

Exploring the Nexus Between Oil Price Shocks, Inflation and Monetary Policy in the United States: A Structural VAR Investigation

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Abstract

This study examined the effect of West Texas Intermediate (WTI) crude oil price shocks on key macroeconomic variables, namely the Consumer Price Index (CPI), Brent crude oil prices and Federal Reserve Rate (FEDRATE). Monthly data from 2010 to 2025 were used to examine the short- and long-run effects of oil price fluctuations. A Structural Vector Autoregression (SVAR) framework was utilized to explore the dynamic interactions among these variables. The empirical analysis findings suggest that WTI price fluctuations exert significant short-run effects on Brent prices, inflation and the FEDRATE, while their long-run impacts gradually decline. Brent prices respond strongly and immediately to WTI shocks, reflecting the close integration between domestic and international oil markets. CPI exhibits an inflationary response in the short run, whereas the FEDRATE shows a positive short-run reaction, consistent with an active monetary response to oil-induced inflationary pressure. The findings also reflect the growing importance of oil price shocks in explaining fluctuations in Brent prices and monetary policy over time. These findings indicate that oil price shocks remain a major contributor to macroeconomic fluctuations in the U.S. economy. This study underscores the need for policymakers to closely monitor oil price movements and implement policies that mitigate the adverse impact of oil price variations on the economy while promoting energy diversification and long-term economic resilience.

Keywords: Brent Crude Oil, Consumer Price Index, Federal Reserve Rate, Structural Vector Autoregression, West Texas Intermediate.

Introduction

In the last few decades, oil has been an essential energy source and its significance has increased tremendously after the Second World War owing to rapid industrialization and the growth of transportation (1). Today, oil remains an essential factor in the production and economic development of many countries. Fluctuations in oil prices influence various macroeconomic variables such as exchange rates, stock markets, trade balances, investments, fiscal balances and interest rates. Oil prices are a critical determinant of macroeconomic stability, with inflation emerging as one of the most directly affected variables (2). Theoretically, oil price fluctuations influence inflation both directly and indirectly through the following channels. The direct effect is through the demand side, since oil products are used as final commodities; therefore, if oil products constitute a significant share of household expenditure, increases in oil prices will directly cause inflation (3). Indirectly, oil prices influence inflation

through the supply side by increasing production costs, which are then passed on to consumers (4). High oil prices also reduce purchasing power, which could trigger higher wage demands and lead to cost-push inflation (5). This can result in a wage-price spiral, although evidence suggests that this mechanism has weakened in recent decades (6). Moreover, rising oil prices can lead to slow economic growth, potentially reducing demand- and inflationary pressures (7). Therefore, fluctuations in oil prices may exert both inflationary and deflationary influences, depending on the prevailing economic conditions. Crude oil, often termed the "lifeblood of industry" is crucial because of the significant dependence of various sectors on its supply. Inflation has been observed during periods of both high and low oil prices, with exchange rates serving as key transmission channels (8). In addition, unpredictable events such as geopolitical conflicts and natural disasters contribute to price volatility

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(9, 10). The gap between WTI and Brent crude oil prices reflects the differences in regional supply conditions, inventories, infrastructure issues, OPEC + policies, geopolitics and macroeconomic factors. The WTI price is more sensitive to domestic elements, such as Cushing inventories and transport bottlenecks, whereas the Brent price is more sensitive to global conditions, such as OPEC+ policies and emerging market demand (11). The COVID-19 pandemic further demonstrated the vulnerability of the oil market, as global industrial production declined sharply, leading to reduced oil consumption and falling prices. A substantial decline in global demand, especially from China and the aviation sector, was reported during this period (12). In response, the OPEC decided to regulate the oil supply, although coordination challenges with other oil-producing countries limited its effectiveness (13).

Despite extensive research, the dynamics between oil prices, inflation and monetary policy remain fragmented, especially concerning the interactions between WTI and Brent prices and the Federal Reserve's rate. This study extends the existing research by employing an SVAR framework to analyze the dynamic interactions between WTI crude oil prices, CPI, Brent oil prices and the FEDRATE in the U.S. This study examines whether fluctuations in WTI oil prices significantly affect U.S. price levels and key macroeconomic indicators. Using SVAR, Structural Impulse Response Functions (SIRFs) and Forecast Error Variance Decomposition (FEVD), this study examines the transmission of oil price shocks to inflation and monetary policy. As oil is a fundamental input in the production of goods and services (14), fluctuations affect price levels across the economy (15). Hence, a thorough understanding of these dynamics can help central banks design more efficient monetary policies to control inflation and maintain long-term economic stability in the long run.

Despite the extensive literature on oil price shocks and macroeconomic dynamics, several research gaps remain. Most existing studies focus on individual transmission channels, either the oil price effects on inflation or monetary policy responses, without simultaneously examining the interplay among WTI prices, Brent prices, CPI and the FEDRATE within a single analytical framework. Furthermore, previous SVAR-based studies in this

area predominantly rely on data predating 2020, thereby excluding the profound macroeconomic disruptions associated with the COVID-19 pandemic, the unprecedented post-pandemic inflationary episode and the aggressive Federal Reserve tightening cycle of 2022–2023 (16–18). These events represent structurally distinct shocks that may have altered the nature and magnitude of oil price-transmission mechanisms. The period from 2010 to 2025 presents a uniquely comprehensive empirical opportunity to examine the pre- and post-pandemic oil market dynamics. This period offers new insights into the changing relationship between oil prices, inflation and monetary policy in the United States. This study fills the existing gaps by employing a unified SVAR framework to simultaneously examine the dynamic interactions among WTI, Brent, CPI and FEDRATE during this timeframe.

This study contributes significantly to the existing literature in several ways. First, it diverges from the conventional method of analyzing oil price shocks in isolation by concurrently integrating the dynamic interactions among WTI and Brent crude oil prices, CPI and FEDRATE within a unified framework (SVAR). Second, the joint inclusion of WTI and Brent prices enables a comprehensive evaluation of the transmission mechanisms across both domestic and global oil markets, a dimension that has been insufficiently explored in prior research. Third, this study employs monthly data spanning 2010 to 2025, a period that includes significant events such as the COVID-19 pandemic, the subsequent inflationary surge and the Federal Reserve's monetary tightening cycle, thereby offering a more contemporary empirical foundation than earlier studies. Finally, the combined application of Structural Impulse Response Functions (SIRFs) and Forecast Error Variance Decomposition (FEVD) facilitates a multidimensional assessment of oil price shock transmission, capturing both the directional effects and quantitative significance of these shocks on key macroeconomic variables. This study was guided by the following objectives:

- a) To examine whether fluctuations in WTI crude oil prices significantly affect CPI and key macroeconomic indicators in the U.S. economy.
- b) To analyze the dynamic interactions between WTI crude oil prices, CPI, Brent oil prices and FEDRATE within a SVAR framework.

- c) To trace the transmission of WTI oil price shocks to inflation and monetary policy using SIRFs and the FEVD.

HA1: WTI oil price significantly impacts CPI, Brent price **and** the FEDRATE in the U.S. economy

Methodology

Theoretical Framework

The variables considered in this study are grounded in established economic theories that explain the transmission mechanisms of oil price shocks to the broader economy. Crude oil is a primary energy input for industry and transportation. Variations in oil prices directly affect production costs and overall price levels, particularly the CPI. In numerous economies, affordable energy access enhances national productivity, whereas rising energy costs can lead to cost-push inflation. Furthermore, variations in oil prices are linked to substitution effects in the economy. An increase in oil prices can prompt structural changes in the energy sector by promoting the replacement of fossil fuels with alternative energy sources such as nuclear, wind and solar power (17). Conversely, persistently low oil prices can reduce the incentives for investing in renewable and unconventional energy sources, thereby increasing dependence on non-renewable energy resources. This interaction between energy prices and the production structure amplifies the macroeconomic consequences of oil-price movements.

The association between economic performance and oil price changes is widely documented in the economic literature (17). Oil price shocks affect not only output and inflation but also financial variables. Monetary policy is another important transmission channel. When the Federal Reserve reduces interest rates to revive the economy, expectations of future economic activity and energy demand change, leading to fluctuations in crude oil prices (19). Conversely, rising oil prices

could increase inflationary pressures, leading the Federal Reserve to tighten the monetary policy, thereby creating feedback between oil markets and interest rates. Moreover, oil prices are interconnected with international benchmarks such as Brent crude oil. WTI is an indicator of the domestic market situation in the U.S., whereas Brent prices are more sensitive to global supply factors, geopolitical developments and global demand conditions. This dual structure justifies the inclusion of both WTI and Brent prices in the model to reflect domestic and global transmission mechanisms. Given these intricate interrelationships between oil prices, inflation and monetary policies, the SVAR framework is appropriate because it allows for the identification of structural shocks and tracing their dynamic transmission across macroeconomic variables.

Data And Variables

This study considered monthly time-series data for the U.S for the period 2010–2025. The following variables were considered.

- a) WTI spot price
- b) CPI
- c) Brent price (BRENT)
- d) FEDRATE

All data related to macroeconomic variables were obtained from the Federal Reserve Economic Data (FRED) database (20). To stabilize the variance and enhance the reliability of the time-series analysis, all variables were converted to their natural logarithmic values (ln), which is standard practice in macroeconomic modelling.

SVAR Framework

This study adopts the SVAR framework suggested by other researcher (5), which imposes long-run restrictions to determine structural shocks. This identification approach is aligned with the long-run neutrality hypothesis, which states that a permanent nominal shock has no long-term effect on real variables.

Equation [1] specifies the reduced-form VAR model as follows:

$$y_t = c + \sum B_i y_{t-1} + u_t \quad [1]$$

where y_t is the vector of endogenous variables and u_t is the reduced-form residual vector.

Equation [2] transforms the reduced-form VAR into an SVAR model to detect structural shocks:

$$A y_t = a_0 + B L y_{t-1} + \varepsilon_t \quad [2]$$

where A is a contemporaneous coefficient matrix, $B L$ is a lag polynomial matrix and ε_t is the structural shock vector.

Equation [3] specifies the vector of variables considered in this study as follows:

$$y_t = [\ln WTI_t, \ln BRENT_t, \ln CPI_t, \ln FEDRATE_t] \quad [3]$$

All variables are considered endogenous, allowing for dynamic feedback effects between oil prices, inflation and monetary policy.

The C(1) matrix, which is the cumulative long-run impact of structural shocks on endogenous variables, is subjected to identification restrictions. The Cholesky triangular decomposition method, which is a standard macroeconomic practice, is used for identification.

The imposed zero restrictions indicate that

- a) Oil price shocks can have long-run impacts on nominal variables such as CPI and interest rates.
- b) Monetary policy shocks have no effect on oil prices in the long run, consistent with long-run neutrality assumptions

The long-run identifying restrictions impose a lower triangular structure on the C(1) matrix as follows: (i) WTI shocks affect all variables contemporaneously; (ii) Brent, CPI and FEDRATE shocks do not affect WTI in the long run; (iii) CPI and FEDRATE shocks do not affect Brent in the long run; (iv) FEDRATE shocks do not affect CPI in the long run

The C(1) coefficients that are not zero imply that a structural shock produces a permanent impact on the respective variable, whereas restrictions equal to zero imply that there is no impact in the long run. This method of identification enables the study to trace the dynamic transmission of oil price

shocks to inflation, global oil benchmarks and monetary policy using the SIRFs and FEVD.

Econometric Procedure

The empirical analysis follows a systematic econometric procedure. The initial step was to conduct unit root tests to observe the stationarity characteristics of the variables. Second, the optimal lag length is determined using standard criteria such as the AIC and HQ. Third, a stability test was conducted to ensure that the VAR system met the stability condition. Since long-run relationships may exist among the variables, a co-integration analysis was conducted prior to the structural estimation. The SVAR model is then estimated using long-run identification restrictions. The SIRFs method is employed to investigate the dynamic impact of oil price shocks on CPI, Brent prices and FEDRATE. FEVD is used to analyze the contribution of each structural shock to the forecast error variance of each variable.

Results

Unit Root Analysis

The stationarity properties of the variables were examined before estimating the SVAR model to avoid spurious results. Table 1 presents the results of the ADF unit root test conducted on the logarithmic series of WTI, Brent price, the CPI and the FEDRATE.

Table 1: Results of ADF Test

Variable	Test Level	ADF	Prob.	Integration Level
BRENT	Level	-11.59208	0	I(0)
CPI	1st Difference	-7.553916	0	I(1)
WTI	1st Difference	-10.38642	0	I(1)
FEDRATE	1st Difference	-3.691196	0.005	I(1)

Note: ADF = Augmented Dickey–Fuller unit root test statistic, Prob. = probability value, I(0) = stationary at level (integrated of order zero), I(1) = stationary at first difference (integrated of order one)

The findings show that the Brent crude oil price is stationary at the level, suggesting the integration of order zero I(0). In contrast, CPI, WTI crude oil price and FEDRATE are non-stationary at level but become stationary after first differencing, indicating that these variables are integrated of order one, I(1). The corresponding probability values confirm statistical significance at conventional levels. As the variables exhibit a mixed order of integration, the SVAR framework is

suitable for capturing both the long-run relationships and short-run dynamics between the variables. These findings justify proceeding with further econometric analysis, including lag length selection, co-integration testing and SVAR estimation.

SVAR Framework

The next step was to determine the optimal lag length in the VAR system after ascertaining the stationarity of the variables. Standard information

criteria, namely the AIC, SC and HQ, were used to determine the optimal lag length. As reported in Table 2, both the SC and HQ criteria identify two lags as optimal, although the AIC results suggest a lag order higher than two. Because data are available monthly and to ensure the parsimony of the model, a lag length of two was selected for

subsequent SVAR estimation. The selection of an optimum lag length is essential to ensure that the model adequately captures the dynamic interactions among the variables without over-parameterization. Using the selected lag structure, the VAR system was estimated and converted into a SVAR model to analyze the long-run interactions.

Table 2: Lag Length Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	576.5657	NA	1.66e-12	-10.09851	-9.953691	-10.03974
1	1400.508	1545.803	1.46e-18	-24.04439	-23.03067	-23.63303
2	1492.442	162.7148	5.44e-19	-25.03437	-23.15175*	-24.27042*
3	1548.149	92.68031	3.89e-19	-25.38316	-22.63164	-24.26662
4	1586.378	59.54352	3.83e-19	-25.42262	-21.8022	-23.95349
5	1630.570	64.13646	3.46e-19	-25.56761	-21.07828	-23.74589
6	1660.367	40.08140	4.11e-19	-25.45783	-20.0996	-23.28351
7	1717.535	70.82704*	3.10e-19*	-25.83247	-19.60534	-23.30557
8	1757.373	45.12602	3.29e-19	-25.90040*	-18.80436	-23.0209

Note: LogL = Log-likelihood, LR = sequential modified likelihood ratio test statistic, FPE = Final Prediction Error, AIC = Akaike Information Criterion, SC = Schwarz Information Criterion, HQ = Hannan–Quinn Information Criterion. * Indicates the lag order selected by the criterion

Table 3: Long run Structural Impact Matrix

	LBRENT	LCPI	LFEDRATE	LWTI
LBRENT	0.604659	-0.35559	0.399537	0.538175
LCPI	0.145280	-1.04695	1.822680	0.943757
LFEDRATE	2.840240	-13.798	32.23138	13.78350
LWTI	0.361301	-0.09318	-0.03064	0.388204

Note: LBRENT, LCPI, LFEDRATE and LWTI denote the natural logarithms of Brent crude oil price, Consumer Price Index, Federal Reserve Rate and West Texas Intermediate crude oil price, respectively

The SVAR framework was used to analyze the long-run interactions between WTI and Brent crude oil prices, CPI and the Federal Reserve rate. Long-run identifying restrictions were imposed using a recursive (triangular) structure aligned with the assumption of long-run neutrality. Table 3 highlights the estimated long-run impact matrix. The coefficients in the long-run impact matrix indicate the magnitude and direction of the long-term effects of structural shocks on these

variables. Positive coefficients reflect a direct (same direction) long-run interaction, whereas negative coefficients reflect an inverse relationship. For example, the positive WTI coefficient to Brent's long-run effect (0.361301) indicates that a structural shock to WTI prices has a positive long-run impact on the Brent price. Similarly, the coefficients indicate the degree to which oil price shocks are transmitted to inflation and monetary policy variables in the long run.

Table 4: Characteristics of Long-run Relationships

Feature	Indication	Source Computation
Positive Sign	Direct/Same-direction movement	LWTI to LBRENT: 0.361301

Note: LWTI and LBRENT denote the natural logarithms of West Texas Intermediate and Brent crude oil prices, respectively.

Table 4 summarizes the directional characteristics of the SVAR framework used in this study. The positive coefficient of WTI to Brent (0.361301) shows a direct or same-direction long-run relationship between the two oil price benchmarks. The results suggest that a structural shock to WTI is associated with a corresponding

long-run shift in Brent crude oil prices, indicating the close integration between domestic and global oil markets. The results of the above analysis provide the foundation for further dynamic analysis using structural impulse response functions and forecast error variance

decomposition, as discussed in the following sections.

Structural Impulse Response Functions (SIRFs)

Structural impulse response functions (SIRFs) were used to analyze the dynamics of the endogenous variables to a one-standard-deviation structural shock in WTI crude oil prices over a fifteen-period duration. Figure 1 shows the responses of Brent crude oil prices, CPI, FEDRATE

and WTI crude oil prices to a shock caused by WTI crude oil prices.

Figure 1A illustrates the impulse response function, which tracks the reaction of Brent crude oil prices to shifts in the WTI benchmark. The response is immediately positive and increases sharply, reaching its peak in the second period, indicating a robust short-run transmission of shocks from WTI to Brent prices, consistent with the law of one price and high integration between the domestic and global oil markets (21, 22).

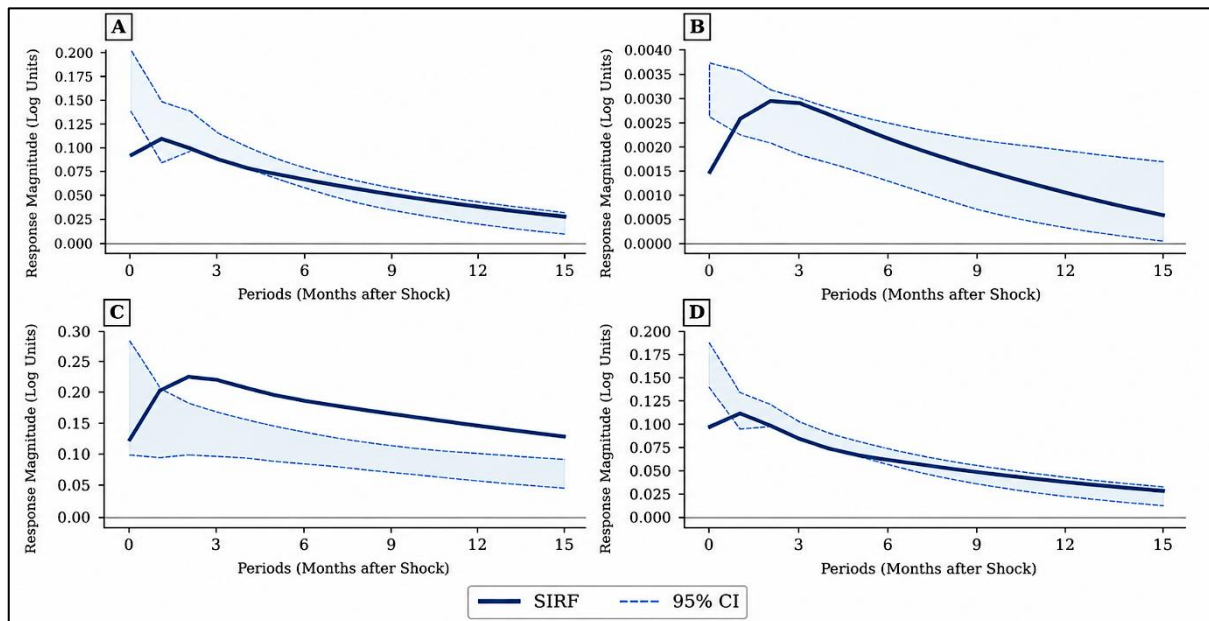


Figure 1: Structural Impulse Response Functions to WTI Oil Price Shock. (A) Response of Brent crude oil prices to WTI shock, (B) Response of CPI to WTI shock, (C) Response of Federal Reserve Rate to WTI shock, (D) Response of WTI to its own shock. Periods (1–15) are shown on the X-axis and the response magnitude is shown on the Y-axis. Dashed lines represent the 95% confidence intervals

After the peak, the response gradually declines over subsequent periods, although it remains positive for most horizons. Figure 1B illustrates the CPI response to a shift in WTI oil prices. CPI initially responds positively, with the effect peaking around the third period, consistent with the cost-push inflation theory, whereby rising energy input costs are transmitted to consumer prices through supply chains (4, 5). Following this short-run increase, the response declines and gradually turns negative in later periods, suggesting that the inflationary effects of oil price shocks are temporary and moderated over time by adjustment mechanisms in consumption, production and monetary policy. Figure 1C shows the SIRFs of FEDRATE for the WTI price shock. A positive response is observed in the early stages, reaching its peak around the third period,

indicating a short-run monetary policy reaction to oil-induced inflationary pressures consistent with the Taylor Rule framework, which prescribes that central banks raise interest rates in response to inflation above the target (19). In later periods, the response drops and the confidence interval crosses the zero mark, implying that the long-run influence of oil price shocks on interest rates becomes weaker. Figure 1D depicts the response of WTI prices to structural shocks. The reaction increases sharply in the short run, with the highest point observed in the second period, followed by a gradual decline to the baseline level. This implies that oil price shocks are not highly persistent and their effects diminish over time. The SIRFs demonstrate that the short-run effects of WTI price shocks are more dominant on Brent prices, inflation and interest rates, while their long-run

impacts tend to weaken, highlighting the temporary nature of oil price disturbances in the U.S. economy.

Forecast Error Variance Decomposition (FEVD)

The FEVD method was used to examine the relative contribution of structural shocks in explaining the forecast error variance of each variable over a fifteen-period horizon. FEVD provides insights into how the importance of different shocks evolves over time. The findings are shown in Figures 2A–

2D. Figure 2A shows the variance decomposition of Brent crude oil prices (LBRENT). During the initial period, Brent prices are entirely explained by their own shocks, accounting for nearly 100% of variance. However, as the forecast horizon extends, the explanatory power of Brent's own shocks declines steadily, falling to approximately 52% by the tenth period. This suggests that shocks from WTI prices, CPI and the FEDRATE become significant over time, indicating that Brent prices are increasingly influenced by macroeconomic and monetary factors in the long run.

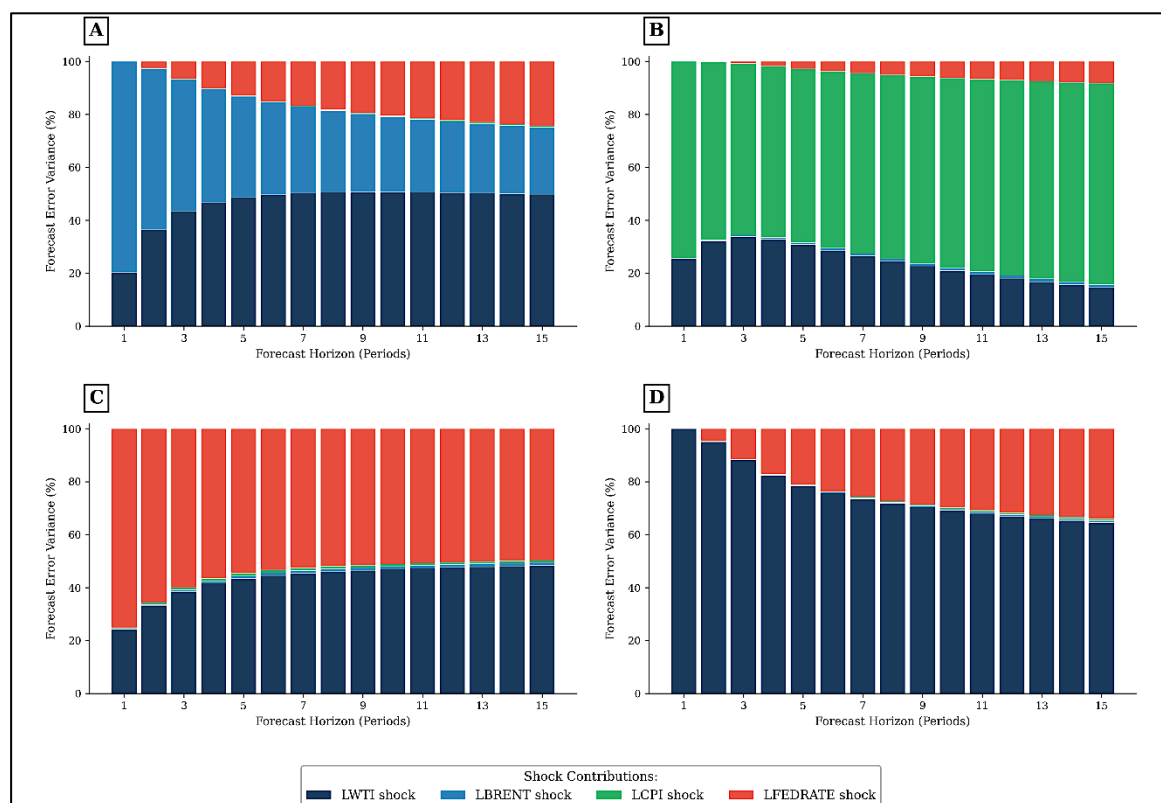


Figure 2: Forecast Error Variance Decomposition. (A) Variance decomposition of Brent crude oil prices (LBRENT), (B) Variance decomposition of CPI (LCPI), (C) Variance decomposition of Federal Reserve Rate (LFEDRATE), (D) Variance decomposition of WTI crude oil prices (LWTI). The forecast horizon (periods 1–15) is shown on the X-axis, the percentage of forecast error variance explained is shown on the Y-axis

Figure 2B shows the variance decomposition of the LCPI. The CPI is mostly explained by its shocks throughout the forecast horizon. However, external variables gradually contributed to variance over time. Among these variables, Brent crude oil prices emerged as the most significant external contributor, accounting for approximately 8–9% of CPI variance in the long run. The impacts of WTI prices and the FEDRATE remain relatively small, suggesting a limited but persistent external influence on inflation dynamics. The variance decomposition of

LFEDRATE is presented in Figure 2C. Monetary shocks largely explain their own variance, accounting for more than 85% of all periods in the study. However, oil price shocks and inflation increasingly contribute to the variability of interest rates. WTI prices represent the largest external contributor in the fifteenth period, followed by CPI and Brent prices, implying that fluctuations in oil prices and inflation play substantial roles in determining long-run monetary policy responses. Figure 2D shows the variance decomposition of the LWTI from the VDC. Although WTI's own shocks

dominated its variance across all periods, external macroeconomic factors had a substantial influence. The CPI explains a significant share of WTI variance in both the long and short run, stabilizing at around 15% by the fifteenth period. FEDRATE is also significant, with its influence declining in the short term and recovering in the long term. Brent prices provide an additional, albeit smaller, contribution to the WTI price variability. The FEVD results suggest strong interdependence between the variables. Specifically, inflationary shocks exerted a substantial effect on WTI prices and WTI shocks explained a significant proportion of the Brent price variance. This confirms the presence of an indirect transmission mechanism, whereby domestic inflationary pressures impact global oil prices through the close interaction between the WTI and Brent crude oil markets (18, 23, 24). Both the SIRFs and FEVD results support the interrelated nature of oil prices and other macroeconomic variables in the U.S. economy and confirm the acceptance of HA1.

Discussion

The empirical analysis shows that oil price shocks are important in shaping macroeconomic dynamics in the U.S., especially through their interaction with inflation and monetary policies. The unit root analysis supports co-integration orders among the variables, justifying the use of a SVAR framework to capture both short-run changes and long-run interactions (25, 26). The SIRFs analysis reveals that a shock to WTI oil prices produces distinct short-run effects on Brent prices, the CPI and the FEDRATE. The positive response of Brent prices to WTI shocks reflects the close integration between domestic and global oil markets and is consistent with the law of one price, which predicts that integrated markets will co-move in response to common shocks, as documented in earlier studies (21, 22).

The response of CPI to oil price shocks confirms the presence of short-term inflationary pressures following increases in oil prices, consistent with the cost-push inflation theory, whereby rising energy costs increase production costs that are subsequently transmitted to consumer prices (4, 5). The decreasing and eventually negative response in the long run imply that such inflationary effects are temporary, subsiding over

time due to adjustment mechanisms in consumption, production and monetary policy responses (2, 27). The FEDRATE exhibits a positive short-run reaction to oil price shocks, suggesting an active monetary policy response to oil-driven inflationary pressures, consistent with the Taylor Rule framework, which prescribes central bank tightening when inflation rises above the target (19). The gradual decline in the response over time indicates that these disturbances primarily influence monetary policy in the short run, whereas interest rate dynamics in the long term are shaped by broader macroeconomic factors, consistent with prior empirical findings on policy responses to shocks in developed economies (12, 16).

The FEVD results further strengthen the SIRFs findings by highlighting the evolving contribution of oil price shocks over time. While each variable is largely driven by its own shocks in the short run, external influences are more evident in the long run. Notably, inflationary shocks exhibit a substantial proportion of WTI price variability and WTI shocks explain a significant proportion of Brent price variance. This confirms the presence of an indirect transmission mechanism, whereby domestic inflationary pressures impact global oil prices through the strong interaction between the WTI and Brent markets (18, 23). Therefore, both the SIRFs and FEVD results support the interrelated nature of oil prices and macroeconomic variables in the U.S. economy. Oil price shocks cause strong short-run macroeconomic effects that gradually diminish over time, indicating that although oil markets are a critical source of economic fluctuations, their long-run effects are moderated by policies and market responses. These findings extend the existing literature by providing comprehensive empirical evidence of the interrelationship between WTI, CPI, Brent and FEDRATE within a unified SVAR framework.

The unit root and long-run structural results also merit closer discussion. The mixed order of integration identified for WTI, CPI and FEDRATE, alongside the stationarity of Brent prices at level, is consistent with prior evidence that oil benchmarks and macroeconomic aggregates rarely share a uniform time-series order, which is precisely why a long-run identified SVAR, rather than a simple VAR or single-equation model, is

appropriate for this setting (26). The long-run structural impact matrix reinforces this point: the comparatively large FEDRATE coefficients relative to those of CPI and Brent indicate that permanent shocks are absorbed disproportionately through the policy rate, consistent with the Federal Reserve's role as the primary long-run stabiliser of nominal disturbances originating in energy markets.

These findings are broadly consistent with country-specific SVAR evidence from oil-importing and oil-exporting economies. For example, comparable short-run transmission from oil prices to macroeconomic aggregates has been documented for Saudi Arabia (19), Malaysia (18) and Indonesia (24), suggesting that the short-run dominance and long-run attenuation pattern identified in this study is not unique to the U.S. but reflects a more general feature of oil-price transmission mechanisms across structurally different economies. Simultaneously, the magnitude and speed of adjustment differ across these settings, consistent with the view that country-specific factors, such as energy import dependence, exchange rate regimes and the credibility of monetary policy, condition how quickly oil price shocks are absorbed (28). From a theoretical standpoint, the results are consistent with the Taylor Rule prediction that central banks respond to inflationary pressure with a lagged tightening of policy rates, while the eventual reversal of the CPI response supports the argument that the wage-price spiral mechanism has weakened in recent decades (6). Taken together, these results suggest that while oil price shocks remain an important short-run driver of U.S. inflation and monetary policy, their diminishing long-run influence reflects the increasing effectiveness of monetary policy credibility and market adjustment mechanisms in absorbing energy price disturbances.

Conclusion

This study examined the impact of WTI oil price shocks on key macroeconomic variables within the U.S. economy using a SVAR framework over the period 2010–2025. The empirical findings confirm the existence of dynamic interdependence among oil prices, inflation and monetary policy. The results from the SIRFs and FEVD indicate that WTI oil price shocks have a pronounced short-term

effect on Brent prices, inflation and interest rates, whereas their long-term impacts gradually diminish. Brent prices exhibit an immediate and strong response to WTI shocks, reflecting the close integration between the domestic and global oil markets. Inflation demonstrates short-term sensitivity to oil price fluctuations, whereas the FEDRATE responds positively, underscoring the role of monetary policy in mitigating oil-induced inflationary pressure. The findings confirm that oil price shocks remain a significant source of macroeconomic fluctuations in the U.S. economy. This study has several implications. First, owing to the significant short-term responses of macroeconomic variables to oil price shocks, it is imperative for U.S. policymakers to closely monitor fluctuations in WTI when developing monetary policy. Timely and well-calibrated policy adjustments can mitigate inflationary pressures resulting from energy-price volatility. Second, the pronounced transmission of shocks from WTI to Brent prices underscores the necessity for measures aimed at enhancing energy market stability, such as the strategic deployment of petroleum reserves and increased market transparency. These measures can decrease susceptibility to abrupt changes in oil prices. Third, policymakers should encourage energy diversification and sustainability to limit long-term vulnerability to oil-price fluctuations. Investing in renewable energy sources, improving energy efficiency and reducing reliance on fossil fuels can strengthen macroeconomic resilience. Finally, fostering growth in non-energy sectors and supporting technological advancement would decrease structural reliance on oil-related dynamics and contribute to sustained economic stability in the long run.

Although this study has made some valuable contributions, it has a few limitations that need to be acknowledged. First, the analysis is restricted to the United States; therefore, the findings might not apply directly to other economies, especially those that export oil or are emerging markets, where the transmission mechanisms can be quite different. Second, the study considers only four macroeconomic variables but does not consider other factors that might be important, such as exchange rates, industrial production, or global demand conditions, which could affect the relationship between oil prices, inflation and

monetary policy. Third, the results depend on the assumptions made regarding the identification restrictions and lag selection. Finally, using CPI as the only measure of inflation may not adequately capture sectoral price dynamics, as producer price indices and core inflation measures could produce different outcomes.

Future research may benefit from the use of time-varying parameter VAR (TVP-VAR) models. These models are excellent for capturing structural changes and evolving dynamics in different economic settings. Another interesting path is to examine how positive and negative oil price shocks affect things differently by using nonlinear SVAR models. Furthermore, the inclusion of variables such as exchange rates, unemployment and industrial output could offer a more comprehensive understanding of oil price shock propagation. Comparative analyses across countries, contrasting oil-importing and oil-exporting economies, could further enhance our understanding of how structural differences influence these mechanisms.

Abbreviations

ADF: Augmented Dickey–Fuller, AIC: Akaike Information Criterion, FRED: Federal Reserve Economic Data, HQ: Hannan–Quinn Criterion, SC: Schwarz Criterion.

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Author Contributions

Kumar Supreeth: Conceptualization, Methodology, Data curation, Formal analysis, Investigation, Writing – original draft, Purna Prasad Arcot: Supervision, Validation, Writing – review.

Conflict of Interest

The authors declare no conflicts of interest in the conduct of this study.

Data Availability

The data used in this study are publicly available from the Federal Reserve Economic Data (FRED) database maintained by the Federal Reserve Bank of St. Louis, accessible at <https://fred.stlouisfed.org>

Declaration of Artificial Intelligence (AI) Assistance

An AI-based tool (Paperpal) was used during the preparation of this manuscript for translation, grammar correction and word choice to enhance the readability and clarity of expression in the English language. The analytical framework, interpretation of the results and findings remain solely the responsibility of the authors.

Ethics Approval

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