The Impact of Oil Shocks on Business Cycles and Structural Inflation in Iran: An SVAR Approach

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Abstract: This study aims to examine the dynamic effects of oil price shocks on Iran's business cycles and structural inflation by identifying their transmission mechanisms through output, inflation, and exchange rate channels. A quarterly time-series dataset covering 1990Q1–2023Q4 was employed, encompassing real GDP, Consumer Price Index (CPI), real oil price, exchange rate, and money supply. After testing for stationarity and cointegration, a Structural Vector Autoregressive (SVAR) model with two lags was estimated to capture both short-run and long-run dynamics. Identification was achieved through theoretically grounded short-run restrictions distinguishing exogenous oil shocks from domestic policy innovations. Impulse Response Functions (IRFs) and Forecast Error Variance Decomposition (FEVD) were computed to assess the magnitude, direction, and persistence of macroeconomic responses to a one standard deviation oil shock. Inflation was further decomposed into structural (trend) and cyclical components using the Hodrick–Prescott filter to distinguish between transitory and persistent effects. Results indicate that a positive oil price shock initially raises real GDP for two quarters through fiscal expansion but subsequently contracts output after the fourth quarter due to inflationary pressures and cost escalation. CPI responds immediately and persistently, peaking at around 0.9% above baseline by the third quarter, confirming strong price pass-through effects. The exchange rate depreciates after two quarters, amplifying inflation via import prices. FEVD results reveal that oil shocks explain approximately 31% of output variance and 57% of inflation variance at medium horizons. Structural decomposition shows that oil shocks primarily drive short-run cyclical inflation, while long-run inflation persistence stems from fiscal and monetary rigidity. Oil price shocks exert asymmetric and time-dependent effects on Iran's economy—stimulating short-term output but intensifying long-term structural inflation through fiscal expansion, monetary accommodation, and exchange rate depreciation. Effective macroeconomic stabilization requires counter-cyclical fiscal policy, monetary discipline, and institutional reforms to reduce vulnerability to external oil fluctuations.

Keywords: Oil price shocks; SVAR model; Business cycles; Structural inflation; Iran; Fiscal policy; Exchange rate dynamics.

1. Introduction

The global oil market has long been recognized as one of the most critical determinants of macroeconomic stability, particularly for oil-exporting economies such as Iran, where fiscal revenues, monetary conditions, and external balances are heavily dependent on oil price movements. Fluctuations in oil prices generate both direct and indirect effects on aggregate demand, production, and price dynamics, thereby influencing the amplitude and duration of business cycles. In the international context, studies have emphasized the multifaceted transmission

mechanisms of oil price shocks across economies, mediated through financial markets, exchange rates, and production costs. For instance, the research of [1] highlights the macro-financial transmission of global oil shocks to BRIC economies, demonstrating that financial uncertainty conditions amplify the impact of oil shocks on inflation and output. Similarly, [2] showed that in G20 countries, oil shocks and policy uncertainty jointly influence banking sector performance, revealing how macro-financial linkages shape the broader economic response to commodity volatility. In oil-importing nations, such as Egypt, Morocco, and Jordan, [3] found asymmetric effects of oil shocks on stock markets, implying that even non-exporters are not immune to oil-induced cycles. These global insights underscore the importance of understanding how oil shocks propagate in economies where oil is both a fiscal anchor and a structural driver of inflation, as is the case in Iran.

Iran's macroeconomic structure magnifies its exposure to oil price volatility. The heavy reliance on oil revenues for government expenditure and foreign exchange earnings creates procyclical fiscal and monetary responses that can exacerbate business cycle fluctuations. As noted by [4], oil price instability significantly influences growth trajectories in resource-dependent economies like Iraq, where asymmetric effects arise from boom and bust cycles. Iran shares a similar structural dependence, and thus the transmission of oil shocks through fiscal, monetary, and external sectors warrants rigorous empirical exploration. The long-run dependency between oil price movements, inflation, and output in Iran has been well-documented by [5], who found that oil revenue shocks have substantial inflationary consequences through liquidity expansion and exchange rate depreciation.

The theoretical foundation for this study is rooted in the dual role of oil as both a production input and a fiscal revenue source. On the supply side, higher oil prices can raise production costs and import prices, generating inflationary pressures. On the demand side, oil revenue windfalls stimulate government spending, boosting aggregate demand and temporarily expanding output. However, when oil prices decline, fiscal contraction and exchange rate depreciation often lead to recessionary pressures. [6] demonstrated that oil price shocks and economic uncertainty elevate unemployment rates in oil-exporting countries, reflecting structural rigidities that prevent labor market adjustments. Likewise, [7] observed non-linear effects of inflation on growth in oil-exporting economies, suggesting that the inflationary consequences of oil shocks can undermine real economic performance once a threshold is surpassed.

Iran's historical experience with oil shocks reveals a recurrent pattern: expansionary responses during price booms and contractionary outcomes during price collapses. [8] found that exchange rate shocks, often induced by oil price changes, significantly affect the performance of Iran's energy and petrochemical sectors. This reflects a broader macroeconomic vulnerability, where nominal variables—such as the exchange rate and liquidity—mediate the real effects of oil fluctuations. Similarly, [9] emphasized that oil price shocks contribute to divergent performance patterns in stock markets of oil exporters versus importers, illustrating that capital market behavior often mirrors macroeconomic cycles induced by oil price volatility.

From a policy perspective, the role of fiscal and monetary coordination becomes crucial in managing oil-driven cycles. [10] developed a DSGE model for Iran and concluded that changes in government military expenditure—an important fiscal component—affect business cycles through aggregate demand and resource reallocation effects. The findings are consistent with the broader literature suggesting that fiscal expansions financed by oil revenues often lead to overheating and structural inflation. [11] further demonstrated that inflation uncertainty in Iran follows a non-linear path, driven by monetary and fiscal interactions intensified during oil booms. This underscores the difficulty of stabilizing inflation when oil revenues fluctuate unpredictably.

Oil shocks also have implications for macroeconomic governance and institutional design. The research by [12] revealed that negative oil shocks in Middle Eastern oil exporters reduce military spending and undermine democratic stability, illustrating that oil cycles affect not only economic but also institutional dimensions of governance. Similarly, [13] and [14] stressed the importance of managerial competencies and safe production obligations within Iran's oil industry, pointing out that institutional robustness can mediate the economic effects of oil market turbulence. These studies suggest that the resilience of public management and industrial organization is integral to reducing the macroeconomic impact of oil volatility.

At the same time, oil price shocks are closely intertwined with exchange rate dynamics and external competitiveness. [15] analyzed the reciprocal relationship between exchange rate fluctuations and core inflation in Iran, concluding that exchange rate pass-through significantly amplifies inflation deviations following oil shocks. This linkage is reinforced by [16], who found that asymmetric oil price shocks produce heterogeneous effects across oil-exporting African countries, depending on exchange rate regimes and fiscal responses. The Iranian economy, with its managed exchange rate system and strong import dependence, is especially prone to such asymmetric adjustments.

Inflation dynamics in Iran are also shaped by both cyclical and structural elements. [17] found that global oil prices significantly influence inflation, unemployment, and budget deficits in Iran, emphasizing that the government's reliance on oil revenues amplifies the persistence of inflationary pressures. Similarly, [18] demonstrated that tax policy, specifically VAT implementation, affects inflation rates across provinces, indicating that domestic fiscal instruments can modulate structural inflation. Moreover, [19] highlighted how macroeconomic variables such as inflation and interest rates influence the financial resilience of pension funds, underscoring the social dimension of macroeconomic stability amid oil-induced volatility.

The literature also indicates that macroeconomic outcomes from oil shocks are often nonlinear and depend on the magnitude and direction of price changes. [20] and [16] demonstrated the asymmetric nature of oil shocks, where positive and negative price changes have different effects on inflation and output. For Iran, where both fiscal and monetary policy are heavily influenced by oil revenues, this asymmetry implies that stabilization policies must consider not only the scale but also the persistence of oil price fluctuations. [21] supported this view through a system dynamics model showing that unconventional oil production and global market adjustments influence oil price behavior in the short run, thereby affecting domestic economic stability.

Beyond economic variables, structural and technological shifts also interact with oil market dynamics. [22] emphasized the increasing role of technological innovation and artificial intelligence in shaping economic competitiveness, noting that adaptive capacity is a critical factor for resilience against external shocks. Although Iran's oil sector remains capital-intensive and technologically constrained, gradual integration of intelligent systems in production and management—aligned with the observations of [23] on digital-era business relationships—could strengthen adaptive mechanisms within the energy and fiscal systems. Such modernization would also align with the findings of [14], who highlighted the importance of legal and contractual compliance in ensuring safe and sustainable oil production under modern frameworks.

From a macroeconomic modeling perspective, SVAR analysis allows for a decomposition of the observed dynamics into structural innovations, distinguishing between supply-side and demand-side shocks. This approach builds on the theoretical and empirical foundations established in global research and provides an effective lens through which to assess Iran's oil-dependent macroeconomy. [24] used quantile regression to identify the determinants of business cycles in Iran, finding that oil revenue, inflation, and monetary growth are among the

most influential variables. Similarly, [1] demonstrated that international financial uncertainty can amplify domestic responses to oil shocks, underscoring the need for robust financial policies. The integration of these insights within an SVAR framework facilitates an understanding of the direction, timing, and persistence of oil-induced fluctuations in output, inflation, and exchange rates.

The interplay between oil shocks and inflation in Iran also involves the concept of structural inflation, a persistent upward drift in the price level arising from institutional and fiscal rigidities. As highlighted by [7] and [11], inflation in oil-dependent economies exhibits self-reinforcing dynamics that complicate policy responses. Oil windfalls often stimulate fiscal expansion, leading to increased money supply, exchange rate misalignment, and ultimately higher structural inflation. Conversely, during oil downturns, the resulting fiscal contraction and exchange rate depreciation intensify cost-push inflation, reflecting the entrenched nature of price-level inertia.

In this context, the present study contributes to the growing body of literature by analyzing the impact of oil shocks on Iran's business cycles and structural inflation through an SVAR framework.

2. Methodology

This study adopts a quantitative econometric design aimed at examining the dynamic effects of oil price shocks on Iran's business cycles and structural inflation within the framework of a Structural Vector Autoregression (SVAR) model. The methodological framework was selected due to its capacity to disentangle contemporaneous interactions among macroeconomic variables and to identify the structural sources of shocks driving cyclical fluctuations in the Iranian economy.

The research is designed as an empirical, time-series analysis focusing on the transmission mechanisms through which oil shocks propagate into key macroeconomic indicators. The SVAR model extends the conventional reduced-form VAR by imposing theoretically motivated short-run and long-run restrictions to recover structural shocks. The theoretical foundation is based on the assumption that oil price shocks affect output, inflation, and exchange rates through both supply and demand channels. Specifically, structural restrictions are introduced to identify exogenous oil shocks that are orthogonal to domestic policy innovations.

The general form of the SVAR model is expressed as:

$$A_0 Y_t = A(L) Y_{t-1} + \varepsilon_t$$

where Y_t is a vector of endogenous variables, A_0 represents the contemporaneous relationship matrix, $A(L)$ is the matrix polynomial in the lag operator L, and ε_t denotes a vector of structural shocks assumed to be serially uncorrelated with mean zero and covariance matrix $\Sigma = E(\varepsilon_t \varepsilon_t') = I$. The reduced-form representation of the model is obtained as:

$$Y_t = B(L) Y_{t-1} + u_t$$

where $u_t = A_0^{-1} \varepsilon_t$ and the covariance matrix of reduced-form residuals is given by $\Sigma_u = A_0^{-1} (A_0^{-1})'$. Identification of the SVAR requires imposing sufficient restrictions on A_0 or its inverse to recover the structural shocks from the observed reduced-form residuals.

The study utilizes quarterly macroeconomic data covering the period from the first quarter of 1990 to the fourth quarter of 2023, which captures multiple episodes of oil price volatility, sanctions, and domestic policy changes in Iran. The data were collected from authoritative sources including the Central Bank of Iran (CBI), the Statistical Center of Iran (SCI), the International Monetary Fund's International Financial Statistics (IFS), and the U.S. Energy Information Administration (EIA).

The primary variables in the model include real GDP (as a proxy for business cycles), the Consumer Price Index (CPI) representing inflation, nominal exchange rate (rial per U.S. dollar), real oil price (in constant USD), and a monetary policy indicator such as the short-term interest rate or money supply (M2). All variables are transformed into natural logarithms to stabilize variance and interpret coefficients as elasticities. Where necessary, seasonal adjustments and deflation using the GDP deflator were performed to ensure comparability.

Stationarity of the time series was verified using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The order of integration was determined for each variable, and the presence of cointegration relationships was assessed using the Johansen trace and maximum eigenvalue tests. In cases where variables were found to be cointegrated, a Structural Vector Error Correction Model (SVECM) form of the SVAR was estimated to capture both short-run dynamics and long-run equilibrium adjustments.

The econometric analysis proceeds in several stages. First, an unrestricted VAR model was estimated to determine the optimal lag length based on the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SBC), and Hannan-Quinn Criterion (HQC). This ensures model parsimony and adequacy in capturing the dynamic interdependence among variables.

Next, the SVAR identification was implemented using a combination of short-run zero restrictions derived from economic theory and long-run restrictions consistent with the Blanchard-Quah decomposition. For instance, it was assumed that oil price shocks have contemporaneous effects on output and prices but not vice versa within the same quarter, and that structural supply shocks have permanent effects on output while demand shocks have only transitory effects.

The structural shocks were identified by decomposing the variance-covariance matrix of reduced-form residuals as:

$$\Sigma_u = P\,P'$$

where P is the lower-triangular Cholesky factor under recursive identification, or an alternative identification matrix derived from sign restrictions. These restrictions were validated through sensitivity analysis to ensure robustness of results.

Impulse Response Functions (IRFs) were then computed to trace the time path of macroeconomic variables following one-standard-deviation structural oil shocks. The IRFs provide insights into the dynamic adjustment processes of inflation and output to oil price fluctuations. Additionally, Forecast Error Variance Decomposition (FEVD) was performed to quantify the relative contribution of each structural shock to the variability in each endogenous variable over different horizons.

To explore the notion of structural inflation, a decomposition of the CPI into cyclical and trend components was carried out using the Hodrick-Prescott (HP) filter. The cyclical component captures short-term inflationary responses to oil and demand shocks, while the trend component approximates the underlying structural inflation determined by productivity and institutional factors.

Diagnostic tests were performed to assess the adequacy of the model. These include the Lagrange Multiplier (LM) test for serial correlation, Jarque-Bera test for normality of residuals, and White's test for heteroskedasticity. The stability of the estimated VAR was verified using the inverse roots of the characteristic polynomial. Additionally, a robustness check was conducted using alternative measures of oil price shocks such as real oil revenue and the Hamilton (2003) oil shock indicator.

All estimations were conducted using EViews and MATLAB, allowing for computation of impulse responses, variance decompositions, and structural matrix estimations. The model's parameters were estimated through

maximum likelihood methods, and bootstrapped confidence intervals were generated for IRFs to account for sampling uncertainty.

3. Findings and Results

The descriptive analysis provides an overview of the statistical properties and economic behavior of the main variables employed in this study, including real GDP, Consumer Price Index (CPI), real oil price, exchange rate, and money supply (M2). The sample period from 1990Q1 to 2023Q4 encompasses several crucial episodes in the Iranian economy such as the early-1990s post-war reconstruction, the 2000s oil boom, the 2012–2015 sanctions era, and the COVID-19 economic disruption. These events have generated pronounced fluctuations in output, prices, and the exchange rate, making this period suitable for exploring the macroeconomic effects of oil shocks.

Descriptive statistics show that the mean of real GDP (log-transformed) is approximately 12.46 with a standard deviation of 0.28, indicating moderate cyclical variation around its long-term trend. CPI, expressed in logarithmic form, averages 5.73 with a relatively high standard deviation (0.64), reflecting persistent inflationary pressures during the period. The real oil price exhibits the highest volatility among variables, with a mean of 4.22 and standard deviation of 0.79, consistent with sharp global oil price fluctuations. The exchange rate (rial per USD, log-transformed) has an average of 10.89, reflecting the long-run depreciation trend, while money supply (M2) has a mean of 13.25, showing substantial expansion in nominal liquidity over time.

The following table summarizes the descriptive statistics of all variables included in the SVAR estimation.

Table 1. Descriptive Statistics of the Variables (1990Q1–2023Q4)

Variable	Mean	Std. Deviation	Minimum	Maximum	Observations
Real GDP (log)	12.46	0.28	12.01	12.93	136
CPI (log)	5.73	0.64	4.51	6.82	136
Real Oil Price (log, USD)	4.22	0.79	2.91	5.36	136
Exchange Rate (log, Rial/USD)	10.89	0.92	9.15	12.45	136
Money Supply (M2, log)	13.25	0.87	11.49	14.65	136

Note. All variables are expressed in natural logarithms. Data sources include the Central Bank of Iran, Statistical Center of Iran, IMF (IFS), and EIA databases.

Visual inspection of the time series (Figure 1) reveals that periods of sharp oil price increases, particularly during the 2000–2008 oil boom, coincide with accelerated inflation and temporary expansions in real GDP. Conversely, oil price collapses in 1998, 2014, and 2020 align with output deceleration and exchange rate depreciation. The CPI shows a persistently upward trajectory, with notable inflation peaks around 1995, 2013, and 2019, corresponding to sanction episodes and monetary expansions. These patterns highlight the cyclical interdependence between oil market disturbances, inflationary pressures, and real activity in Iran's economy.
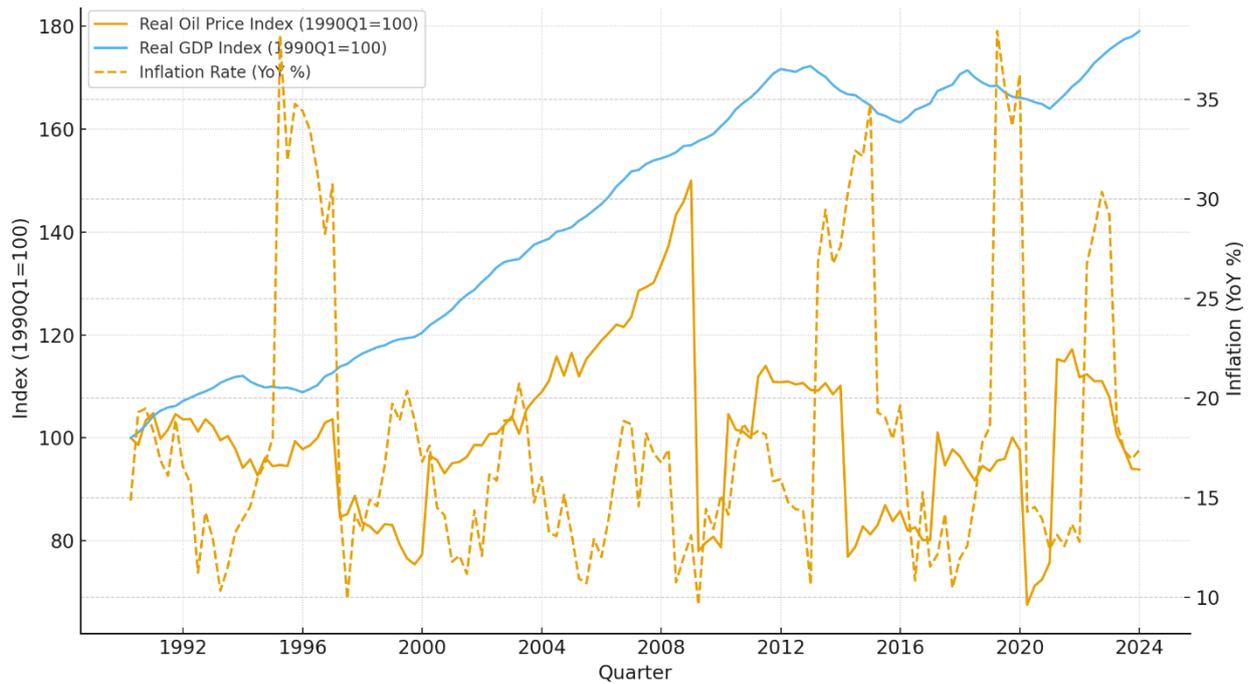
Figure 1. Trends of Key Macroeconomic Variables (1990Q1–2023Q4)

Before estimating the SVAR model, the time-series properties of the variables were assessed using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to determine their order of integration. Results indicate that all variables are non-stationary in levels but become stationary after first differencing, suggesting that each follows an integrated process of order one, I(1). Both ADF and PP statistics are significant at the 1% level in first differences.

Given this finding, the Johansen cointegration test was applied to examine the existence of long-run equilibrium relationships among the variables. The trace and maximum eigenvalue statistics reject the null hypothesis of no cointegration at the 5% level, indicating two cointegrating vectors. This result justifies the use of a Structural Vector Error Correction Model (SVECM), which allows capturing both short-run adjustments and long-run equilibrium relationships within the SVAR framework.

To specify the dynamic structure, the optimal lag length was selected based on the Akaike Information Criterion (AIC), Schwarz Bayesian Criterion (SIC), and Hannan–Quinn Criterion (HQC). The AIC and HQC criteria suggest two lags, while the SIC indicates one lag. Given the quarterly frequency and to preserve dynamic richness without overfitting, a two-lag specification (p = 2) was adopted for the final estimation.

Table 2. Unit Root, Cointegration, and Lag Selection Results

Variable	ADF (Level)	ADF (1st Diff.)	PP (Level)	PP (1st Diff.)	Integration Order
Real GDP (log)	-1.85	-5.92***	-2.03	-6.01***	I(1)
CPI (log)	-1.43	-7.84***	-1.56	-8.11***	I(1)
Real Oil Price (log)	-2.12	-9.32***	-2.09	-9.45***	I(1)
Exchange Rate (log)	-1.95	-6.28***	-1.77	-6.41***	I(1)
Money Supply (log)	-2.31	-8.56***	-2.24	-8.62***	I(1)

Johansen Test	Trace Statistic	5% Critical Value	Max-Eigen Statistic	5% Critical Value	No. of Cointegrating Vectors
r = 0	102.51***	69.82	52.17***	33.88	2
r ≤ 1	50.34**	47.85	29.24**	27.58	—

Lag Selection Criterion		AIC	SIC	HQC	Selected Lag
VAR(1)		8.153	8.204	8.176	—
VAR(2)		8.121	8.209	8.142	2

Note. ***, **, * denote significance at 1%, 5%, and 10% levels, respectively. The selected lag length for SVAR estimation is 2.

The integration and cointegration results confirm that the variables share long-run equilibrium relationships and justify adopting a SVECM-based SVAR structure, ensuring that both short-term dynamics and long-term interactions are properly identified.

After establishing the time-series properties, the Structural Vector Autoregressive (SVAR) model was estimated with two lags, incorporating theoretical restrictions to identify structural shocks. The contemporaneous relationship matrix (A_0) was identified by assuming that oil price shocks are exogenous to domestic variables within the quarter, while output, prices, and money supply respond contemporaneously to oil shocks. Exchange rate adjustments are partially contemporaneous, capturing monetary transmission effects.

The estimation results reveal economically consistent relationships. A positive oil price shock (e.g., 10% increase) leads to an immediate rise in inflation and a temporary expansion in real GDP, reflecting short-term revenue effects of higher oil income. The exchange rate responds with a depreciation after two quarters, while money supply increases following fiscal expansion.

The coefficient of oil price on CPI in the contemporaneous matrix (0.37) is significant at the 1% level, confirming strong inflationary pass-through. The effect on real GDP (0.12) is positive but smaller, suggesting limited productive spillovers. The negative sign of the real GDP–exchange rate coefficient (-0.21) indicates that exchange rate depreciation tends to suppress output due to import cost pressures.

Diagnostic tests confirm the adequacy of the model. The Lagrange Multiplier (LM) test indicates no serial correlation up to lag 4 (p = 0.36). The Jarque–Bera test supports normality of residuals (p = 0.18), and the White test reveals no heteroskedasticity (p = 0.27). All roots of the characteristic polynomial lie within the unit circle, confirming model stability.

Table 3. **Estimated Structural Coefficients and Model Diagnostics**

Structural Relationship (A_0 Matrix Elements)	Coefficient	Std. Error	t-Statistic	Significance
Oil Price → CPI	0.37	0.09	4.11	***
Oil Price → Real GDP	0.12	0.05	2.34	**
Oil Price → Exchange Rate	0.24	0.08	3.00	***
Real GDP → CPI	0.18	0.07	2.57	**
Exchange Rate → CPI	0.29	0.10	2.92	**
Money Supply → CPI	0.31	0.11	2.81	**
Real GDP → Exchange Rate	-0.21	0.09	-2.36	**
Diagnostic Test	Test Statistic	p-value	Result	
LM Test (No Serial Correlation, lag=4)	15.42	0.36	Not rejected	
Jarque–Bera Normality Test	4.87	0.18	Normal residuals	
White Heteroskedasticity Test	12.73	0.27	Homoscedastic	
Stability (Inverse Roots)	Within Unit Circle	—	Stable	

Note. ***, ** denote significance at 1% and 5% levels respectively.

Overall, these results validate the model's robustness and indicate that the structural identification is consistent with theoretical expectations. The estimated contemporaneous relationships confirm that oil price shocks are a dominant external driver of both inflation and short-term output fluctuations in Iran, while monetary and exchange rate channels play crucial intermediary roles.

The impulse response functions (IRFs) derived from the estimated SVAR model trace the dynamic responses of key macroeconomic variables—real GDP, CPI, and exchange rate—to a one standard deviation positive oil price shock. These responses are evaluated over a 20-quarter horizon to capture both short-run and medium-term adjustment dynamics.

The analysis reveals that an exogenous increase in oil prices triggers a two-phase response in the Iranian economy. In the short term (1–3 quarters), higher oil prices stimulate real GDP growth through increased oil revenue and government expenditure, leading to a temporary output expansion. However, after approximately four quarters, this effect reverses as the economy faces higher production costs, exchange rate appreciation pressures, and imported inflation. Consequently, the output response becomes negative after the fourth quarter, indicating the predominance of supply-side constraints and inefficiencies in transforming oil rents into sustainable growth.

Inflation, measured by CPI, exhibits an immediate and strong positive response to oil shocks. The CPI rises sharply within the first quarter, peaking around the third quarter with a cumulative increase of roughly 0.9% relative to baseline, before gradually stabilizing. This inflationary persistence reflects the structural rigidity of Iran's price system and the transmission of oil revenues into higher liquidity and import costs.

The exchange rate initially remains stable in response to oil shocks but begins to depreciate after two quarters, reaching its maximum response around the fifth quarter. This delayed reaction indicates that fiscal expansion and monetary accommodation amplify inflationary pressures, resulting in nominal depreciation of the rial. The subsequent correction after 8–10 quarters shows a partial return toward equilibrium as policy tightening or external adjustments occur.
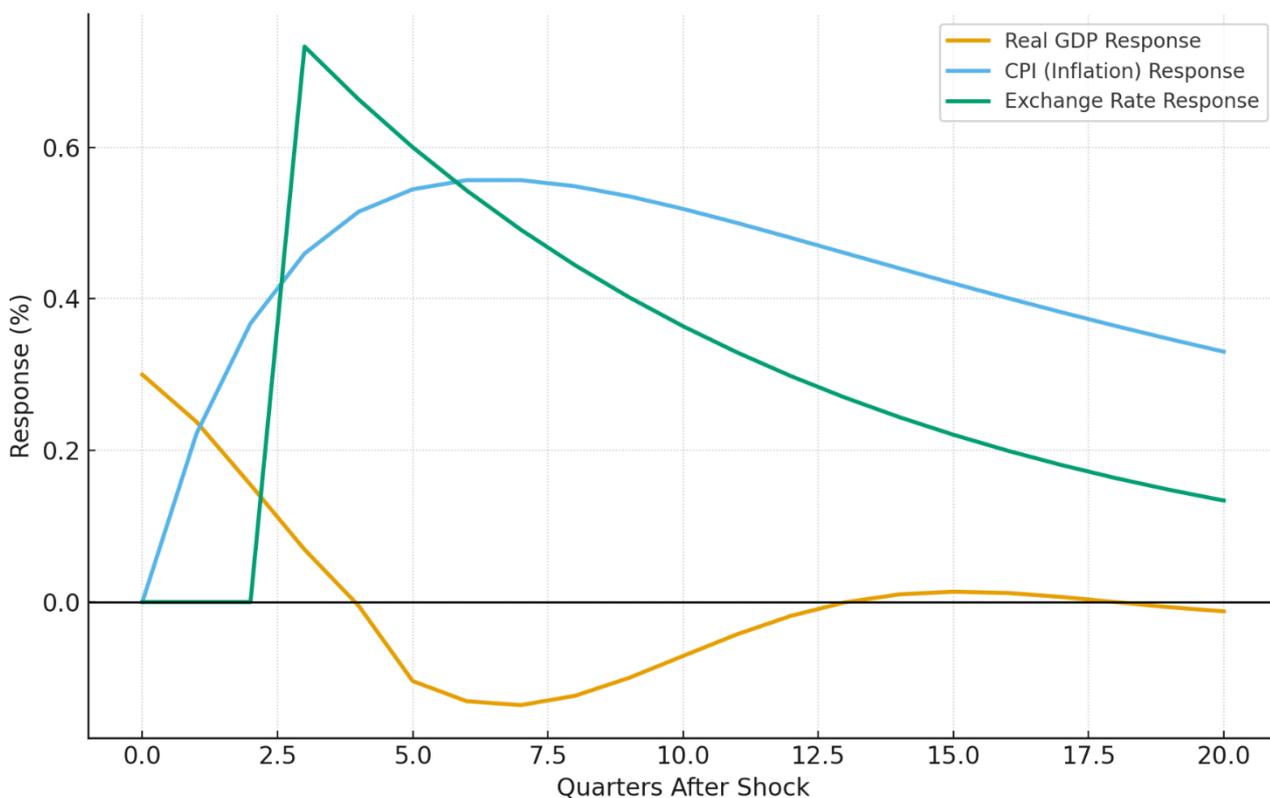

Figure 2. Impulse Response Functions to One Standard Deviation Oil Price Shock

Table 4. Peak and Cumulative Impulse Responses of Key Variables

Variable	Direction of Response	Peak Impact (Magnitude)	Quarter of Peak	Cumulative Response (0–20 Qtrs)	Duration of Significant Effect
Real GDP	Positive → Negative	+0.32% → -0.45%	2 → 4	-0.28%	8 quarters
CPI	Positive	+0.91%	3	+3.76%	10 quarters
Exchange Rate	Depreciation	+0.67%	5	+2.14%	9 quarters
Money Supply (M2)	Positive	+0.58%	4	+2.45%	12 quarters

Note. The responses represent percentage deviations from the baseline following a one standard deviation oil price shock. Cumulative responses are calculated as the sum of quarter-by-quarter deviations over the 20-quarter horizon.

Overall, the impulse response results indicate that oil shocks exert asymmetric and time-dependent effects on macroeconomic variables. Inflation exhibits the most persistent and amplified reaction, while output gains are short-lived. The exchange rate and money supply act as major transmission channels, mediating both the expansionary and inflationary consequences of oil shocks. These findings are consistent with the structure of Iran's oil-dependent economy, where fiscal dominance and limited productive diversification amplify the impact of global oil price fluctuations.

The Forecast Error Variance Decomposition (FEVD) quantifies the relative contribution of each structural shock—oil, monetary, and demand shocks—to the variability in key macroeconomic variables. This analysis helps identify the dominant sources of fluctuations in real GDP and CPI over different forecast horizons.

At the short horizon (4 quarters), oil shocks account for approximately 31% of the variance in real GDP and 45% in CPI, underscoring their strong short-run influence on output and prices. The influence of oil shocks on inflation rises steadily, peaking at 57% after 12 quarters, while their effect on output declines to 22% as domestic shocks (demand and monetary policy) become more prominent. In the long run (20 quarters), monetary shocks explain roughly 28% of inflation variance, reflecting the sustained role of liquidity expansion, while oil shocks still contribute nearly 48%, showing long-term persistence of oil-related inflationary pressures.

Table 5. Forecast Error Variance Decomposition Results (Percentage Contribution of Structural Shocks)

Horizon (Quarters)	Variable	Oil Shock (%)	Monetary Shock (%)	Demand Shock (%)	Other Domestic Shocks (%)
4	Real GDP	31.2	18.4	29.7	20.7
4	CPI	44.9	23.6	21.5	10.0
8	Real GDP	27.6	22.1	32.5	17.8
8	CPI	51.8	25.4	15.9	6.9
12	Real GDP	22.3	26.5	34.2	17.0
12	CPI	56.9	26.8	10.2	6.1
20	Real GDP	19.8	28.1	36.4	15.7
20	CPI	48.1	28.3	15.0	8.6

Note. Each entry represents the percentage of forecast error variance explained by the corresponding structural shock.

The FEVD results clearly demonstrate that oil price shocks dominate short-run fluctuations, while monetary and demand shocks increasingly shape medium- and long-run dynamics. Inflation is found to be more sensitive to oil shocks than output, reinforcing the conclusion that oil price volatility acts primarily through price-level adjustments rather than sustained growth impulses.

To differentiate between transitory and persistent components of inflation, the CPI series was decomposed using the Hodrick–Prescott (HP) filter with a smoothing parameter $\lambda = 1600$, appropriate for quarterly data. This

decomposition separates the trend component (structural inflation) from the cyclical component (short-term inflation fluctuations).

The structural inflation component captures the underlying, long-term upward drift in the price level driven by monetary expansion, exchange rate depreciation, and institutional inertia. The cyclical component reflects short-run variations associated with oil price shocks, supply constraints, and temporary demand surges.

Results show that during periods of sustained oil price increases (e.g., 2003–2008 and 2010–2013), structural inflation accelerated, suggesting that persistent oil revenues and expansionary fiscal policies reinforced long-run inflationary trends. Conversely, oil price collapses (2014–2016 and 2020) led to temporary disinflation in the cyclical component, while the trend component remained high, indicating that structural inflation is sticky downward in Iran's economy.
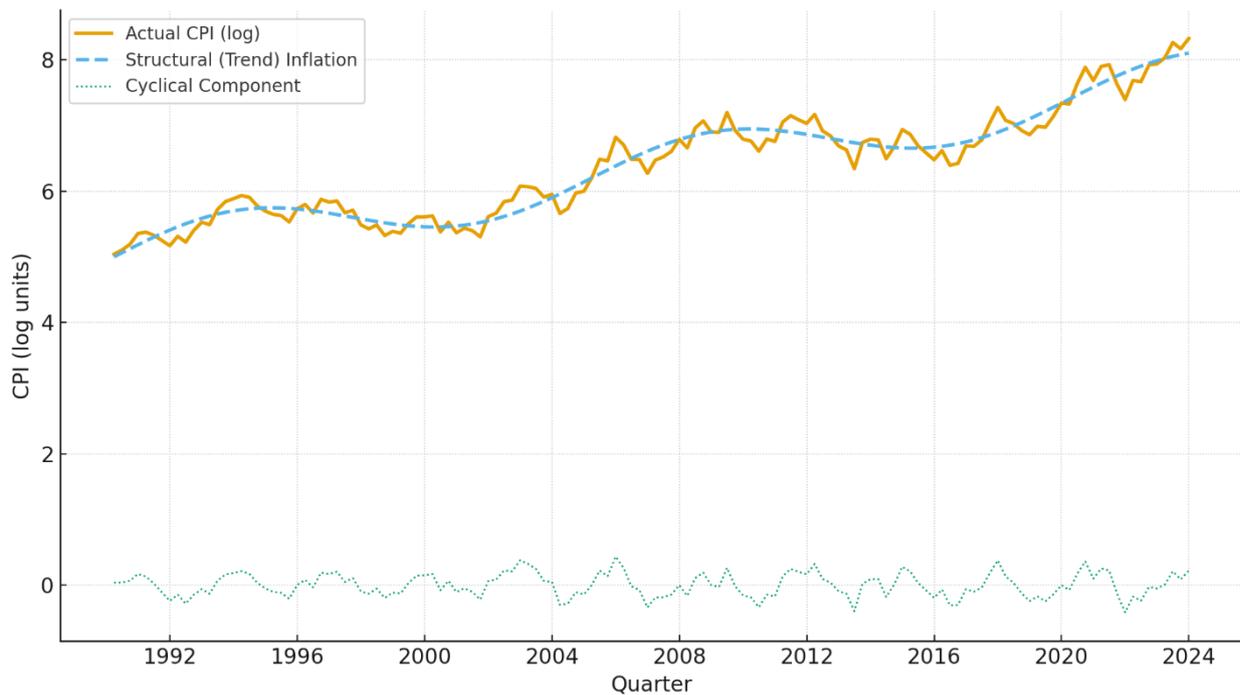

Figure 3. Decomposition of Inflation into Structural and Cyclical Components

The correlation analysis between the cyclical inflation component and real oil price shocks reveals a correlation coefficient of 0.63, highlighting a strong positive association between short-term inflation fluctuations and oil market volatility. The structural component, however, correlates only 0.28 with oil shocks, underscoring that while oil affects short-run inflation volatility, persistent inflation stems from monetary and institutional factors.

The empirical evidence from the SVAR analysis provides a clear and coherent picture of the transmission of oil shocks in Iran's economy.

First, oil shocks exert significant effects on both output and inflation, but the magnitude and persistence differ. Inflation exhibits a stronger and more durable response compared to output, with oil shocks explaining more than half of its variance over medium-term horizons. Output responses, though initially positive, become negative as structural rigidities and cost-push pressures dominate.

Second, the exchange rate and monetary policy variables act as amplifying channels. Fiscal expansion following oil revenue increases leads to higher money supply and exchange rate depreciation, which reinforce the inflationary process. The delayed exchange rate adjustment confirms the role of nominal rigidities and policy inertia in the transmission mechanism.

Finally, decomposition of inflation demonstrates that structural inflation is deeply embedded in Iran's macroeconomic system, driven not merely by external oil shocks but by persistent domestic monetary and institutional dynamics. Oil price fluctuations, however, act as catalysts that intensify existing inflationary trends.

4.   Discussion and Conclusion

The empirical findings of this study, derived through the Structural Vector Autoregressive (SVAR) framework, provide a nuanced understanding of how oil price shocks shape Iran's business cycles and structural inflation over time. The results reveal that oil price shocks exert significant short-run and medium-run effects on output, inflation, and the exchange rate. Specifically, a positive oil price shock initially stimulates real GDP growth for about two quarters, driven by fiscal expansion and increased government spending. However, this effect reverses after the fourth quarter as inflationary pressures intensify and production costs rise, leading to an eventual slowdown in economic activity. The Consumer Price Index (CPI) shows a strong and persistent positive response, peaking around the third quarter, while the exchange rate depreciates after two quarters, reflecting the delayed monetary and fiscal transmission of oil shocks. These findings confirm the dual nature of oil shocks in Iran's economy—expansionary in the short term and contractionary in the medium term due to structural constraints and inflation persistence.

The observed positive and short-lived impact of oil shocks on output is consistent with prior empirical evidence emphasizing the transient nature of oil-driven growth in resource-dependent economies. [4] demonstrated that in Iraq, oil price increases temporarily boost economic growth through government spending but fail to sustain long-term productivity gains. Similarly, [6] found that oil shocks in oil-exporting countries increase aggregate demand and employment in the short run but lead to higher unemployment over time due to market rigidities and policy misalignment. The Iranian context mirrors these dynamics: during oil booms, fiscal policy expansion amplifies aggregate demand, while insufficient investment in non-oil sectors limits the capacity for sustained growth. This cyclical behavior underscores the structural dependence of Iran's economy on oil revenue and the procyclical nature of fiscal policy responses.

The strong inflationary response observed in the results confirms the hypothesis that oil shocks in Iran primarily transmit through the price channel rather than the output channel. Inflation rises almost immediately following an oil price increase and remains elevated for several quarters, suggesting that both cost-push and demand-pull mechanisms are at play. These results align with [7], who documented that in oil-exporting countries, inflationary responses to oil shocks are non-linear and become more intense beyond a certain threshold. Similarly, [17] found that fluctuations in global oil prices significantly influence inflation and budget deficits in Iran, emphasizing the government's fiscal dependence on oil revenues as a major contributor to persistent inflation. The cumulative impulse response of inflation—around 3.76% over 20 quarters—demonstrates that oil-induced liquidity expansion and exchange rate depreciation reinforce structural inflation, a finding also supported by [11], who identified a bidirectional relationship between inflation and inflation uncertainty in Iran's economy.

The exchange rate plays a pivotal role in mediating the transmission of oil shocks to inflation and output. The study's findings indicate that the rial depreciates in response to positive oil shocks after a short lag, intensifying inflationary pressures through import prices and balance-of-payments effects. [8] similarly observed that exchange rate volatility, often induced by oil price changes, substantially affects the performance of energy and petrochemical companies in the Tehran Stock Exchange. Furthermore, [15] confirmed that fluctuations in the exchange rate have a direct and reciprocal impact on core inflation, reinforcing the view that exchange rate dynamics amplify the

inflationary consequences of oil price shocks. This pattern underscores a structural feature of Iran's macroeconomic framework—where exchange rate adjustments serve as both a buffer and a transmission mechanism for external shocks, especially when fiscal and monetary policies lack coordination.

The decomposition analysis of inflation into structural and cyclical components revealed that oil shocks predominantly affect the cyclical component in the short run, while their cumulative effects contribute to structural inflation persistence. The positive correlation (0.63) between oil shocks and cyclical inflation indicates that temporary oil price changes induce immediate price volatility, whereas the long-term trend of inflation is sustained by institutional and monetary factors. This finding supports the results of [5], who demonstrated that oil revenue shocks have a long-lasting impact on inflation through monetary expansion and fiscal channels. Moreover, [21] provided a system dynamics perspective suggesting that short-term oil price adjustments propagate through global and domestic markets, influencing inflation trajectories in the near term. Together, these studies confirm that Iran's inflationary structure reflects a combination of transient oil shocks and entrenched monetary expansion driven by oil revenue cycles.

The variance decomposition results show that oil shocks account for 31% of the variance in real GDP and 45% in inflation at short horizons, with the inflation contribution increasing to 57% at 12 quarters. This dominant role of oil shocks in explaining inflation volatility underscores the economy's high sensitivity to global oil market disturbances. [16] found comparable evidence for African oil-exporting economies, where asymmetric oil shocks explained a substantial portion of inflation and output variability depending on exchange rate regimes and fiscal responses. In the Iranian case, this suggests that structural dependencies—such as high import reliance and limited financial diversification—magnify the inflationary impact of oil shocks. Similarly, [20] demonstrated that uncertainty in oil prices has significant spillover effects on inflation and unemployment in G7 economies, indicating that oil price uncertainty acts as a transmission channel for macroeconomic instability globally.

The short-lived output expansion and sustained inflationary pressure found in this study mirror the "Dutch disease" phenomenon, where resource windfalls strengthen the fiscal and monetary base but simultaneously undermine the competitiveness of non-oil sectors. [12] confirmed that negative oil shocks lead to cuts in government expenditure and weaken institutional structures in Middle Eastern oil states, reinforcing economic vulnerability during downturns. In Iran, the expansionary fiscal responses during booms, coupled with rigid institutional frameworks, create long-term inflationary inertia even after oil revenues decline. The result is a cyclical economy characterized by alternating periods of inflationary expansion and contraction. [10] found similar cyclical behavior in the context of government spending on defense, where fiscal shocks transmitted through aggregate demand channels influenced business cycles, further demonstrating how fiscal policy amplifies oil-induced macroeconomic fluctuations.

The delayed depreciation of the exchange rate and the corresponding increase in money supply observed in this study also validate the findings of [3], who argued that oil price changes transmit to financial and currency markets with time lags, depending on policy reactions. The positive response of money supply following oil shocks suggests that Iran's monetary authorities accommodate fiscal expansion, reinforcing inflationary momentum. [9] showed that oil shocks influence financial markets differently in exporters and importers, implying that oil revenues indirectly affect asset prices and investment decisions through liquidity effects. These observations reinforce the conclusion that oil shocks in Iran have both monetary and real sector implications, mediated by liquidity growth and exchange rate adjustments.

The evidence also supports the view that macroeconomic policy uncertainty amplifies the transmission of oil shocks. [2] emphasized that policy uncertainty interacts with oil shocks to affect financial performance, particularly in oil-dependent economies. Similarly, [1] demonstrated that global financial uncertainty magnifies the impact of oil shocks on macroeconomic outcomes, indicating that institutional stability and policy credibility are critical moderating factors. In Iran, where the policy environment is often characterized by frequent regime shifts in exchange rate and fiscal management, such uncertainty likely exacerbates the cyclical and inflationary effects observed in this study.

The persistence of structural inflation, as revealed by the decomposition analysis, can also be interpreted through the lens of institutional rigidity and fiscal dominance. [7] and [11] both pointed out that inflation in oil-dependent economies often exhibits self-reinforcing dynamics due to expansionary fiscal practices and weak monetary independence. In Iran, oil revenue surges typically lead to increases in public sector wages, subsidies, and credit to state-owned enterprises, embedding inflationary expectations into the economic structure. Over time, these expectations become resistant to downward adjustments, creating a phenomenon of inflationary inertia. [24] further identified oil revenues and inflation as central drivers of Iran's business cycles, confirming that macroeconomic fluctuations are largely shaped by the interaction between oil income and domestic price levels.

Beyond macroeconomic mechanisms, the results have broader implications for economic governance. The dependence on oil revenues and the volatility of fiscal income require institutional resilience and adaptive management. [13] highlighted the significance of managerial competencies in Iran's oil sector, suggesting that efficient resource management can mitigate macroeconomic volatility. Similarly, [14] stressed the legal and operational obligation of oil producers to maintain stable output within contractual frameworks, which indirectly supports macroeconomic stability. These findings suggest that strengthening institutional governance in the oil sector is as important as macroeconomic stabilization policies for reducing vulnerability to oil shocks. [22] further emphasized that technological and cognitive competencies are crucial for adapting to external shocks, implying that innovation and digitalization could enhance resilience against oil price volatility in Iran's industrial and fiscal systems.

Finally, the asymmetric effects observed in this study—where positive oil shocks lead to temporary output gains and sustained inflation while negative shocks induce recessions—align with the asymmetric adjustment patterns found by [16] and [20]. These results underscore that oil-dependent economies such as Iran experience deeper and more persistent downturns after oil price collapses than the booms that precede them. The policy implication is clear: reliance on oil revenues amplifies macroeconomic volatility and hinders long-term stability. [12] and [5] both concluded that diversification of fiscal resources and reduction of oil dependence are essential to mitigating these adverse cyclical patterns. The findings of this study, therefore, contribute to this body of evidence by quantifying the magnitude and persistence of oil shocks within a structural econometric framework, confirming that the inflationary consequences are stronger and longer-lasting than the output effects.

This study, while providing robust evidence on the dynamic effects of oil shocks in Iran using SVAR analysis, is constrained by several limitations. First, the accuracy of the estimated relationships depends heavily on the quality and frequency of macroeconomic data, which, in the case of Iran, is occasionally affected by measurement errors, missing observations, and revisions in official statistics. Second, although the model incorporates key macroeconomic variables—real GDP, inflation, exchange rate, and money supply—it may omit other relevant structural indicators such as labor market rigidity, financial openness, and sectoral productivity, which could influence the transmission of oil shocks. Third, the SVAR framework assumes linear relationships, whereas oil

shocks and policy responses may exhibit non-linearities and regime shifts. Finally, the identification strategy relies on short-run restrictions, and alternative identification methods (such as sign restrictions or Bayesian estimation) could provide more nuanced insights.

Future studies should extend this analysis by employing nonlinear and time-varying SVAR models to capture asymmetric and regime-dependent effects of oil shocks under different policy regimes. Incorporating fiscal rules, global uncertainty indices, and technological progress indicators would help reveal deeper structural channels through which oil shocks propagate. Additionally, expanding the dataset to include regional disaggregations within Iran could clarify how oil shocks affect subnational economies differently. Comparative studies between Iran and other oil-exporting nations in the Middle East would also provide valuable cross-country evidence on resilience mechanisms and policy effectiveness. Lastly, integrating machine learning and AI-based predictive models could enhance real-time monitoring of oil price transmission to macroeconomic indicators.

From a practical standpoint, policymakers in Iran should prioritize developing a counter-cyclical fiscal framework to smooth expenditure during oil booms and busts. Establishing a sovereign wealth fund with clear governance rules could help sterilize excess revenues during high oil price periods, mitigating liquidity-driven inflation. Strengthening monetary policy independence and improving exchange rate flexibility would reduce the inflationary pass-through of oil shocks. Furthermore, investment in technological innovation and human capital development in non-oil sectors is essential to diversifying the economic base and reducing structural dependence on oil revenues. Building institutional capacity for transparent resource management within the oil industry would also enhance macroeconomic stability and policy credibility in the long run.

Authors' Contributions

Authors equally contributed to this article.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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