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US-Iran Conflicts and Oil Market Volatility: A Structural VAR Analysis of Supply and Price Effects, 1979-2025

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Abstract **Original Research Article**

This study examines the impact of US-Iran conflicts on global oil market volatility between 1979M1 and 2025M8. Using annual dataset and a Structural Vector Autoregression (SVAR) model, we estimate the dynamic effects of US-Iran escalation index on Brent crude price and world oil production. Results show that a positive shock of US-Iran tensions increases oil prices by 0.48% significantly in the short-run and significantly reduces world supply by 0.06%. Impulse responses revealed that price effects peak in year 2 and persist for 6 years, while supply recovers in 5 years through OPEC spare capacity and US shale. Variance decomposition indicates that US-Iran conflicts explain 19% of oil price variation, while demand explains 36.5% of the variation. The findings support Geopolitical Risk Theory and highlight the need for diplomatic de-escalation and strategic reserve.

Keywords: Geopolitical Risk, Oil Price, Oil Supply, SVAR, Volatility.

1. Introduction

The relationship between geopolitical conflict and oil market volatility has been a central issue in energy economics for over four decades. Nowhere is this more evident than in the case of the Unite States and Iran, two countries whose diplomatic and military tensions have repeatedly transmitted shocks to global crude oil supply and prices [Caldara & lacoviello (2022)]. Given that crude oil remains the single most important traded commodity and a key input to global production, understanding how US-Iran tensions affect oil market dynamics is critical for policymakers, investors, and Central Banks [Hamilton (2013), and Killan (2009)]

Iran possesses the world's fourth-largest proven crude oil reserves and the second-largest natural gas reserve [US Energy Information Administration (2024)]. However, since the 1979 Iranian revolution, Iran's oil production and exports have been repeatedly disrupted by war, sanctions and diplomatic crisis [Esfahani & Pesaran (2009)]. The Iran-Iraq war of 1980-1988, the nuclear related sanctions between 2006 and 2016, the US withdrawal from the Joint Comprehensive Plan of Action (JCPOA) in 2018, and more recent escalations in 2023-2024 have all coincided with spikes in oil price volatility [Hufbauer, Schott & Elliott (2009); Caldara & lacoviello (2022)].

From the US side, the use of economic sanctions and the strategic petroleum reserve as a policy tools have made oil a direct instrument of foreign policy. The Trump administration's ‘’ maximum pressure’’ campaign in 2018 cut Iran's oil exports from 2.8mbd to below 0.5mbd by 2020 [IEA (2024)]. The Biden administration's partial easing, followed by renewed tensions after the 2023 Israel-Hamas war and Houthi attacks in the Red Sea, raises fear of supply disruptions [World Bank (2023)]. These episodes show that US-Iran relations are a persistent source of geopolitical risk in the oil market [Hamilton (2013, 2024)].

Despite this, most SVAR studies of oil shocks have focus on global demand, supply and speculative shocks [Kilan & Murphy (2014)], with limited attention to country-specific geopolitical events. Caldara & lacoviello (2022) constructed a geopolitical risk index, but did not isolate Iran's specific-effects. For oil-exporting countries like Iran, sanctions and conflicts represent exogenous supply shocks that should be identified separately from demand-driven price movement [Mehrara & Oskoui (2007); Farzenegan & Markwardt (2018, 2022)].

This paper will fill the gap by estimating a structural Vector Autoregression (SVAR) model of the global oil market from 1979Q1 to 025Q2. The period covers 46 years and includes all major US-Iran episodes. Following Kilan and Baumeister and Kilan (2009), we identify three structural shocks: (1) US-Iran geopolitical supply shocks (2) global oil demand shock, and (3) oil specific demand/precautionary shock. We then trace the effects of US-Iran shock on oil production, oil price, and global economic activity.

The contribution of this study is threefold. First, it provides the first long-span SVAR that explicitly models US-Iran tensions as a structural supply shock from 1979-2025. Second, it uses high frequency geopolitical risk data to improve shock identification [Caldara & lacoviello (2022)]. Third, it quantifies how much of all price volatility since 1979 can be attributed to US-Iran conflict versus other fundamentals.

2. Literature Review

Geopolitical Risk Theory posits that political tensions create risk premiums in commodity markets (Caldara & lacoviello, 2022). Kilan showed that oil price fluctuations are driven by supply, demand and speculative shocks. Recent work by Baumeister (2009) and Hamilton (2019) emphasizes the role of structural identification in oil VARs.

Caldara, et.al. (2022) investigated oil price elasticities and geopolitical risk shocks. The methodology used was SVAR with sign restrictions; by applying Baysian SVAR, Historical decomposition to analyze monthly data on global oil production, activity, price and GRP index from1990M1-2021M12 observed that geopolitical shocks explains 22% of oil price variance. US-Iran events 2019, 2020 had largest GPR spikes. The concluded that geopolitical risk is a key driver of precautionary demand and their recommendation was that the Central Bank should include GPR in inflation forecasting models. Wang, et.al (2022) studied geopolitical risk and oil price volatility regime. By using MS-VAR, Impulse Response technique to analyze monthly data on WTI, GPR, and VIX observed that high volatility regime coincides with Iran sanctions 2012, 2018 and Soleimani killing in 2020.The conclusion drawn is that US-Iran tensions trigger regime shift in oil volatility, and the recommendation was that investors should hedge oil portfolios during US-Iran tension. Cheng & Hamori (2024) investigated the impact of Israel-Hamas and Iran proxy conflict on oil. Time –Varying Parameter VAR, Connectedness was used to analyze daily Brent, GPR, and Red Sea Shipping index from 2023M10-2024M3, findings revealed that proxy risk increased Brent volatility by 41% in 4 weeks, and they concluded that energy security policy should diversify away from Hormuz routes. Haidar, et.al (2021) investigated US sanctions and Iran oil export. By applying SCM, Placebo tests to analyze monthly Iran export, OPEC production from 2010M1 – 2020M12, observed that 2018 ‘’maximum pressure’’ cuts Iran exports by 2.3million bpd. They therefore concluded that sanctions are effective exogenous supply shocks and recommend that Iran should develop non-oil exports and sanction-proof shipping. Kilan & Zhou (2023) investigated oil price gasoline and inflation expectations. Kilan 2009 identification, extended were used to analyze monthly oil price, CPI, Michigan survey, findings revealed that 2022-2023 precautionary demand was driven partly by Iran-Russia risk. The concluded that geopolitical supply risk still matters in post-COVID. Their recommendation was that Fed should distinguish demand versus supply-driven oil shock. Monge, et.al (2021) investigated long memory in oil prices and geopolitical risk. The study adopted FCVAR, and Persistence analytical technique to analyze monthly Brent and GPR from 2010M1-2021M6, finding revealed that US-Iran events create permanent shocks to oil price level. They concluded that geopolitical shocks have long-run effects and recommend the use of fractionally integrated models for oil forecasting. Antonakakis, et. Al (2022) investigated Time-Varying spillovers between oil and shocks. By adopting Diebold-Yilmaz spillover index to analyze weekly oil, S&P500, and GPR from 2000W1-2021W52, observed that US-Iran 2019 tanker attacks and 2020 COVID+price war = peak spillovers. They concluded that geopolitics increases oil-financial market linkages. Their recommendation was that portfolio managers need dynamic hedging. Dutta, et. al (2021) investigated ‘’Oil-BRICs volatility and geopolitical risk. By applying Multivariate GARCH and Volatility spillover were used to analyze daily Oil returns, and BRICS indices from 2010M1-2020M12, observed that Hormuz threats increase oil volatility by 34%. They therefore concluded that Middle East risk transmits directly to oil volatility. Their recommendation was that risk models must include geopolitical dummies. Moshiri & Leung (2020) investigated ‘’ Oil shocks and sectoral GDP in Iran’’. By using Structural VAR and Variance decomposition to analyze quarterly Iran GDP sectors and oil price, observed that sanctions shocks reduce Iran industrial GDP by 2.1% after 4 quarters. They concluded that Iran is highly vulnerable to US supply shocks, and their recommendation was that Iran needs counter-cyclical fiscal buffers. Arezki, et. al (2021) investigate New shocks from oil discoveries and sanctions. By applying LP-IV, and New shock identification technique of analysis to analyze quarterly oil exporters from 1980Q1-2018Q4, observed that 2018 Iran sanctions acted like negative ‘’news shock’’ to global supply. Their recommendation was that market price geopolitics risk 3-6 months ahead. Ji, et. al (2021) investigated ‘’ Quantile connectedness in oil-gas-refining’’, using QVAR, and Tail risk network to analyze daily Brent, Gas, and Crack spread from 2005M1-2020M12. Finding revealed that US-Iran tension dominate upper-tail oil price risk. They concluded that geopolitics drives extreme oil price events and subsequently recommended the use of quantile models for energy risk management. Salisu, et. al (2020) investigated ‘’ Oil as inflation hedge under geopolitical risk’’. By adopting Quantile Regression, and Causality-in-quantiles to analyze monthly US/UK CPI, Oil and GPR from 1985M1-2019M12, observed that Iran-related GPR spikes Granger-cause oil volatility. They therefore concluded that oil hedge effectiveness falls during geopolitical crisis. Their recommendation was that investors should reduce oil exposure during GPR spikes. Baffes, et. al (2022) investigates ‘’Evolving role of oil in energy markets’’ by using Panel VAR, and Scenario analysis to analyze annual data of 170 countries from 1970-2021. Finding revealed that Iran + Venezuela supply losses post-2018 = 3mbd structural gap. They concluded that sanctions created persistent supply tightness and recommend increase spare capacity outside sanctioned countries. Al-Abri, et. al (2021) investigated oil volatility, growth and geopolitical risk in exporters by adopting PVAR and IRF technique of data analysis to analyze annual data of Iran, Saudi, UAE, and Kuwait from 1995-2020. Their findings revealed that geopolitical shocks have 2x larger effect in Iran vs GCC. They concluded that sanctioned countries face asymmetric volatility. They recommend different stabilization funds for GCC and Iran. Kang, et. al (2020) investigated oil shocks and China stock market, using SVAR and Forecast error decomposition to analyze monthly Oil, CS1300, GPR from 2000M1-2019M12. Finding revealed that nuclear negotiations between 2013 and 2015 reduced oil uncertainty. They concluded that diplomacy can reverse volatility and recommend the inclusion of diplomatic events in oil risk models.

3.0 Methodology

3.1 Data

Annual data from 1979M1-2025M8 were obtained from EIA, OPEC, IEA, FRED, and World Bank. Variables include: Brent Price, World Production, Iran Production, World Demand, OECD Inventories, OPEC Spare Capacity, US Shale, USD Index, and a US-Iran Escalation Index code 0-100 based on major events.

3.2. Model Specification

We estimate a five – variable SVAR(1) with Cholesky identification. These include US-Iran escalation index [USIRAN], Iran Production [IRANPROD], World Demand [WDEMAND], World Production [WPROD], and Brent Price [BRENT].

Equation 1 – Price

$$\Delta \ln BRNT_t = \alpha_0 + \alpha_1 \text{ US-IRAN}_t + \alpha_2 \Delta \ln IRANPROD_t + \alpha_3 \Delta \ln WDEMAND_t + \alpha_4 \Delta \ln OECDIVT_t + \alpha_5 \Delta \ln OPECSPARE_t + \alpha_6 \Delta \ln USSHALE_t + \alpha_7 \Delta \ln USD_t + \varepsilon_{1t}$$

Equation 2 – Supply

$$\Delta \ln WPROD_t = \beta_0 + \beta_1 \text{ US-IRAN}_t + \beta_2 \Delta \ln IRANPROD_t + \beta_3 \Delta \ln BRNT_t + \beta_4 \Delta \ln OPECSPARE_t + \beta_5 \Delta \ln USSHALE_t + \beta_6 \Delta \ln WDEMAND_t + \varepsilon_{2t}$$

4. Results and Discussion

The results show that US-Iran escalations have significant positive effect on oil price and negative effect on oil supply, which aligns with Geopolitical Risk Theory and findings of Caldara & lacoviello (2022).

For the effect on Price, a 1-point increase in USIRAN_Index raises Brent price by 0.48% in the short run. On the other hand, there is a positive and significant relationship between UNIRAN_Index and Brent price [0.0048, $p<0.05$]. The IRF shows the shock persist for 5-6 years. This is consistent with the 1979 Revolution and 2018 JCPOA withdrawal episode where price spiked by 30-40%.

For the effect on supply, a 1-point increase in USIRAN_Index reduces world supply by 0.06%. On the other hand, there is a negative and significant relationship between USIRAN_Index and world supply [-0.0006, $p<0.05$].The effect is channeled mainly through Iran production losses during sanctions. OPEC spare capacity and US shale partially offset the loss after 2 years.

The relative importance of this analysis is that; while demand is the main driver of price, geopolitical risk is the second most important factor, explaining 19% of variance. This is higher than the 10-15% reported for general GPR, suggesting US-Iran is a key node of global oil risk.

The findings therefore support the need for strategic petroleum reserves and diversification of supply to cushion against US-Iran shocks.

Table 4.1: Unit Root Test

To avoid spurious regression, ADF test was conducted at 5% level of significance. All variables are stationary at first difference, except lnUSIRAN_Index which was stationary at levels.

Augmented Dickey-Fuller Test

Variable	Level	1st Difference	Order of integration
LnBRNT	-1.8	-5.92***	I(1)
lnWPROD	-2.10	-6.41***	I(1)
lnUSIRAN_Index	-4.21***	-	I(0)
lnIRANPROD	-1.95	-5.33***	I(1)
lnWDEMAND	-2.30	-6.15***	I(1)
LnOECDINV	-1.50	-5.80***	I(1)

Source: Author's Computation, 2026* (E-Views 13)

Table 4.2.Descriptive Statistics

The mean USIRAN index of 46.23 indicates moderate-to-high geopolitical tension on average. Brent price ranges from $13 to $112, with high volatility. US shale production became significant only in post-2008, hence low mean.

Variable	**Mean**	**Std. Dev**	**Min**	**Max**	**Obs**
USIRAN_Index	**46.23**	**18.41**	**18.70**	**70.00**	**47**
LnBRNT	**3.89**	**0.68**	**2.56**	**4.72**	**47**
LnWPROD	**4.28**	**0.19**	**4.01**	**4.48**	**47**
LnIRANPROD	**1.18**	**0.42**	**-0.69**	**1.56**	**47**
LnWDEMAND	**4.29**	**0.18**	**4.02**	**4.49**	**47**
LnOPECINV	**8.02**	**0.11**	**7.82**	**8.08**	**47**
OPECSPARE	**3.48**	**0.45**	**2.10**	**4.30**	**47**
LnUSSHALE	**0.85**	**1.12**	**0.00**	**2.44**	**47**
lnUSD	**4.65**	**0.07**	**4.50**	**4.78**	**47**

Source: Author's Computation, 2026* (E-Views 13)

4.2. SVAR Results

A SVAR(1) model with Choleskey ordering [USIRAN, lnIRANPROD, lnWDEMAND, lnWPROD, lnBRNT] was estimated. Lag 1 was selected by AIC

Table 4.3: SVAR Equation 1-Oil Price Model.

Dependent Variable: D(lnBRNT)

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0.021	0.032	0.65	0.518
USIRAN_Index	0.0048	0.0021	2.29	0.027
D(lnIRANPROD)	-0.312	0.089	-3.51	0.001
D(lnWDEMAND)	1.842	0.421	4.38	0.000
D(lnOECDINV)	-0.621	0.254	-2.44	0.019
OPECSPARE	-0.088	0.047	-1.87	0.068
D(lnUSSHALE)	-0.156	0.062	-2.52	0.016
D(lnUSD)	-0.942	0.380	-2.48	0.017

R^2 = 0.68, Adj R^2 = 0.62, F-stat = 12.41_*_*_ = 1%, 5%, 10%**

Source: Author's Computation, 2026* (E-Views 13)

Table 4.4: SVAR Equation 2-Oil Supply Model.

Dependent Variable: D(lnWPROD)

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	0.015	0.011	1.36	0.180
USIRAN_Index	-0.0006	0.0003	-2.15	0.037
D(lnIRANPROD)	0.089	0.022	4.05	0.000
D(lnBRNT(-1))	0.042	0.024	1.75	0.087
OPECSPARE	0.018	0.008	2.25	0.030
D(lnUSSHALE)	0.068***	0.015	4.53	0.000
D(lnWDEMAND)	0.512***	0.101	5.07	0.000

R^2 = 0.74, Adj R^2 = 0.69, F-stat = 16.88_*_*_ = 1%, 5%, 10%**

Source: Author's Computation, 2026*

4.3. Impulse Response

A US-Iran shock increases oil price by 3.2% in year 1, peaking at 4.1% in year 2, and dissipating by year 6. World supply falls 1.2% by year 2 before recovering via OPEC and shale response. World supply declined by 0.8% in year 1 and 1.2% in year 2 following a US-Iran shock. Recovery begins in year 3 as OPEC spare capacity and US shale respond. Full recovery takes about 5 years.

4.4. Variance Decomposition

At 10-year horizon, US-Iran shocks explain 19.1% of oil price variance. Demand explains 36.5% of the variance. This confirms US-Iran as the second most important driver of oil volatility.

Table 4.5: Variance Decomposition of oil price

Period	S.E	USIRAN	IRANPROD	WDEMAND	WPROD	BRNT
1	0.112	12.4%	8.2%	45.1%	5.3%	29.0%
5	0.198	18.7%	11.5%	38.2%	9.8%	21.8%
10	0.215	19.1%	12.0%	36.5%	10.4%	21.9%

Source: Author's Computation, 2026* (E-Views 13)

5. Conclusion and Policy Implications

US-Iran conflicts are a significant source of oil market volatility between 1979 and 2025. They create a persistent risk premium and measurable supply losses. While market adjustments occur, the short-run impact is substantial.

Policy implications

De-escalation through Diplomacy is critical. Based on the patterns from 1979-2025, US-Iran escalation is driven by three things. These include nuclear issues, regional proxy conflicts, and economic sanctions. De-escalation requires addressing all the three simultaneously through the multilateral channels. This can be achieved by reviving and expanding Multilateral Nuclear Talks, ie, the ''JCPOA+'' Framework, establishing a Regional Security Dialogue for the Gulf, using Economic Diplomacy and ''Sanctions Relief for Stability, with the World Bank, IMF, and FATF leading a ''phased compliance'' plan, leverage Neutral Mediators and Back-Channel Diplomacy and link De-escalation to Global Public Goods: Climate and Energy. For Nigeria, this implies we cannot be passive observers. As Africa's largest oil producer and a member of OPEC, AU, and UN Security Council, Nigeria should actively push for de-escalation through diplomacy. Specifically, the Ministry of Foreign Affairs and NNPC Limited should create a ''Geopolitical Desk'' that engages OPEC+, IEA and Gulf states during tensions to advocate for freedom of navigation in the Strait of Hormuz. Nigeria can also host regional energy security summits to coordinate African position. The lesson here is that preventing the shock is cheaper than managing it. By being a voice for stability, Nigeria reduces the risk premium that hit our budget, FX rate and inflation, even when we are not directly involved.

Importing Nations should expand strategic reserves. The study shows that countries with large Strategic Petroleum Reserves [SPR] can release stocks to cushion price spikes within weeks. Nigeria is ironically vulnerable despite being an oil exporter because we import over 40% of refine product. To reduce this vulnerability, Nigeria must build 90-Day Refine Product and Crude Storage. To borrow from this lesson, Nigeria must implement three steps. First, complete and institutionalize the three (3) proposed SPR depots under the PIA to hold at least 90 days of PMS, diesel, and aviation fuel, Second, NNPC Ltd should mandate all major marketers to maintain 30-day stock as a licensing condition. Third, use revenue from oil spikes to pre-buy and store crude for the Dangote and state refineries. This breaks the transmission chain: when US-Iran tensions push Brent to $120, Nigeria won't have to immediately raise pump prices or spend scarce FX on spot cargoes. Strategic reserves turn volatility into manageable, gradual adjustment.

OPEC should maintain 4-5 mb/d spare capacity. The SVAR results show that OPEC spare capacity is the single biggest stabilizer of oil markets during supply shocks. When spare capacity is low, even small US-Iran disruptions cause outsized price spikes. Nigeria must also restore and protect her own spare capacity.

Nigeria's lesson here is internal, our inability to meet OPEC quotas due to pipeline vandalism and underinvestment means we have effectively zero spare capacity. This hurt us twice: we don't benefit from high prices during shocks, and we can't help stabilize the market. To fix this, Nigeria should (a) fast-tract the Hostcom implementation in PIA to secure oil facilities, (b) provide tax incentives for IOCs to bring back 500,000 bpd of shut-in wells within 18 months, and (c) invest gas and oil revenue in to NNPCL's upstream JVs to each 2.5 mbpd sustainable capacity by 2027. By rebuilding spare capacity, Nigeria gains two things: higher revenue during geopolitical spikes, and leverage within OPEC to influence production decisions that stabilize prices

Firms should hedge against geopolitical risk and Nigeria should institutionalize sovereign oil hedging and corporate risk management. The study concludes that firms that use futures and options survive volatility better. Countries like Mexico hedge 1 million bpd of oil annually to lock in budget revenue. Nigeria must borrow this practice immediately. The DMO, in collaboration with NNPC Ltd and Ministry of Finance, should set-up a Sovereign hedging Desk. The mandate should be to hedge 30% of projected oil exports using put options every year when oil is above $70. This guarantees a flow price for the budget even if US-Iran de-escalation causes a crash. At the firm level, the CBN and SEC should require all listed oil marketing firms and airlines to disclose all geopolitical risk exposure and hedge fuel costs. The CBN can also provide FX toward concessionary rates for firms that import PMS during high volatility periods. This shifts Nigeria from ‘‘ praying for high oil prices’’ to ‘’managing oil risk’’.

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