations fail to reach an agreement on oil supply (Mohaddes and Pesaran 2017). COVID-19’s ongoing coronavirus outbreak sent shockwaves across the oil industry, amplifying the already-existing problems. In the beginning, there was a nice surprise (Filis et al. 2011). Because Saudi Arabia and Russia were unable to agree on cuts to lubricant output by March 2020, Saudi Arabia has undoubtedly boosted its oil production above its present capacity of 12.5 million barrels per day. A 30% decline in March 2020 oil prices was caused by the company selling its goods at below-market prices. Oil prices had fallen to their lowest level since January 1991, when WTI plummeted 33% during the Persian Gulf War. The present oil exchange conflicts and changing oil prices are of little relevance to any of the three leading oil producers (Gil-Alana and Monge 2020). In response to Donald Trump’s administration, Saudi Arabia and Russia have agreed to reduce their oil output on April 11, 2020. Consequently, the oil price skyrocketed, demonstrating volatility of roughly 20% and more after that.

COVID-19’s lockdowns in several nations sparked a chorus of disbelief in the oil industry. Fuel consumption decreased drastically because of the coronavirus pandemic, hurting a broad range of electrical markets (Apergis and Apergis 2020). Because of the worldwide effect of preaching, there was a sense of uncertainty. Because of the uncertainties, governments were encouraged to close down essential businesses in the major oil-importing industrialized and rising nations. Immediately before COVID-19, oil consumption fell substantially, which was already visible due to the high degree of uncertainty, notably in the USA and Japan (Smyth and Narayan 2018). The oil market is, in fact, still highly volatile (Su et al. 2019a, 2019b). The recent revelation of COVID-19 vaccines, for example, sparked an increase in oil prices (Ferrer et al. 2018).

Furthermore, there is a great deal of uncertainty around each company and the recovery from COVID-19, which might lead to an unexpected increase in demand (Charfedine and Barkat 2020). Global unemployment is rising due to warning signals and symptoms appearing from industrialized and emerging economies. Public deficits and debt levels are also at historic highs, owing to the government’s continued use of financial advice to help the country’s healthcare infrastructure. According to Beckmann et al. (2020), the current situation in the oil industry is unusual. The coronavirus pandemic has given the oil company a new lease of life, in addition to the same vintage background of geopolitical climate and more political turbulence and the protracted weakness of commodities markets for the cause of the present global economic crisis.

In this essay, we examine the impact of the present public health issue on oil costs and suggest ways to lessen such consequences (Nasreen et al. 2020). In the framework of COVID-19, we see oil price variations as a shock that influences all supply and demand. We must also consider the possibility of improving oil price volatility forecasts as we examine the data from these shocks (Kumar 2019). This information is particularly critical to help investors and policymakers better understand oil charge patterns in the context of a comparable fitness crisis. Oil price fluctuations, an essential but complicated topic, are continually under discussion (Husain et al. 2019). As it turns out, oil is not always the most straightforward first-rate component in manufacturing, but it is also a key influence in consumer energy purchases. Changes in the amount of oil in the tank are the primary cause of fluctuations in oil rates. Economic
speculation and geopolitical concerns cannot influence these fluctuations concurrently or directly in oil prices (Hailemariam et al. 2019). The global financial crisis of 2008–2009, for example, caused unexpected demand for oil at a period when price swings in the 1970s were due to delivery shocks (Akcay 2021).

According to 2014–2015, the US shell revolution has profoundly altered the oil business (Dawar et al. 2021). US shale oil output had risen since 2014 when shale oil was first discovered. More than a third of the crude oil produced along the Gulf Coast is derived from shale oil. To be sure, oil prices have changed significantly in recent years, and the USA has now overtaken Russia and OPEC as the world’s top oil producers, respectively. Just because it is not to say there is not a role for the delivery shock in today’s oil market, instead, it is that shale oil production in Austria and New Zealand has made it less of a factor. Complexity has been increased because of oil companies inside companies and oil pricing standards. In reality, oil prices fluctuated greatly in 2014 due to these changes (Cheng et al. 2019).

As a result of an investigation of how epidemics affect the link between oil prices and stock returns, hedging tactics for energy risk may be improved. First, crude oil and natural gas producers in non-financial businesses have always benefited from increased oil prices. Companies in the home improvement, utility, entertainment, and waste and disposal sectors that rely on oil are among the biggest winners because of the recent drop in oil prices. Second, the oil price is moderated by COVID-19 in the financial and non-financial businesses. A modest positive (negative) exposure to oil price risk has been reported in non-financial businesses such as oil supply and demand industries during COD-19.5 (e.g., banks). The price COVID-19 is seeing a small amount of unfavorable publicity. For financial and non-financial businesses, the exposure to oil price risk remains substantial across all regions and even in the context of alternative asset pricing frameworks.

**Literature review**

The most frequently recognized definition of a bubble is when the price of an asset considerably deviates from its fundamental value (Li et al. 2021a, 2021b). As a result, investors are willing to pay a premium for an asset if they feel it will be worth more in the future. The notion of a reasonable bubble was initially introduced (Iqbal et al. 2021a, 2021b). A fast surge in asset values followed by a later fall is another hallmark of financial bubbles that have become well-known and recognized. The discussion of the function of market speculation in raising oil prices is one of the book’s most significant issues. According to Li et al. (2021a, 2021b), the vulnerability presented by speculation is typically exploited to push up oil prices (2009). According to the findings, rising market expectations considerably influence cost fundamentals (Anh Tu et al. 2021). In this research, theories significantly influence how oil flows and air pockets are organized. As trading volume grows, stock charge bubbles are more prone to repeat themselves. An analysis by Iqbal and Bilal (2021a, 2021b) found that the rise in oil prices is caused by various economic and energy-related variables. Over-enthusiastic hobbyist was the root cause of the collapse of the resource bubble and disintegration identified by Umar et al. (2021). Consequently, professionals need strong and observant equipment to find the beginning of the air pocket and determine whether to interfere. Political and energy supply shocks and global financial leisure activity have been linked to this air pocket direct (Iqbal et al. 2021a, 2021b). Methods for assessing the presence of financial market bubbles have been utilized in many ways (Ahmad et al. 2021). According to the previous studies that often use a technique known as Markov system exchange (MRS), it is possible to identify price bubbles by employing the force edge autoregressive (Engle and Granger, 1987). Huang et al. (2021) utilize an econometric model to study the incidence of air pockets in the US stock market. Payne and Waters (2007) employed an ADF-like test to examine the land venture trust market’s sporadic lowering of air pockets and obtained findings consistent with periodic bubble bursts (Iqbal and Bilal 2021a, 2021b).

Financial markets were explored in research that looked at the spread of COVID-19 and oil price volatility. We can examine the short-term and long-term effects of the COVID-19 danger on the environment using wavelets. As a result of this, they hypothesized that financial shocks might be disseminated more widely. In the COVID-19 setting, Buckman et al. (2020) focused on market sentiment. This study used a language method to show how news opinion and an overview-based consumer sentiment metric were highly linked (especially helpful in a setting like the COVID-19 emergency). Our examination of COVID-19’s impact on oil price volatility focused on the volatility of oil prices and the susceptibility of financial arrangements. So far, the effect of COVID-19 on the organic markets in both countries seems to support this. Because we focused on monetary arrangement vulnerability, we could detect further COVID-19 impacts via the vulnerability channel. VAR models utilized response through study results, resulting in an appropriate multivariate system for analyzing COVID-19’s effect on oil price instability (Zhang et al. 2021).

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It has become clear that the current monetary structure is more vulnerable than ever before, especially considering recent events like the COVID-19 outbreak and the sharp decline in the price of oil. Oil price declines and the COVID-19 outbreak are putting international financial markets at risk (Zhao et al. 2022). According to the OECD group, increasing oil costs are a big issue. They called on oil producers to reduce output and slash costs to levels commensurate with continued economic prosperity and security in 2004 when the OECD’s money priests issued their plea. Oil-producing nations may aid in balancing the global economy and fostering global financial stability in a low-interest and increased stockpile cost war (Sun et al. 2022). For example, it is possible to examine how oil prices affect growth and interest rates by looking at the correlation.

Whenever oil prices rise, the rate of monetary development slows down, and the variety of viable outcomes for economic expansion is reduced (Anh Tu et al. 2021). Consequently, diminishing financial development chances hurt stock prices since they lower the income projections of corporations. Price shocks may directly influence industry interest or supply, depending on how the shock impacts utilization and the availability of discretionary cash flow (Iqbal and Bilal 2021). Companies’ profits will suffer due to a fall in interest rates, which affects the amount of money they earn regularly. On the other hand, oil-exporting nations would perceive increasing oil prices as a positive pay effect, greater overall interest, higher results, and increased stock costs if the pay impact overcomes the increased creation expense (Li et al. 2021a, 2021b). Lower short-term interest rates are likely to affect speculation and financial rewards, which will be affected by the rise in oil prices. A shift in oil prices might also alter growth and, therefore, the financial arrangements that influence yield (Huang et al. 2021).

**Methodology**

**Time-varying parameter vector autoregressive (TVP-VAR) model**

The study used the extended form of the vector autoregressive (VAR) model with the help of time-varying parameters. Thus, the study applied this framework and examined the spillover connection between oil prices, risk exposure, and financial stability in OECD economies. The study selected the random effect size. By avoiding arbitrary selection, Bayesian approaches are less prone to anomalies and severe persistence than other methods (Antonakakis et al. 2020; Gabauer et al., 2020). This enables us to examine low-frequency and short-time series dynamical connections. The econometric measurement of TVP-VAR model is as follows:

\[
y_t = B_0y_{t-1} + \varepsilon_t, \text{ where } \varepsilon_t \sim N(0, S_t)
\]

\[
\begin{align*}
\text{vec}(B_t) &= \text{vec}(B_{t-1}) + \nu_t, \text{ where } \nu_t \sim N(0, R_t) \\
y_t &= \sum_{i=1}^{p} B_i y_{t-i} + \varepsilon_t = \sum_{j=0}^{\infty} A_j \varepsilon_{t-j}
\end{align*}
\]

We use time-varying coefficients and error covariance to derive dynamic connectivity metrics using extended forecast error variance decompositions. It comprises study proxies: the oil price and the OECD’s financial stability in the first instance and the oil price and the OECD’s energy risk exposure in the second case.

\[
\phi_{ij,t}(H) = \frac{\sum_{h=1}^{H-1} \psi_{ij,t}^{2g}}{\sum_{h=1}^{N} \sum_{t=1}^{H-1} \psi_{ij,t}^{2g}},
\]

with \(\hat{\phi}_{ij,t}(H)\) that denotes the h-step ahead GFEVD, \(\psi_{ij,t}(H) = \sum_{h=1}^{H-1} A_{H-h} \varepsilon_{t}, \Sigma_{h} \text{ the covariance matrix for the error } \varepsilon_{t}, \text{ and } \sum_{t=1}^{H} \phi_{ij,t}(H) = 1, \sum_{t=1}^{N} \phi_{ij,t}(H) = N \text{ by construction. These measurements are based on the constructs’ energy risk exposure, oil prices, financial stability, and directional and net connectedness. Accordingly, the extent of cross-market connectivity may be measured by calculating the total forecast error variance that is influenced by the shock connection across all markets, which is measured as:}

\[
\sum_{t=1}^{N} \phi_{ij,t}(H) \times 100 = \frac{\sum_{t=1}^{N} \phi_{ij,t}(H)}{\sum_{t=1}^{N} \phi_{ij,t}(H)} \times 100.
\]

Equations (3) and (4), which reflect the net total directional connectedness index, are used to determine net connectedness.

\[
C_{i\rightarrow j,t}^{g}(H) = \frac{\sum_{t=1}^{N} \phi_{ij,t}(H)}{\sum_{t=1}^{N} \phi_{ij,t}(H)} \times 100
\]

This is done by subtracting the net connectedness from variable \(I\) to all other variables \(j\).

**SVAR-GARCH-M model**

The study focused on investigating the clear consequences of oil price volatility on the two indices, rather than the indirect
impact of non-sector market volatility such as oil prices on financial stability. We use the study parameters to quantify financial stress and the Baker et al. (2016) are entitled with financial stability parameters. The study further assessed the impact of oil price changes on these two indexes, for which the structure system is given below:

\[ B y_t = C + \sum_{i=1}^{p} A_i y_{t-i} + \Delta H^{1/2} + \epsilon_t, \epsilon_t \mid \Omega_{t-1} \sim \text{iid}(0, H_t) \]  

(6)

Bivariate VARs may be constructed by estimating one free component in B and restricting the B matrix based on our assumption that only increases in oil prices have a simultaneous impact on financial stability (and on EPU for the second case). We were able to calculate a free variable in matrix form for a binomial VAR by adopting the strategy, applying limits on matrix B, and assuming that the structural shocks \( t \) are mutually independent. Structure inventions \((F (t-1))\) and structurally disruptions, \( -t \), are believed to be conditionally uncorrelated and independent of each other. This assumption by Elder and Serletis (2010) assumes that mechanical instability has no concurrent association with a diagonal covariance matrix \((H)\) \((t.)\) Modeling the variance as a multivariate regression GARCH is the preferred method.

\[ \text{diag}(H_t) = C_v + \sum_{j=1}^{1} F_j \text{diag}(\epsilon_t, \epsilon_t') + \sum_{j=1}^{1} G_j \text{diag}(H_{t-1}) \]  

(7)

This means that \( y (i,t) \) conditional’s variability \((F j and G i)\) is exclusively influenced by its prior squared errors and conditional variations. We use the Broyden, Fletcher, Goldfarb, and Shanno (BFGS) algorithm structure for the prediction of the binomial VAR-GARCH-M model utilizing full complete estimation method and statistically maximization of a log weighting factor, such as \( B, C, C_c, A, \Lambda, F, \) and \( G \).  

\[ l_y = -n/2 \ln(2\pi) + 1/2 \ln|B|^2 - 1/2 \ln|H_t| - 1/2 \ln(\epsilon_t' \epsilon_t) \]  

(8)

The IRFs for our SVAR-GARCH-M model can be represented as indicated by Elder (2003) as:

\[ \frac{\partial E(y_{j,t+k} \mid \epsilon_t, \Omega_{t-1})}{\partial \epsilon_t} = \sum_{i=0}^{K-1} \Theta_i B^{-1} \Lambda(F + G)_{t+i} B^{-1} F' l_1 \]  

(9)

where \( l_0 = \frac{\partial \epsilon_t}{\partial \epsilon_t} \) is an \( N \times \epsilon_t \) vector with \( \epsilon_t \) in the \( i \)th spot and 0 s elsewhere, and \( l_1 = \frac{\partial \epsilon_t'}{\partial \epsilon_t} \) is an \( N \times 1 \) vector with 2\( \epsilon_t \) in the \( N(i-1) + i \)th spot and 0 s elsewhere.

These measurement models show a direct influence of a shock \( \_ (i,t) \) on the dependent prediction of \( y \) \((j,t+k)\), while the first term reflects the effect of implied volatility on \( y \) \((j,t+k)\). The median conditioned interquartile range of the increase in oil prices. Our SVAR-GARCH-M error probability bands are built using random walk Metropolis (RWM) with 2500 burn in draws and 10,000 keeper draws. They illustrate the median of modeled reactions to oil price volatility, with 0.16 and 0.84 distributions for thresholds, respectively. Less is more when it comes to the strategies described above. Because we do not discriminate between supply and demand shocks in energy markets, we interpret the frequency components as an aggregate mix of price volatility during the study period. Second, we compare our model’s resonance frequency to a more typical generalized linear. Finally, we utilized the ARCH approach to compute our proxy variable for oil price uncertainty. Our model does not consider other factors.

### Data

Monthly data from January 2008 to December 2020 is used in this analysis, covering the era of the economic crisis, the European sovereign debt crisis, the COVID-19 pandemic, and the subsequent recession in OECD nations. These OECD countries include Austria, Australia,
Belgium, Canada, Chile, Colombia, Italy, Japan, Norway, and New Zealand. Canada is a net oil exporter, in contrast to Europe’s net oil importer status (IEA, 2020). Data-Stream, Thomson Eikon, Fred, and the BIS databases are used to build the financial stability series. The financial stability is a measure of financial wellbeing in the banking industry, the stock market, and the foreign currency market.

Results and discussion

Study results

The best fit was found in a bivariate VARX model with two additional slacks derived from the EPU and financial stress. Table 5 sums up the notion that was formed. Observations of a memory effect on oil value unpredictability have led us to advise that the last choice be maintained at its current value. According to a new study, crude oil prices are influenced by the COVID-19 shock. Value-related EPUs are also important in oil price volatility, indicating that a susceptibility connected with the confidence and sentiments of financial supporters has been a hotspot for oil value fluctuations. Increasing financial backer pressure and the EPU positively and significantly impacts oil price volatility. COVID-19 was more sensitive to two simultaneous shocks according to our earlier studies (supply shock and request shock). Using a similar VAR assessment for China’s coronavirus top, the flexibility of oil value unpredictability toward vulnerability increased from 3.1705 to 0.000123, a 288% rise toward vulnerability. This is quite crucial. Consequently, we discovered that oil price volatility had a beneficial effect on vulnerability (see Table 1). Recorded motivation response works are being used to demonstrate the link between oil value volatility and vulnerability.

Table 2’s estimations explained to assess these motivating reaction capacities, and the whole example situation was examined. A Monte Carlo simulation of power response was utilized to record this capability (number of redundancies: one thousand). With the Chelsey decomposition, we discovered the precise size of the shock. An effect of fee-related vulnerability and oil price uncertainty may be delayed by 2 days, according to our results (see Table 4).

Table 2 Serial correlation

| Parameters | OP     | ERE    | COVID   | FS     |
|------------|--------|--------|---------|--------|
| OP         | 1      |        |         |        |
| ERE        | 0.3162*| 1      |         |        |
| COVID      | −0.7411*| −0.0856*| 1      |        |
| FS         | 0.6414*| 0.7282*| 0.1979*| 1      |

*Means significance at 5%

In fact, oil price volatility responds substantially after 2 days, and it continues to do so for the next 10 days since the shock has not worn off. The fall of Gil-Alana and Monge also supports this view (2020). In addition, there may have been a slight lag in reaction time because of the need to switch introductions between the various oil producers in the USA. Finally, even if an oil price shock has a long-term impact on vulnerability, it is less substantial than an oil price shock’s quick response to a vulnerability shock. In contrast to previous investigations, our summary offers the writing on a wide range of exploration sites, including bubble intervals and disease effects in usual oil, notably at a point in the COVID-19 pandemic.

For this investigation, we used the LPPLS popularity strategy based on the DS LPPLS truth markers, which could analyze both good and poor air pockets linked to outstanding real occurrences using forward expectation, demonstrating its capacity to hypothesize climbs in advance. An indefensible faster than dramatic improvement (see Fig. 1) is activated by the LPPLS model in a way that is indefensible in terms of numerical and measurable material technological know-how of bifurcation and trade ranges, the economic hypothesis of an affordable assumption, and social financing of agents’ crowding, all in the name of a restorative response (Shu et al., 2021). Commotion brokers can use mass flooding and impersonation exchanges to reduce resource costs by using the LPPLS version’s ability to detect particular properties of the fee instructions that are often seen in bubble structures. Even in light of the current oil price trends and COVID-19’s flare-up, this summary provides valuable tips on identifying the problematic air pocket at some point in time.

In general, the risks of oil transportation in South Asian nations are significantly reduced by the easy availability of cash in the commercial sector. Indian rough merchants are more likely to vary than those from other South Asian nations, according to Table 3. These danger boundaries that threaten the rough importation security of South Asia have changed over time at different levels of the circulation chain because of the combined effects of macroeconomic conditions, an unrefined global business structure, and South Asian requirements for rough and associated boundaries. The risk limits for oil import security are revealed, and the structural shift emphasizes the unfamiliar reliance, and the unfamiliar appropriation point is brought to light. This is a major concern. There has been an increase in the hazard openness of South Asian nations’ rough importation distribution channels due to the loss of indigenous company sectors. The unrefined import security of South Asians was put in jeopardy by the unfamiliar dependent point of the conveyance channel, where the collected rough import source was the major danger border.

It is clear from the contrasting after-effects of crude oil exploration and production and cost levels and financial
proportions that our assessments act as an adversary of total petroleum derivative and demand shocks. For example, in Leduc and Liu (2016), total vulnerability stuns with negative total interest bearings are recognized as efficiency factors (Fasani and Rossi 2018). This demonstrates the entire vulnerability that hurts the global economy due to the decline in really global action due to falling oil prices. In addition, the development of the global crude stockpile reduces the cost of a barrel of petroleum throughout the globe. The response of the international oil business sectors reduces the weakness of crude costs below global crude inventories and increases crude expenses. For example, the breakdown of crude costs uncertainty plays a crucial role in explaining changes in the OECD oil prices and energy risk exposure.

Prior to this, despite the effects of complete vulnerability pre-provided food, macroeconomic limits really dropped due to the enormous crude dispersion vulnerability in the business sectors. There is a one percent difference between crude stock and total uncertainty at the zenith point. As was the case in the past, they immediately lowered crude oil prices. The strange thing is that it continues to send oil prices down as quickly as it has in the past. At least to a certain extent, it appears that a lack of confidence in crude oil could serve as an impetus for the development of macroeconomic and crude region territories (see Fig. 2), as the effects of uncertainty spreading from a complete financial framework to crude region are pre-caught by the expansion of combined uncertainty.

Some power tests were carried out as a means of confirming our findings. In particular, we re-assessed a VAR model using three factors—US oil interest, oil supply, and the WTI oil record—to directly evaluate the relationships between oil value instability and these shocks. Month-to-month data

Table 3 Dynamic connectedness to estimate the spillover connection.

|        | OP   | ERE  | COVID | FS    | Connect- |
|--------|------|------|-------|-------|----------|
| Austria| 0.1358 | 0.0571 | -0.0012 | 0.0777 | 0.0811   |
| Australia| 0.4375 | 0.2859 | -0.1177 | 0.5796 | 0.244    |
| Belgium | 0.3509 | 0.2163 | 0.1235 | 0.2183 | 0.126    |
| Canada  | -0.0404 | 0.1935 | 0.3169 | 0.2513 | 0.0782   |
| Chile   | -0.1913 | -0.4676 | 0.0122 | -0.2184 | 0.369    |
| Colombia| -0.6381 | -0.6857 | -0.0038 | -0.4279 | 0.256    |
| Italy   | 0.1989 | 0.6094 | 0.0481 | 0.4166 | 0.151    |
| Japan   | 0.2129 | 0.3438 | 0.0604 | -0.2824 | 0.953    |
| Norway  | 0.4194 | 0.6439 | -0.1218 | -0.3952 | -0.887   |
| New Zealand | 0.2327 | 0.2706 | 0.2461 | -0.3489 | 0.731    |
| Mean    | -0.5147 | 0.4789 | 0.6263 | -0.3246 | 0.992    |
| NPDC    | -0.1888 | 0.7167 | -0.3208 | -0.2505 | 0.231    |

Fig. 1 Spillover flow of study constructs in selected OECD economies
was used in this evaluation since daily data for oil supply and demand were unavailable. As a result, we used the US oil interest as an intermediary for oil interest, even though it is not truly reflective of the entire international demand for oil production. Figure 5 shows the results of a VAR model that we ran from January 2014 to March 2018 to examine the drive response works. According to the results of this study, an increase in OPEC oil production might hurt oil value volatility and be unrelenting. To be clear, the purpose of an inventory shock/slice is to increase oil prices, hence reducing oil value instability. However, the shale upset has diminished the impact of this stock shock, as previously said. Because of this, the oil value unpredictability work may be shown to be reliable. However, an increase in US oil usage (USOC) might significantly influence oil price volatility, but only after a 3-month wait and with an impact that could evaporate at any moment in time. US oil consumption is only a level of global oil consumption that helps clarify this (around 20%). Nonetheless, we believe that new organic market shocks in the oil industry due to COVID-19 significantly influence oil price volatility.

However, the increased dependency on oil imports is likely to pose a substantial challenge to the security of South Asian nations, while demand has climbed in agricultural countries for the most part. As a result, global crude oil stockpiles climbed by 7.7%, gross crude imports increased by 8.7%, and South Asian crude imports surged by 25.8% between 2011 and 2015 (see Fig. 3). As a result, the region’s strategy for energy security protection is jeopardized by increasing crude import dependency rather than consolidating crude import sources. There was a lot of turbulence in the 1980s oil markets due to the global financial crisis.

The depreciation of the rupee and the acceleration of India’s economic growth are both exacerbated when oil-producing countries like India are involved. Oil prices are influenced by several factors, including global and environmental issues, which might lead to unexpected fluctuations in the oil price. Understanding the oil unconventionality is critical because it can cause economic weakness and instability in many different nations. In addition, the unconventionality of oil esteem causes rapid growth and joblessness rates. Examining gold’s role in the global monetary system, assess if gold is a safe haven from the provisions of key developing and agricultural nations. Gold is recommended as both a barrier and a safe haven for essential South Asian monetary transactions, according to the creators of the product. For example, dry and warm summers in Europe might have an impact on agricultural products like wheat. A more
pressing worry is why gold and other precious metals have continued to soar, rather than the more current need to have a safe haven for financial supporters and speculative interests at stake. For the Asian oil market, this conclusion is not a surprise since environmental securities are available to support ecologically friendly initiatives, such as renewable energy projects. A rise in the price of crude oil would cause financial institutions to move to alternative energy sources since environmentally friendly power organizations aim to offer a trade for crude oil. As a result, the price of environmentally friendly electricity might be expected to rise at a slower pace than the price of crude oil.

Due to oil’s critical role in the global economy, many studies have been conducted on oil price movements’ financial and monetary effects. Researchers began to pay attention to the relationship between oil prices and macroeconomics in the twentieth century. There have been several oil fates and subsidiaries since the “financialization” of the oil business, and the separation has been increasing. The impact of oil price shocks on those sectors cannot be ignored when it comes to the financial markets. The relationship between crude oil and the financial markets has been seriously considered. Oil price fluctuations will likely considerably impact the financial markets through the following two pathways. First, oil price fluctuations may affect a company’s production cost, as oil makes up such a large part of the output. Increasing energy costs might harm company profits and family incomes, harming stock prices and overall financial growth.

On the other hand, Kilian and Park (2009) propose the “business cycle theory.” They propose that crude oil prices are a macroeconomic indicator and that a good development in the global business cycle simultaneously animates the crude oil market and the monetary market. Since oil is an unprocessed item that is used in the manufacture of oil, experts have begun to examine how the volatility of the monetary system affects oil price dynamics.

A study of the impact of oil price fluctuations on the financial vulnerability of emerging market firms is presented in this article. Specifically, we use the monetary pressure list to assess the monetary market’s susceptibility, including credit and liquidity hazard, corporate default hazard, and problems in contract markets. The following factors encourage us to investigate more. Many publications on oil price shocks look at the effects of various shocks separately specifies that price increases in oil might have radically different ramifications for the actual oil price, depending on the primary reason for the price increase. However, there are certain drawbacks to this approach. As Ready (2018) points out, the principal vector autoregressive model (SVAR) must identify shocks based on information connected to current or future changes in oil prices. Even more remarkable is that 77% of the contemporaneously acknowledged financial market shocks were accounted for in Kilian and Park (2009). In any event, it is almost hard to determine whether these increases in anticipatory interest are driven by concerns regarding supply or assumptions about the desired adjustments. A vector autoregressive (VAR) approach is used to decay price fluctuations into supply, demand, and hazard shocks (Tables 4 and 5). The term “oil price shock” refers to an increase in oil prices caused by changes in supply, demand, or risk. There seems to be just one study that focuses on the link between fragmented oil price shocks and monetary stress. The VAR system of Ready (2018) was not considered, nor were emerging business sectors selected by the panelists in this study (2018a).

Research on the influence of oil price changes on emerging market enterprises’ financial stability is analyzed in this article. A more precise method of measuring market vulnerability is the monetary pressure list, which comprises credit and liquidity hazard, corporate default hazard, contract market difficulties, and monetary market instability. In order to find out more, we need to consider the following criteria. Shocks in the oil market are examined independently by various publications because Kilian and Park

### Table 4 Lee-Strazich unit root analysis test

| Factor | T-Stats | β₁ | B₂ | Critical values |
|--------|---------|----|----|----------------|
| OP     | -0.1913 | -0.4676 | -0.0122 | -0.2184 | -0.3619 | -0.3536 |
| ERE    | -0.6381 | -0.6857 | -0.0038 | -0.4279 | 0.2513 | -0.0782 |
| COVID  | 0.1989  | -0.0404 | -0.0481 | 0.4166  | -0.1551 | -0.4229 |
| FS     | -0.2129 | -0.3438 | -0.0604 | -0.2824 | 0.1353 | 0.0916 |

1 means oil prices, 2 means energy risk exposure, 3 means financial stability

### Table 5 TVP-VAR model estimates

| m | e(1) | e(1) | e(1) | VAR  |
|---|------|------|------|------|
| 1 | -0.1656 | 0.0239 | 0.7284 | -0.00595 |
| 1 | (0.004) | (0.001) | (0.004) | (0.002) |
| 2 | 0.8532  | 0.7548 | 0.0337 | 0.0977 |
| 2 | 0.0396  | 0.5133 | 0.0177 | 0.6754 |
| 3 | 0.7626  | 0.1754 | -0.0018 | 0.6044 |
| 3 | (0.001) | (0.002) | (0.000) | (0.000) |

1 means oil prices, 2 means energy risk exposure, 3 means financial stability.
(2009) explains that price surges in oil may have dramatically different consequences on oil prices depending upon the underlying cause of their rise. There are, however, a few downsides to this strategy. For the SVAR model to be helpful, it must be able to recognize shocks related to changes in oil prices in the present or the future, as explained by Ready (2018). Even more impressive is the fact that Kilian and Park, (2009) accounted for 77% of the financial market shocks that were known at the time (2009). However, it is difficult to tell whether these increases in anticipatory interest are the result of supply-side worries or assumptions about the anticipated alterations, to put it politely. Price variations are decayed into supply, demand, and hazard shocks by using a vector autoregressive (VAR) technique. Oil price shocks are defined as price rises due to supply, demand, or risk factors. Fragmented oil price shocks and monetary stress have only been the subject of one research, it seems (see Table 6). According to this survey, neither the VAR system of Ready (2018) nor rising business sectors were picked by the panelists (2018a).

Second, we explore the nonlinear connection between oil price shocks and China’s monetary pressure following the fall in oil prices. It is becoming more and more critical to consider nonlinear relationships between oil prices and monetary business sectors as evidence of nonlinear dynamics in oil prices, the securities exchange, and rises in trade rates. Oil and stock prices seem to be moving in separate directions, yet the two appear to be linked at other moments in time. Using a nonlinear approach, we examined the correlation between oil prices and the Chinese monetary market in an attempt to explain this apparent contradiction. A straight model shows that oil prices and monetary movements are difficult to model, as shown by Zhang (2008) and Rahman and Serletis (2010).

On the other hand, we argue that a nonlinear model is more adapted to explain the relationship between oil price fluctuations and a list of monetary pressures. According to the results of BDS testing, a nonlinear relationship between them is possible. Because of this, we employ a Markov system exchange model, as Basher and colleagues did, to represent the nonlinear link.

An increasing amount of focus has been placed on correlations between oil prices and the status of the financial markets lately. When oil prices are volatile, it affects the global economy and currency stability. Crude oil patches’ unpredictability has a significant influence, which cannot be discounted. Academic papers often address the relationship between oil prices and the financial markets. Oil security exchanges and their overflows are monitored by a worldwide network of observers, such as Ma et al. (2019). Stock returns may be adversely affected by oil price fluctuations, according to some investors. In the first place, the study establishes an association between oil price swings and stock returns. They discover that this relationship is inversely across countries, including Canada, Japan, the UK, and the USA. According to Kalian and Park, supply shocks, total interest shocks, and explicit interest shocks all play a substantial influence in the re-evaluation of US oil prices (2009). They also point out that changes in the interest rate environment in the oil market have a detrimental impact on the US stock market.

### Robustness of findings

Degiannakis et al. (2014) analyze the influence of oil price shocks on Europe’s stock markets using three indices of instability. Since oil prices and interest rates have fluctuated, the financial markets have been less volatile. Despite this, a few studies have shown a favorable connection between the two sectors. According to Gong and Lin, public attitudes of China have grown dramatically in the last several years (2017). Broadstock and Filis have identified a long-term correlation between oil price shocks and stock returns (2014). For China, oil price fluctuations do not seem to be as serious as an issue as they are for the USA at this time. According to Wei and Guo (2017), many scholars believe oil price shocks are critical to China’s macroeconomic stability and so focus on the impact of oil price shocks on China’s securities market.

The study developed the TVP-VAR, a well-known nonlinear time series model (1990). This is often the case when it comes to time deposits and board records (see Table 7). The model relies on a mixture of parametric conventions that are likely to rely on

| OP | ERE | FS |
|----|-----|----|
| C-oil | −0.192* | 0.616* | 0.256* |
| (2.01) | (3.43) | (3.19) |
| ARCH-oil | 0.852* | −0.444* | −0.357* |
| (1.29) | (2.88) | (2.41) |
| GARCH-oil | −0.036* | 0.952* | −0.391* |
| (3.14) | (2.99) | (1.76) |
| M-effect | 0.615* | 0.743* | 0.919* |
| (2.31) | (2.02) | (1.11) |
| C-ERE | −0.423* | −0.156* | −0.462* |
| (2.35) | (3.10) | (2.78) |
| ARCH-oil | 0.317* | 0.668* | 0.123* |
| (2.91) | (2.45) | (2.41) |
| GARCH-oil | 0.336* | 0.553* | −0.837* |
| (2.32) | (2.54) | (2.62) |
| M-effect | 0.783* | 0.549* | 0.489* |
| (2.50) | (2.88) | (3.74) |
| Beta FS | 0.547* | 0.472* | 0.527* |
| Model criterion |
| SIC for VAR | 907.12 | 867.56 | 896.44 |
| SIC for GARCH-M | 1248.19 | 1001.61 | 998.50 |
unobserved monarchical aspects and examine various causes of time throughout the system rather than a simple fashion without permanent boundaries and changes in power. When the replacement of all bills is necessitated by unforeseen occurrences. Even though Markov’s method does not assume continual interruptions or a constant amount of power, it does consider various time functions. MRS is used to examine the specific pressure conditions in the Chinese financial market and see whether the effects of the oil price shock on China’s economic market are different from one another. An impartial judicial system has already been deployed for oil price shocks and economic pressure. In any case, the traditional minimum squares may exceed the assumption of a set recurrence threshold, and the recurrence may be misinterpreted with the version’s assistance. Therefore, an observable system component is used as a constraint for any changes to the framework in the MRS version. Starting with a model developed by Hamilton, the time series models developed by Markov have emerged as an attractive alternative for emphasizing various unexpected situations (1990). Nonlinearity and departures from the norm are becoming increasingly widespread in experimental work because of the use of system-changing models.

### Discussion

In the last 20 years, the usage of energy products for power supply, transportation fuel, and the functioning of enterprises has risen significantly. Carbon dioxide (CO₂) production is increasing at an alarming rate, which directly impacts the ecosystem and global climate change. As a result, a globalized globe and industrialized nations have come to appreciate the need for alternative energy sources, such as clean energy. Making a move to cleaner forms of energy is driven by a desire to keep the cosmos safe and well-maintained. An increasing worldwide desire for electricity goods also necessitates large capital expenditures in clean energy industries. In addition, there has been a growing preference for renewable power and a rise in environmental problems, which has led to an increase in the significance of clean energy projects for the government, investors, and manufacturers. As a result, academics and financiers are increasingly keeping an eye on the performance of renewable energy companies.

For this reason, a few studies have been done on the economic and financial repercussions of oil price variations. Researchers started to investigate the link between oil prices and fundamental economics in the twentieth century. Oil futures and derivatives have mushroomed due to the oil industry’s “bank lending,” and the fragmentation has been intensifying ever since. The influence of oil price shocks on the financial markets cannot be disregarded, and the link between crude oil and financial markets has been examined extensively (Yang et al. 2022). Price changes in oil are anticipated to impact the financial markets through the following two pathways significantly. First, oil price fluctuations directly affect businesses’ production costs, which is understandable given the importance

![Table 7 Robustness of findings through quantile estimation](image-url)

|       | φ1(τ) | ω0(τ) | λ0(τ) | λ1(τ) | OP  | ERE | FS  |
|-------|-------|-------|-------|-------|-----|-----|-----|
| 5%    | 0.711*|−0.369*|−0.682*|0.359*|−0.0054*|0.734*|0.242*|
|       | (0.004)|(0.001)|(0.002)|(0.000)|(0.002)|(0.000)|(0.002) |
| 10%   | 0.703*|0.419*|0.619*|0.157*|−0.537*|−0.129*|−0.139*|
|       | (0.004)|(0.008)|(0.059)|(0.000)|(0.000)|(0.000)|(0.000) |
| 20%   | 0.355*|0.702*|0.192*|−0.817*|0.084*|−0.122*|0.317*|
|       | (0.001)|(0.299)|(0.000)|(0.001)|(0.000)|(0.000)|(0.001) |
| 30%   | 0.894*|0.007*|0.188*|0.757*|0.656*|0.491*|−0.396*|
|       | (0.001)|(0.003)|(0.001)|(0.002)|(0.000)|(0.001)|(0.000) |
| 40%   | 0.398*|0.008*|−0.601*|−0.769*|−0.405*|−0.009*|0.711*|
|       | (0.002)|(0.002)|(0.000)|(0.000)|(0.000)|(0.001)|(0.000) |
| 50%   | 0.816*|0.591*|0.287*|0.621*|0.999*|0.874*|0.552*|
|       | (0.001)|(0.001)|(0.000)|(0.001)|(0.000)|(0.000)|(0.000) |
| 60%   | 0.725*|0.434*|0.341*|0.457*|0.628*|0.789*|0.182*|
|       | (0.001)|(0.003)|(0.000)|(0.002)|(0.002)|(0.001)|(0.002) |
| 70%   | 0.265*|0.181*|0.652*|−0.386*|0.507*|0.726*|0.185*|
|       | (0.008)|(0.001)|(0.002)|(0.001)|(0.002)|(0.000)|(0.000) |
| 80%   | −0.052*|0.811*|−0.625*|−0.295*|0.442*|0.203*|−0.214*|
|       | (0.006)|(0.002)|(0.001)|(0.001)|(0.001)|(0.001)|(0.001) |
| 90%   | −0.583*|−0.692*|−0.839*|0.573*|−0.267*|−0.0428|0.334*|
|       | (0.003)|(0.001)|(0.000)|(0.000)|(0.001)|(0.000)|(0.000) |
| 95%   | 0.037*|0.756*|0.384*|−0.214*|−0.566*|0.528*|0.465*|
|       | (0.002)|(0.006)|(0.000)|(0.001)|(0.000)|(0.001)|(0.001) |
of oil as a raw material. The actual income of families might be considerably impacted by higher costs, which could lead to a decline in stock prices and economic growth as a whole. On the other hand, other studies refer to “real economy theory.” Others claim that the price of crude is a macroeconomic indicator and that a favorable change in global business cycles concurrently boosts both crude oil and financial markets. Rather than just raw material for the production, oil has been typically used to evaluate an item, prompting experts to look at the possibility that economic stress might significantly impact oil changes in value (Bilal et al. 2022).

Most of these researchers found a strong correlation between oil and the financial industry, but few investigations devoted attention to the issue between oil prices and the whole capital sector. Monetary insecurity in developing economies is examined in this study. We utilize a financial instability index to evaluate unpredictability in the financial market, encompassing credit and liquidity risk, corporate default risk, distress in mortgage markets, and hazards in stock markets. The following items serve as inspiration for our work. There are three types of oil price volatility, according to Kilian and Park (2009), and many publications analyze these events independently because of these three types of oil price shocks and because it is suggests dividing oil prices into three types of shocks (Kilian and Park 2009). This structure, however, has certain flaws. However, one drawback is that the SVAR data must be tied to changes in oil prices that are either now occurring or will occur in the near future for the SVAR to help detect shocks.

Energy efficiency precaution demand shocks were also shown to explain 77% of the contemporaneous shocks in Kilian and Park (2009). However, it is impossible to tell whether these changes in precautionary demand are caused by supply worries or forecasts of demand changes. A vector autoregressive (VAR) model using the detection algorithms of Ready (2018) is used to deconstruct oil price fluctuations into production, need, and risk shocks in order to prevent these problems. Our understanding is that a price surprise in oil is produced by a shift in supply, demand, or risk. One other research has examined the link between deconstructed oil price shocks and financial stress, but this is the first time we have seen it done.

We decompose oil prices into their components before looking at how oil price shocks affect China’s financial stress. Nonlinear correlations between oil prices and the stock market, exchange rates, and other macroeconomic time indications are becoming more popular because of the rising indications of a quadratic interaction between crude prices and the stock market, currency values, and other macroeconomic time indicators. While oil and stock prices may seem to be moving in opposite directions, this is not always the case. Because of this discrepancy, we presented an empirical investigation of the nonlinear link between oil prices in China and the Chinese financial market. Zhang (2008) demonstrates that the link between the price of oil and economic activity cannot be reconciled with linear models. Therefore, we believe a nonlinear model is better to explain the link between oil price shocks and a financial stress index in the context described above. A further test, the BDS test, indicates that there may be some kind of nonlinear connection between the variables in question.

The nonlinearity of the relationship is thus captured by using a Markov puppet government model, as proposed by previous studies. Among system dynamic approaches, Hamilton’s MRS model is one of the most prominent. Applied to time series and panel data, it is commonly employed. According to the MRS framework, the chance of occurrence of a given event relies on the chances of an undiscovered stochastic process, and the model allows for time-varying causation across regimes. Exogenous events have shown effective when the adjustment seems to be driven mainly by the MRS model. Time-varying causality regimes may be accommodated by the Markov technique, unlike linear models with fixed parameters and no regime changes. It is possible that oil price shocks on the Chinese financial market change depending on the kind of stress. Hence, we adopt the MRS model. A government link has primarily been the focus of past research on the connection between oil price shocks and financial stress. Conventional ordinary least regression’s constant hypothesis, on the other hand, may be too rigid, resulting in an incorrect specification of the extrapolation itself.

There has also been some research on the link between oil prices and debt markets, currency rates, etc. The actual returns on the US bond index are examined by Kang et al. (2014) in light of demand and supply shocks in the international oil market. A further consideration in Al-Khazali and Mirzaei (2017) is whether the effect of oil price increases is uniform across banks on non-performing bank loans. There are also a variety of findings when it comes to the correlation between oil prices and the foreign currency market. Ghosh (2011), for example, looks at the connection between the price of Indian crude oil and the value of the rupee. As a consequence of the spike in oil costs, the Indian rupee has lost value against the US dollar. An exchange rate shock influences crude oil prices, which agrees with the predictions. Chen et al. (2016) explain why various studies have come to different findings. Dollar exchange rates react quite differently to international oil prices depending on whether supply or aggregate demand drives such changes. Their empirical data support this.

Conclusions and implications

The coronavirus has a tremendous impact on global personal and economic stability. It studies the effects of COVID-19 on accessibility to risk in both the financial and non-financial sectors worldwide. Oil supplier (client) companies often suffer the most (benefit). The COVID-19 outbreak has tentatively
connected global stock returns to shifts in oil prices. In contrast to the time before COVID-19, oil supply and framework providers exhibit a lower positive openness to oil price risk. During COVID-19, oil and financial firms show a weak negative openness to oil price risk. It seems that our findings are solid at the cost structure of the optional resources. Financial backer, portfolio leaders, and plan developers will find these especially important in reducing the risk of oil charges. We agree that the study on COVID-19 might be extended further and that the oil cost element could be higher for developed and advanced countries and/or oil bringing in enterprises than for countries dealing in oil. Writing on energy risk management has been enriched by the varying time periods between changes in oil prices and the resumption of industrial stocks during outbreaks (Baton et al., 2018). Reconsidering strategies that seem beneficial in social welfare and associated financial difficulties should be considered when they are used in public. Future exploration will benefit from establishing energy risk support strategies that include epidemics.

COVID-19’s financial influence on the worldwide monetary and trade system may be studied via our research of oil price fluctuations, which we feel is a valuable tool to evaluate the economic impact of the pandemic on the pricing of critical resources. In addition to affecting production costs and corporate earnings, unfavorable oil price swings may significantly impact macroeconomic programs that aim to increase growth and boost the economic rate of growth and social welfare. Oil market participants, politicians (e.g., the Federal Energy Regulatory Commission), and energy experts are likely to benefit from our findings. First, the precise timing of bubbles by SADF, GSADF, and LPQLS indicates the contagious influence of the energy market booms on the share market and other commodities. In view of the connections between energy prices and general economic output, it is even more critical to identify aggressive behavior and booms. Finally, the fact that a balloon bust caused the current banking problem is also relevant to our results.

Consequently, authorities must keep an eye on oil sector (favorable and unfavorable) bubbles. This is relevant to macroeconomic policy choices since the US currency and crude prices are linked. First, the sustainability of the currency rate is jeopardized when the energy market experiences booms. Second, authorities will be able to take action if leaks are discovered in a timely manner. Third, energy market booms are fundamental, and they are caused by geopolitical crises or pandemics in the oil industry. It is impossible to plan ahead for something like this. Because of this, authorities must devise suitable measures to mitigate the effects of oil price uncertainty. Consequently, they might invest in renewable energy sources like wind and solar power. It is possible to lessen the industry’s reliance on oil products by investing in other energy sources.

**Author contribution** Conceptualization, methodology, writing (original draft): Haoming Shi; data curation, visualization, editing, data analysis: Haiyang Zheng.

**Data Availability** The data that support the findings of this study are openly available on request.

**Declarations**

**Ethics approval and consent to participate** The authors declared that they have no known competing financial interests or personal relationships, which seem to affect the work reported in this article. We declare that we have no human participants, human data, or human issues.

**Consent for publication** We do not have any individual person’s data in any form.

**Competing interests** The authors declare no competing interests.

**Preprint service** Our manuscript is not posted at a preprint server prior to submission.

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