

Rethinking the Link between Global Economic Conditions and Oil Prices: A Quantile Perspective

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ABSTRACT

This study examines the dynamic interactions between WTI and BRENT crude oil prices and the Global Economic Conditions (GEC) index from May 1987 to October 2025. Using conventional unit root and linear Granger causality tests, we find that oil prices are non-stationary in levels, while GEC is stationary, and that linear causality is weak and asymmetric. To capture heterogeneous effects across market conditions, we apply Granger-causality-in-quantiles (Troster, 2018), revealing strong nonlinear and quantile-dependent relationships. Results show that GEC predominantly drives WTI across extreme market conditions, whereas Brent exhibits bidirectional causality with GEC, particularly in moderate-to-high volatility regimes. Overall, the evidence points out the presence of tail-dependent effects. It suggests that policy makers and investors should interpret oil-economic relationships considering the underlying market regime.

Keywords: BRENT, Global Economic Conditions, Quantile dependence, Granger causality in quantiles, WTI.

INTRODUCTION

Fossil energy is considered as a cornerstone of the world economy since the Industrial Revolution. Oil has gradually taken a central role as the most widely used and influential energy source (Rao et al., 2025). Movements in its price tend to attract close attention from financial markets, policymakers, and energy-intensive industries that rely on price signals to anticipate broader economic conditions (Qian et al., 2022, Lv & Wu, 2022). Shifts in oil prices feed directly into production costs, household energy bills, and transportation expenditures, and these effects often spill over into general economic uncertainty (F. Ahmed et al., 2025). In many countries, abrupt changes in oil prices can also unsettle financial markets (e.g., Maghyereh & Ziadat, 2024; Ahmed et al., 2025). It is therefore not surprising that oil price volatility continues to be regarded as a major contributor to economic slowdowns and negative growth (Raggad, 2021).

The relationship between oil prices and economic performance has been examined extensively, though the findings remain far from consistent. A large body of work reports a clear influence of oil price movements on economic activity (Hamilton, 1983; Mory, 1993; Cunado & Pérez de Gracia, 2003; Kilian, 2008; Sarwar et al., 2017; Akinsola & Odhiambo, 2020); Padhan et al., 2024; Salgueiro & Perobelli, 2025). Other studies, however, point to weaker or more complex dynamics, often finding nonlinear or asymmetric effects (Borozan & Lolic Cipicic, 2022); (Liu et al., 2021); (M. I. Ahmed et al., 2023); (Moussa et al., 2024); (Das et al., 2024). Such discrepancies may reflect

differences in countries' economic structures, energy diversification strategies, or simply whether they are net importers or exporters of oil (Troster et al., 2018).

One issue that often arises in this literature is the reliance on linear econometric approaches. While useful, linear models tend to summarize relationships through average effects and consequently miss the patterns that appear only during market conditions. This is a serious drawback in the context of oil markets, which are known for their sharp swings, abrupt shocks, and uneven reactions across different phases of the economic cycle. Furthermore, although the literature acknowledges non-linearity, the adoption of a comprehensive quantile-based framework to analyze the mutual interactions between Global Economic Conditions (GEC) and oil prices is still limited.

To address these limitations, the present study investigates how WTI and Brent crude prices interact with the Global Economic Conditions (GEC) index over the period from May 1987 to October 2025. Rather than relying solely on traditional methods, we adopt a quantile-based Granger-causality approach, which enables us to explore whether the relationships differ across the full spectrum of market states from deep downturns to periods of strong expansion. This framework (Troster, 2018) makes it possible to detect tail-dependent and nonlinear linkages that standard techniques tend to obscure.

Our analysis offers several contributions. First, it provides a comprehensive investigation of the asymmetric and regime-specific links between global oil markets and overall economic conditions. Second, by looking separately at WTI and Brent, we document significant differences in how each benchmark responds to shifts in the macroeconomy. Third, the outcomes have practical implications for policymakers and market participants who are interested in assessing risk and designing strategies in an environment characterized by ambiguity and repeating shocks.

The evidence we uncover points to pronounced nonlinearities and asymmetries, highlighting that the link between oil prices and the global economy is more complicated than implied by conventional analyses. These results emphasize the significance of employing tools that account for changing market regimes.

The remainder of the paper is structured as follows. Section 2 presents the data and methodological approach. Section 3 discusses empirical results. Section 4 concludes and outlines the main policy implications.

DATA AND ECONOMETRIC METHODOLOGY

Data

The study relies on monthly data covering the period from May 1987 to October 2025 and involving three main series: WTI, Brent crude oil prices, and the Global Economic Conditions (GEC) index. The GEC data were taken from Christiane Baumeister's personal website, while the oil price information comes from the U.S. Energy Information Administration (EIA), which provides consistent and widely used market data. The period was selected to ensure that all variables could be examined over a shared horizon and to capture a broad range of economic and geopolitical developments. This interval includes events such as the persistent impacts of the 1973–1974 oil crisis, the global financial turbulence of 2008, the COVID-19 shock, and the disruptions associated with the Russia–Ukraine conflict. Together, these episodes make the sample remarkably appropriate for examining how oil prices and global economic conditions vary together. Figure 1 presents the trajectories of the variables over the

full

sample

period.

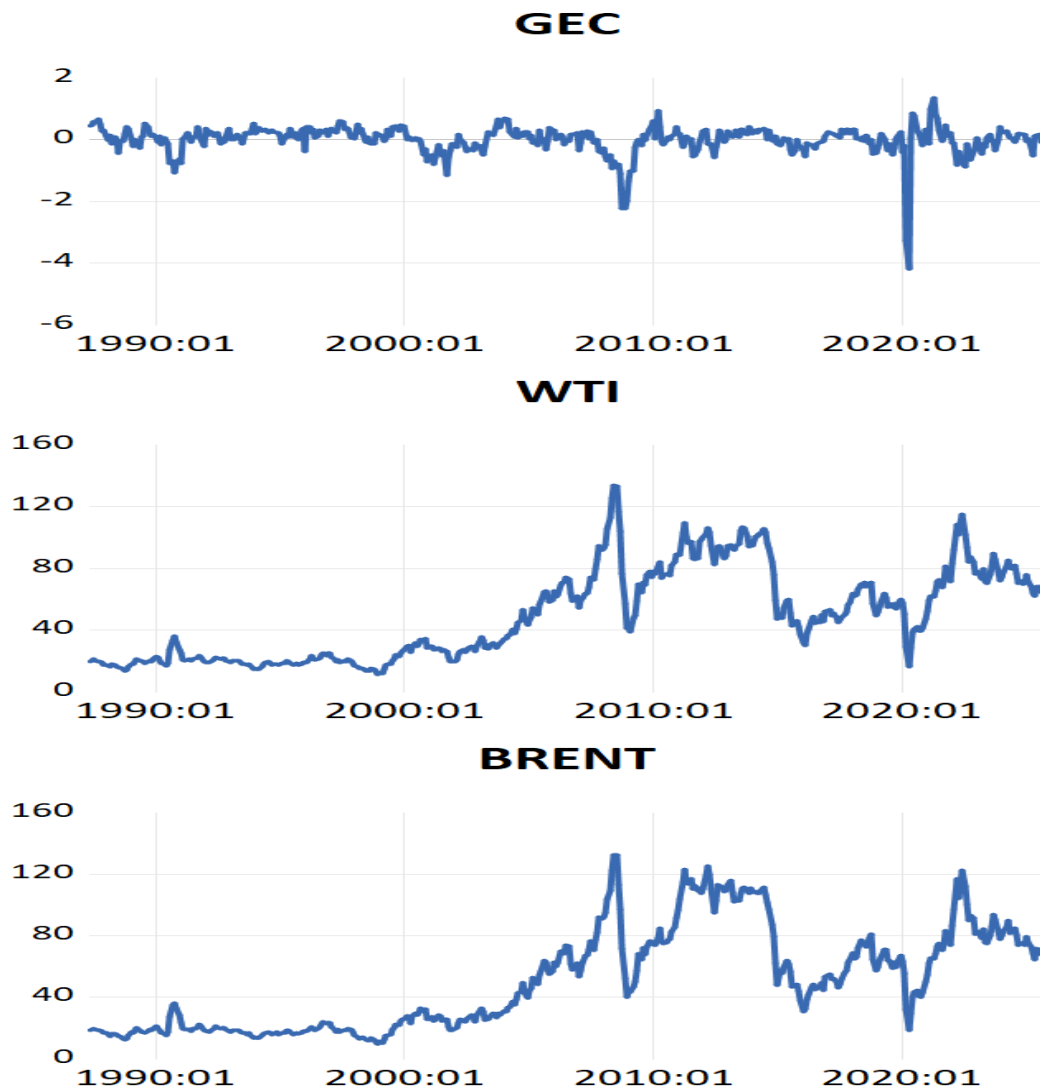


Figure 1. Dynamic Trajectories of the Series under Consideration.

As shown in Figure 1, both WTI and Brent follow similar long-run patterns and react strongly to major global events. Indeed, both series display periods of sharp rises and equally abrupt declines. The 2008 financial crisis, the mid-2010s supply-driven downturn, and the collapse in early 2020 during the COVID-19 outbreak stand out clearly in the data. A marked upswing appears again during the Russia–Ukraine conflict. In contrast, the GEC index exhibits its own distinct fluctuations, rising sharply ahead of the 2008 crisis and dropping drastically in early 2020. In contrast, the GEC index exhibited two main fluctuations: a sharp peak during the 2008 financial crisis and a severe drop in early 2020 following the COVID-19 pandemic. Table 1 summarizes some descriptive statistics for variables taken in log-differences series, except for GEC.

Table 1. Descriptive Statistics and Correlation Matrix.

	BRENT	WTI	GEC
Mean	0.270108	0.247665	-0.00391
Median	0.718831	1.10146	0.061901
Maximum	46.90511	54.5621	1.357964
Minimum	-55.4785	-56.8125	-4.18555
Std. Dev.	9.753526	9.368939	0.456429
Skewness	-0.59941	-0.60885	-3.32127
Kurtosis	9.189754	11.05462	25.84327
Jarque-Bera	763.5353	1274.66	10870.73
Probability	0	0	0

Observations	461	461	461
Correlation matrix			
BRENT	1		
WTI	0.956 ^(a)	1	
GEC	0.388 ^(a)	0.406 ^(a)	1
^(a) denotes the rejection of the null hypothesis at the 1% significance level.			

Both WTI and BRENT exhibit high volatility and are strongly correlated (0.956), reflecting closely linked price movements. Both series have moderate negative skewness (~ 0.6) and high kurtosis (9.19–11.05), indicating slight left-tailed distributions with fat tails. The GEC index shows pronounced negative skewness (-3.32) and extremely high kurtosis (25.84), reflecting rare but extreme economic shocks. All series significantly deviate from normality, as confirmed by the Jarque-Bera test, and correlations between GEC and oil prices are moderate (0.39–0.41), suggesting a weaker relationship than between the two oil benchmarks.

Econometric Methodology

We examine Granger causality between the Global Economic Conditions Indicator (GEC) and WTI crude oil prices (Jan 1986–Oct 2025) using quantile-based methods: the quantile unit root test, and quantile Granger causality test. These approaches capture asymmetric, distributional dynamics beyond the mean, while the quantile unit root test assesses integration across the conditional distribution for richer insights into the GECI–oil price link.

In the first stage, we perform the quantile unit root test introduced by Galvao (2009) to assess the integration properties of the series at different quantiles. A major reason for using this test lies in its ability to investigate stationarity across quantiles of the conditional distribution beyond the limitation of the conditional mean (Troster et al., 2018b). According to Ye et al. (2020), the quantile unit root test is of great utility for determining the dynamic behavior and distribution properties of the data.

Troster's Granger-in-quantiles test:

To formalize the empirical idea, let X_t be a strictly stationary process with information set $\Omega_t = (X_{t-1}, \dots, X_{t-s})'$. Denote the conditional distribution of X_t given Ω_t as $F_{X_t|\Omega_t}(x)$. The quantile autoregressive (QAR) unit root test is then expressed through the following quantile regression model:

$$Q_\tau^X(X_t \setminus \Omega_t^X) = \nu_1(\tau) + \nu_2(\tau)t + \beta(\tau)X_{t-1} + \sum_{j=1}^p \beta_j(\tau) \Delta X_{t-j} + F_u^{-1}(\tau) \quad (1)$$

where $Q_\tau^{X|\Omega_t^X}$ denotes the τ -th quantile of the conditional distribution $F_{X_t|\Omega_t^X}$; $\nu_1(\tau)$ is the intercept term; t represents the time trend; $\beta(\tau)$ captures the persistence coefficient; and F_u^{-1} is the inverse conditional distribution of the error term across quantiles $\tau \in \Gamma \subset [0, 1]$.

The test estimates a persistence coefficient $\hat{\beta}$ for each quantile of Y_t , where the null hypothesis $H_0: \beta(\tau) = 1$ indicates a unit root. The corresponding (t)-statistic follows the approach of Koenker & Xiao (2004) and Galvao (2009) across different quantiles $\tau \in \Gamma$.

In the second stage, we apply Troster's (2018b) quantile Granger causality test to detect nonlinear causal links across different parts of the conditional distribution, allowing assessment of causality at the median and in the tails.

The null hypothesis of the quantile Granger causality test states that Z_t does not Granger-cause Y_t in the conditional quantiles of interest. Formally, for a given quantile $\tau \in (0, 1)$:

$$H_0: Q_\tau(Y_t | J_t) = Q_\tau(Y_t | J_t^Y) \text{ for all } t, \quad (2)$$

where $Q_\tau(Y_t | \cdot)$ denotes the τ -th conditional quantile of Y_t given the information set. Under H_0 , the lagged values of Z_t do not contribute to predicting the τ -th quantile of Y_t . Rejection of H_0 indicates that Z_t has a significant causal effect on Y_t at quantile τ .

The null hypothesis of the Granger causality test states that Z_t does not help predict Y_t beyond what is already captured by the past values of Y_t . Formally, let $J_t^Y = \{Y_{t-1}, \dots, Y_{t-s}\}$ and $J_t^Z = \{Z_{t-1}, \dots, Z_{t-q}\}$ be lagged vectors of Y_t and Z_t . The null of Granger non-causality in distribution is:

$$F_Y(y | J_t^Y, J_t^Z) = F_Y(y | J_t^Y), \forall y \in \mathbb{R}, \quad (3)$$

where $F_Y(\cdot | J_t^Y, J_t^Z)$ is the conditional distribution of Y_t given both lag sets, and $F_Y(\cdot | J_t^Y)$ is given only the lags of Y_t .

Since estimating the full conditional distribution is challenging, the test often focuses on Granger non-causality in mean, a weaker condition:

$$E(Y_t | J_t^Y, J_t^Z) = E(Y_t | J_t^Y), \forall t, \quad (4)$$

meaning the expected value of Y_t is not affected by past values of Z_t . If this equality holds, Z_t does not Granger-cause Y_t in mean, although distributional causality could still exist (Troster, 2018).

Troster (2018b) highlights two limitations of mean-based Granger causality: it ignores potential links in extreme quantiles and does not quantify causality intensity. To address this, he proposed Granger non-causality in conditional quantiles.

By replacing the conditional distributions in Equation (5) with their τ -quantiles, $Q_{\tau}^{Y,Z}(\cdot)$ and $Q_{\tau}^Y(\cdot)$, the null of Granger non-causality in conditional quantiles becomes:

$$H_0^{QC,Z \neq Y}: Q_{\tau}^{Y,Z}(y | J_t^Y, J_t^Z) = Q_{\tau}^Y(y | J_t^Y), \forall \tau \in \Gamma, \quad (5)$$

where $\Gamma \subset [0,1]$ and the τ -quantiles satisfy $Pr\{Y_t \leq Q_{\tau}^Y(y | J_t^Y)\} = Pr\{Y_t \leq Q_{\tau}^{Y,Z}(y | J_t^Y, J_t^Z)\} = \tau$. Using an indicator function, this is equivalently:

$$E[1\{Y_t \leq Q_{\tau}^{Y,Z}(y | J_t^Y, J_t^Z)\}] = E[1\{Y_t \leq Q_{\tau}^Y(y | J_t^Y)\}], \tau \in \Gamma \quad (6)$$

Following Troster (2018b), $Q_{\tau}^Y(\cdot)$ is modeled parametrically as $s(J_t^Y, \phi_0(\tau))$, yielding the null and alternative hypotheses:

$$H_0^{QC,Z \neq Y}: E[1\{Y_t \leq s(J_t^Y, \phi_0(\tau))\}] = \tau, H_A^{QC,Z \neq Y}: E[1\{Y_t \leq s(J_t^Y, \phi_0(\tau))\}] \neq \tau, \forall \tau \in \Gamma \quad (7)$$

This formulation allows testing for Granger causality across the entire conditional distribution, including tails.

The Granger causality test statistic by Troster (2018b) is defined as

$$z_T = \iint_{\Gamma \times W} |v_T(\omega, \tau)|^2 dF_{\omega}(\omega) dF_{\tau}(\tau), \quad (8)$$

where F_{ω} is the conditional distribution of a d -variate standard normal vector, F_{τ} is uniform over n points Γ_n , and $\omega \in \mathbb{R}^d$ are standard normal weights. Its sample version uses a $T \times n$ matrix with components $\psi_{ij} = \Psi_{\tau_j}(Y_i - s(J_t^Y, \phi_T(\tau_j)))$, with

$$z_T = \frac{1}{Tn} \sum_{j=1}^n |\psi_j' W \psi_j|, \quad (9)$$

where W is an $n \times n$ weight matrix and ψ_j' the j -th column of Ψ . Large values of z_T lead to rejection of the null, with critical values computed via subsampling ($b = [kT^{2/5}]$) following (Sakov & Bickel, 2000).

Three QAR specifications for different τ under the null are:

$$\text{QAR1: } s^1(J_t^Y, \phi(\tau)) = v_1(\tau) + v_2(\tau)Y_{t-1} + \beta_t F_u^{-1}(\tau) \quad (10)$$

$$\text{QAR2: } s^2(J_t^Y, \phi(\tau)) = v_1(\tau) + v_2(\tau)Y_{t-1} + v_3(\tau)Y_{t-2} + \beta_t F_u^{-1}(\tau) \quad (11)$$

$$\text{QAR3: } s^3(J_t^Y, \phi(\tau)) = v_1(\tau) + v_2(\tau)Y_{t-1} + v_3(\tau)Y_{t-2} + v_4(\tau)Y_{t-3} + \beta_t F_u^{-1}(\tau) \quad (12)$$

Parameters $\phi(\tau) = (v_1, v_2, v_3, v_4, \beta_t)'$ are estimated via maximum likelihood, and F_u^{-1} is the standard normal inverse.

EMPIRICAL RESULTS AND DISCUSSION

Table 2 displays the results of standard unit root tests, namely the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root tests. It appears that LNBRENT and LNWTI are non-stationary in levels, as the null hypothesis of a unit root cannot be rejected, but become stationary after first differencing at the 1% significance level. In contrast, the Global Economic Conditions Indicator is stationary in levels.

Table 2. Conventional Unit Root Tests.

		BRENT	WTI	GEC
ADF	Level	-1.765	-2.149	-10.876 ^(a)
	first-difference	-11.432 ^(a)	-12.001 ^(a)	
PP	Level	-1.628	-1.722	-9.302 ^(a)
	first-difference	-11.432 ^(a)	-15.526 ^(a)	

Note: ^(a) denotes the rejection of the null hypothesis at the 1% significance level. Variables are in log-form, except GEC.

Since conventional unit root tests focus on the mean, we apply Galvao's (2009) quantile unit root test across 19 quantiles (0.05–0.95). Table 3 reports persistence estimates and t-statistics under the null $H_0: \beta(\tau)=1$ for each τ .

Table 3. Quantile autoregression unit root test results.

τ	GEC		WTI		BRENT	
	<i>persistence</i>	<i>t-statistic</i>	<i>persistence</i>	<i>t-statistic</i>	<i>persistence</i>	<i>t-statistic</i>
0.05	0.989	-0.095	0.654	-2.198	0.568	-2.887
0.1	0.909	-1.527	0.528	-4.911	0.528	-5.041
0.15	0.864	-3.118	0.491	-7.922	0.428	-8.22
0.2	0.859	-3.477	0.428	-10.809	0.393	-10.17
0.25	0.824	-4.925	0.397	-11.034	0.32	-10.775
0.3	0.774	-6.643	0.404	-10.313	0.301	-11.774
0.35	0.767	-6.905	0.362	-11.403	0.307	-12.142
0.4	0.726	-8.411	0.299	-12.801	0.284	-12.352
0.45	0.723	-8.89	0.241	-13.211	0.21	-13.863
0.5	0.735	-9.215	0.183	-15.137	0.197	-13.852
0.55	0.712	-10.733	0.205	-15.124	0.22	-14.525
0.6	0.721	-9.962	0.177	-16.594	0.193	-15.821
0.65	0.703	-11.36	0.173	-17.986	0.163	-18.684
0.7	0.685	-12.269	0.135	-16.785	0.153	-19.65
0.75	0.653	-12.234	0.125	-17.855	0.143	-18.975
0.8	0.648	-10.099	0.163	-16.921	0.138	-20.394
0.85	0.605	-9.645	0.134	-14.413	0.081	-16.544
0.9	0.535	-8.834	0.117	-12.396	0.122	-10.452
0.95	0.43	-5.944	0.215	-5.433	0.177	-5.641

Note: To save space, only result of the first difference are reported.

Table 3 shows the results of the quantile unit root tests across 19 quantiles ($\tau = 0.05-0.95$). All series are stationary at most quantiles, as indicated by significantly negative t-statistics and persistence parameters well below one. These findings confirm those of conventional unit root tests (Table 2), and show that stationarity varies across the conditional distribution, supporting the use of quantile-based causality methods.

Prior to applying quantile-based methods, we examine linear relationships using pairwise Granger causality tests to identify potential directional effects between the variables.

The linear Pairwise Granger causality test (Table 4) reveals important, yet relatively weak, directional relationships between oil prices (WTI and Brent) and global economic conditions (GEC). For WTI, the null hypothesis that “WTI does not Granger-cause GEC” is rejected at the 10% level ($p = 0.0577$), suggesting marginal evidence that WTI price movements help predict fluctuations in global economic conditions. However, the reverse effect-GEC Granger-causing WTI-is statistically insignificant ($p = 0.1350$), indicating that global economic conditions do not exert predictive power over WTI prices in a linear framework. For Brent, the results display the opposite pattern: “GEC does not Granger-cause Brent” is rejected at the 5% significance level ($p = 0.0376$), indicating that changes in global economic conditions do help predict Brent price dynamics. The influence of Brent prices on the GEC index appears relatively weak and is only marginally significant at the 10 percent threshold ($p = 0.0777$). Taken together, the linear Granger causality tests point to generally modest and uneven predictive links. Brent seems to respond more noticeably to shifts in global economic conditions, whereas WTI shows a slightly clearer tendency to feed back into movements in the GEC index.

Table 4. Summary of Pairwise Granger Causality between WTI, BRENT, and Global Economic Conditions (GEC).

Pair	Null Hypothesis	F-Statistic	p-value	Significance (5%)	Interpretation
WTI → GEC	WTI does not Granger Cause GEC	2.8701	0.0577	No	Weak evidence that WTI may affect GEC
GEC → WTI	GEC does not Granger Cause WTI	2.011	0.135	No	No evidence that GEC affects WTI
BRENT → GEC	BRENT does not Granger Cause GEC	2.5693	0.0777	No (but weak at 10%)	Weak evidence that BRENT may affect GEC
GEC → BRENT	GEC does not Granger Cause BRENT	3.3052	0.0376	Yes	Evidence that GEC affects BRENT

Although these linear tests offer a useful first look at directional relationships, they provide only a partial picture. Both oil markets and global economic conditions are prone to abrupt shocks, periods of heightened volatility, and movements that differ sharply across market phases. Linear models, by definition, compress these dynamics into an average response and therefore miss the variations that occur during downturns, expansions, or moments of extreme stress. To address this limitation, the quantile-based Granger causality approach developed by Troster (2018) is considered. This method makes it possible to assess whether causality strengthens, weakens, or even reverses at different points of the conditional distribution. Hence, observing how the relationship behaves in bearish markets, more stable periods, or unusually active ones. It is particularly well suited for detecting tail effects and nonlinear spillovers that standard techniques tend to obscure.

The evidence from the linear tests underscores the need to rely on such nonlinear tools. Quantile Granger causality offers a more appropriate way to uncover the regime-dependent and asymmetric transmission patterns that characterize the interaction between oil prices and global economic conditions.

Table 2. Granger causality-in-quantiles between WTI and GEC: Subsampling p-values.

Quantiles	GEC \Rightarrow WTI	WTI \Rightarrow GEC
[0.05; 0.95]	0.002	0.002
0.05	0.002	0.267
0.1	0.002	0.012
0.15	0.002	0.002
0.2	0.002	0.002
0.25	0.002	0.002
0.3	0.002	0.002
0.35	0.002	0.002
0.4	0.027	0.002
0.45	0.175	0.034
0.5	0.488	0.034
0.55	0.218	0.044
0.6	0.061	0.296
0.65	0.002	0.015
0.7	0.002	0.002
0.75	0.002	0.002
0.8	0.002	0.002
0.85	0.002	0.002
0.9	0.002	0.002
0.95	0.002	0.073

Note: ^(a) and ^(b) denote the rejection of the null hypothesis of no Granger causality-in-quantile at the 1% and 5%

Using the QAR(1) specification¹ and a subsample of size 46, the results The Granger-causality-in-quantiles results (Table 5) reveal a distinctly asymmetric and quantile-dependent relationship between global economic conditions (GEC) and WTI crude oil prices. The p-values show that GEC significantly Granger-causes WTI across almost the entire conditional distribution, particularly in the lower and upper quantiles, where the null hypothesis is rejected at the 1% level. This indicates that during periods of extreme market stress or exuberance, global economic conditions exert a strong predictive influence on oil price dynamics. In contrast, the reverse causality (WTI \Rightarrow GEC) is weaker and more concentrated in specific quantiles, mainly between the 0.10–0.55 range and again around 0.65 and 0.95, suggesting that oil prices influence global economic conditions only under certain economic environments, typically during mild downturns or moderate growth regimes. Notably, WTI does not significantly cause GEC in the extreme lower and upper quantiles, implying that global economic conditions during deep recessions or high expansions are driven more by broader macroeconomic forces than by oil price fluctuations. Overall, the findings confirm a strong, nonlinear, and asymmetric causality running predominantly from GEC to WTI, highlighting that global macro-financial conditions are a primary driver of oil market behavior rather than the other way around.

¹ Findings are robust across different quantile autoregressive specifications. The full results are available upon request from authors.

Similarly, we present in Table 6 the results of the Granger-causality-in-quantiles results for the Brent–GEC relationship. The findings reveal a fundamentally asymmetric and regime-dependent pattern of predictability. The subsampling p-values indicate that GEC Granger-causes Brent crude prices only at selected quantiles, most notably in the mid-to-upper quantiles (0.10, 0.20, 0.75, 0.80, 0.85, 0.90, and 0.95), where the null hypothesis is rejected at conventional significance levels. This suggests that global economic conditions significantly influence Brent price dynamics primarily during phases of moderate to high market activity or stress, rather than uniformly across the distribution. In contrast, the reverse causality from Brent to GEC is more frequent and statistically stronger, with significant effects observed across a wider range of quantiles (0.15–0.40, 0.70–0.85, and at the joint interval [0.05–0.95]). This indicates that Brent price fluctuations transmit more consistently to global economic conditions, especially in mildly stressed or expansionary regimes. Notably, both directions exhibit strong bidirectional causality at the upper quantiles (0.75–0.85), highlighting heightened feedback effects during periods of elevated market volatility or strong economic shifts.

Table 3. Granger causality-in-quantiles between BRENT and GEC: Subsampling p-values.

Quantiles	GEC \nrightarrow BRENT	BRENT \nrightarrow GEC
[0.05; 0.95]	0.066	0.017
0.05	0.248	0.432
0.1	0.032	0.083
0.15	0.09	0.017
0.2	0.034	0.01
0.25	0.112	0.002
0.3	0.323	0.024
0.35	0.665	0.036
0.4	0.58	0.063
0.45	0.505	0.466
0.5	0.536	0.718
0.55	0.476	0.864
0.6	0.442	0.583
0.65	0.333	0.061
0.7	0.597	0.005
0.75	0.032	0.002
0.8	0.002	0.002
0.85	0.002	0.017
0.9	0.002	0.16
0.95	0.019	0.587

Note: ^(a) and ^(b) denote the rejection of the null hypothesis of no Granger causality-in-quantile at the 1% and 5% significance.

Overall, the results demonstrate nonlinear and quantile-specific interactions, with Brent exerting more pervasive predictive power over GEC than GEC does over Brent, an effect consistent with Brent's role as a benchmark crude influencing global financial and macroeconomic activity. These findings, proving the heterogeneous behavior across quantiles and asymmetric dependence, are widely recognized in various recent literature such as in (Guo et al., 2018) ; (Shaikh, 2019); (Dong et al., 2020) ; (Raggad, 2023); (Armah & Amewu, 2024) ; and (Raggad et al., 2024).

CONCLUSION AND POLICY RECOMMENDATIONS

This study examines how WTI and Brent crude oil prices interact with global economic conditions (GEC) by applying both traditional linear Granger causality tests and a quantile-based approach. The standard unit root tests show that the two oil price series behave as expected, non-stationary in levels but stationary after differencing, whereas the GEC index turns out to be stationary from the outset. The linear causality results point to modest and uneven linkages: WTI shows only limited influence on the GEC index, while global economic conditions appear to have a clearer impact on Brent, suggesting that Brent reacts more strongly to shifts in the global economy.

When the analysis is expanded using the quantile-based method proposed by (Troster, 2018), a far more intricate picture emerges. The influence of GEC on WTI becomes especially pronounced during periods of

extreme market tension or exuberance, whereas WTI's effect on economic conditions is noticeable mainly in more moderate phases. Brent behaves differently: the causality runs both ways across several parts of the distribution, and Brent's predictive role becomes particularly evident during episodes of heightened volatility. These results underscore the presence of asymmetric and tail-driven spillovers that are largely invisible when using linear techniques.

The findings carry important implications. Policymakers who monitor global economic conditions may gain a clearer sense of how oil markets could respond during periods of sharp stress or strong expansion. For investors, methods that account for behavior across different quantiles can strengthen forecasting and risk-management practices. Future studies might apply similar techniques to other markets or regions to shed further light on the nonlinear mechanisms that shape energy–economy interactions. Furthermore, researchers may examine whether these asymmetric patterns hold for specific, sensitive regions like emerging economies or net oil-exporting nations.

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