Journal of Information Systems Engineering and Management
2025, 10(3)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Asymmetrical effects of oil price on inflation in Iran (1990-2022): an empirical analysis using the NARDL model

Adnan jassim Abd[1]; Shahram Fattahi[2]; Mojtaba Almasi[3]; Maryam Nafisi Moghadam[4]
[1,2,3,4] *Department of Economics, Faculty of Economics and Accounting, Razi University, Iran*
Email: adnanecono@gmail.com[1]; sh_fatahi@yahoo.com[2]; mojtaba_almasi@yahoo.com[3]; nafisi1988@gmail.com[4]

ARTICLE INFO

Received: 26 Dec 2024

Revised: 22 Jan 2025

Accepted: 09 Apr 2025

ABSTRACT

Oil fluctuations play an important role in the design of macroeconomic dynamics, especially in oil exporting economies such as Iran. The study examines the asymmetrical effects of changes in oil prices on inflation in Iran from 1990 to 2022, which uses the nonlinear autoregressive distributed lag (NARDL) model. Economic growth is also included as an independent variable to reduce the effect of confounding variables. The results suggest that the decline in oil prices significantly reduces inflation in the long term, while rising oil prices have no statistically significant impact. These findings suggest that decision makers should consider asymmetrical responses under inflation when preparing monetary and fiscal policies. Diagnostic checking including stability test confirm the results.

Keywords: Oil prices, inflation, symmetry, inequality, Nardl model, Iran.

INTRODUCTION

Inflation is still an important macroeconomic challenge for decision makers, especially in oil exporting economies. The relationship between oil price and inflation is well established in economic literature, but the nature of this relationship is a debate field, whether symmetrical or asymmetrical. Theoretically, rising oil price increases production costs, leading to high consumer prices (Hamilton, 1983; Killian, 2009). However, the inflation reaction of the fall in oil price is less pronounced, some studies suggest that inflation shows inflexibility downwards due to factors such as wage rigidity and market power (Ball and Manquet, 1994).

Iran provides an ideal case study to detect the problem due to its economic structure. As an oil exporting country, the dynamics of Iran's oil income and exchange rate are closely associated with global oil price movements. During the period of high oil prices, an increase in government expenditure may promote inflation (Farzanegan and Markwardt, 2009).

Given these complications, this study implements the NARDL model to analyze the asymmetrical effects of changes in oil price on inflation in Iran from 1990 to 2022. This approach allows us to capture both short-term and long-term dynamics, providing deep insight into the inflation effects of oil price. In addition, we carry out the unit root test, structural breaks and model stability diagnostics to ensure the strength of our findings.

LITERATURE REVIEWS

The relationship between oil prices and inflation has been studied widely in both developed and developing economies. Many studies highlight direct and indirect transmission mechanisms, where oil prices affect inflation.

Hamilton (1983) was one of the first researchers to empire the link between oil shock and macroeconomic performance in the US economy. Recent studies, such as Killian (2009), emphasize the importance of distinguishing between the shocks of oil supply, shock of oil demand and their impacts on inflation.

For oil exporting countries, Farzanegan and Markwordt (2009) analyze the case of Iran and find that the increase in oil price contributes to inflation through an increase in public spending. Similarly, Mohammadi and Jahn-Parvar (2012) find out how the exchange rate fluctuations increase the inflation effect of the oil price shock. However, these studies largely consider a symmetrical relationship between oil prices and inflation.

The introduction of the NARDL model of Shin et al (2014) has allowed researchers to investigate non-linearity in this relationship. The price oil reduction has a minor effect on inflation compared to an increase in oil prices, a discovery that matches the previous studies (Ball and Mankiw, 1994). Given this, our study extends literature by using the NARDL structure in Iran and by testing asymmetrical inflation reactions for ups and downs in oil price.

3. METHODOLOGY

Journal of Information Systems Engineering and Management
2025, 10(3)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

3.1 Nardl model

To analyze the asymmetrical effects of oil prices on inflation, we apply the non -linear ARDL model proposed by Shin et al. (2014). This model allows us to decompose the change in oil price in positive and negative components to assess whether inflation reacts differently to rising and falling oil prices.

The NARDL model is specified as follows:

$$INFLATION_t = a + \sum_{i=1}^{p} \theta_j^{+} OIL\_PRICE\_POS_{t-j}^{+} + \sum_{i=1}^{p} \theta_j^{-} OIL\_PRICE\_NEG_{t-j}^{-} + \sum_{i=1}^{p} \theta_j^{+} GDP\_GROWTH\_POS_{t-j}^{+} + \sum_{i=1}^{p} \theta_j^{-} GDP\_GROWTH\_NEG_{t-j}^{-} + \gamma X_t + \varepsilon_t$$

Where:

X_t: Control variable (GDP growth rate)

$\theta_j^{+}$and θ_j^{-} : Long-lasting coefficients for positive and negative shocks

ε_t : Error term

Long -term cointegration is estimated using a bound test (Pesaran et al., 2001).

3.2 Data and variables

The study uses annual data for the following variables from 1990 to 2022:

- **Inflation rate**: The consumer price index (CPI) is measured as an annual percentage change.
- **Oil prices**: Brent crude oil average annual price (in USD per barrel).
- **Economic growth**: The annual percentage of actual GDP is measured as an annual percentage change.

Data sources include World Bank and central bank in Iran.

4. RESULTS AND DISCUSSIONS

This section presents the empirical findings from the study, including stability testing, structural break analysis, and stability tests of the NARDL model to ensure the strength of the results. Conclusions provide insight into the dynamic relationship between oil prices, economic growth and inflation in Iran, especially focuses on the presence of asymmetrical effects.

4.1 Unit root test

Kapetanios and Shin (2008) introduced a GLS based nonlinear unit root test. The results are as follows.

Kapetanios and Shin GLS based nonlinear unit root test

Variable	Lags	KS-stat(level)	Lags	KS-stat(1st difference)
Inflation	1	-2.595*	0	-3.235**
OIL_PRICS	0	-1.512	0	-3.556***
GDP_GROWTH	0	-2.435*	0	-3.186***

Before considering the NARDL model, it is necessary to examine the stability properties of the variable to determine their integration order. Kapetanios and Shin (2008) GLS -based unit root test was used, suitable for handling non -linear time series data. The results indicate that inflation and GDP growth levels are stationary at 10 percent significance level, while oil prices is not stationary. However, after the first differences of series, all variables are stationary at the level of significance (5% and 1%), and confirm that they are integrated by order one, I (1). These findings validate the use of the NARDL model, as it allows for a mixture of I (0) and in (1) variables, making it a suitable tool to assess short -term and long -lasting conditions.

4.2 Structural break

Zivot -andrews structural break test was done as follows.

Results of Zivot -andrews test

Journal of Information Systems Engineering and Management
2025, 10(3)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Variable	TB1	t-statistics (level)	TB2	t-statistics (1st difference)
Inflation	2012	-4.549**	2002	-4.776**
OIL_PRICS	2012	-2.574	2017	-4.776**
GDP_GROWTH	1994	-5.175***	1998	-6.911***

Macroeconomic data often shows structural breaks due to political changes, external shocks or economic crises. In order to identify the potential breaking point in the dataset, Zivot -andrews (1992) structural breaking test was implemented. The results suggest that inflation experienced a significant structural break in 2012, which coincides with intensive in international sanctions against Iran, which led to hyperflation and economic instability. Similarly, oil prices show breakpoints in 2012 and 2017, in accordance with the volatility of the global oil market, including geopolitical stress. In addition, GDP growth rate reflects the structural breaks in 1994 and 1998, which corresponds to Iran's economic reforms and later economic instability. These findings outline the importance of explaining structural changes in economic modeling, as ignoring such breaks can lead to biased estimates and misleading conclusions.

4.3 Bound test

Bound test results are as follows:

Results of Bound test

F-statistic	Sig.	I(0)	I(1)
5.310565	10%	2.2	3.09
	5%	2.56	3.49
	2.5%	2.88	3.87
	1%	3.29	4.37

In order to assess the existence of oil prices, GDP increase and inflation between inflation, after the approach to Pesaran et al (2001), the bound test was carried out. The F statistics (5,31) exceed the upper significant limit (I (1)) at all traditional importance levels (1%, 2.5%, 5%and 10%), which provides strong evidence of a long-term variables relationship. This confirms that fluctuations in oil prices and GDP growth continuously affect inflation in Iran, making it mandatory to analyze both short-term and long-term dynamics using the NARDL model. The results also indicates that any short -term deviation from the equilibrium will eventually converge towards the long run equilibrium path, and strengthen the relationship with the studied macroeconomic variables.

NARDL model estimation results

Short-run	
C	54.0426**
INFLATION(-1)*	-2.0593***
OIL_PRICE_POS	0.0521
OIL_PRICE_NEG	-0.6056**
GDP_GROWTH_POS	-3.0436***
GDP_GROWTH _NEG	-1.0265
D(INFLATION(-1))	1.2070***
D(INFLATION(-2))	1.0770**
D(INFLATION(-3))	0.8232**
D(INFLATION(-4))	0.6264**
D(INFLATION(-5))	0.3384
D(OIL_PRICE_NEG)	-0.3481
D(OIL_PRICE_NEG(-1))	0.6214***
D(GDP_GROWTH_NEG)	0.1185
Long run	
OIL_PRICE_POS	0.0253
OIL_PRICE_NEG	-0.2941***
GDP_GROWTH_POS	-1.4779***
GDP_GROWTH _NEG	-0.4984

Journal of Information Systems Engineering and Management
2025, 10(3)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

C	26.2420***	
R-squared		
F-statistic		
Diagnostic tests		
Normality test	Jarque-Bera	Probability
	0.6124	0.7362
LM test	F-stat	Probability
	0.4540	0.6464
ARCH test	F-stat	Probability
	0.1728	0.6813

The NARDL model estimates the price of oil prices, gross domestic product growth rate and a short run and long -term dynamic between inflation. Short term results indicate that the price of negative oil shock significantly reduces inflation, suggesting that low oil prices lead to deflation pressure in the Iranian economy. In contrast, the shock of positive oil price does not have a statistically significant impact on inflation, which means that inflation in Iran does not react strongly to the rising oil prices in the short term. This discovery can be attributed to the delayed broadcasting effects of government price control, fuel and energy supplements or increase in oil prices. In addition, the results suggest that GDP growth has a significant negative effect on inflation in the short term, reflecting the effect of a supply side, where high economic activity leads to an increase in production and efficiency, leading to the price level stabilization.

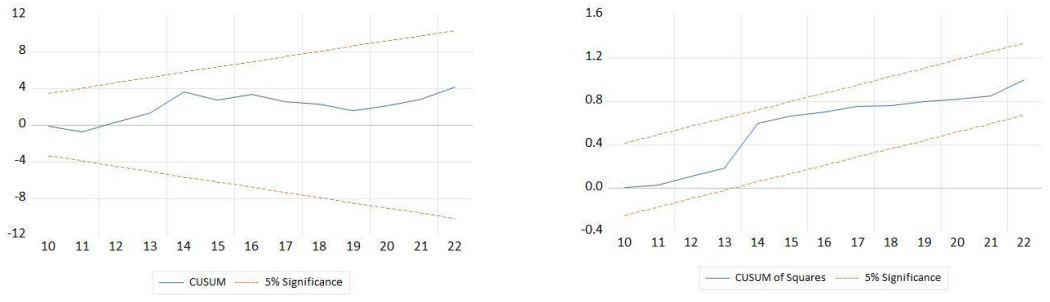
In the long term, the findings of asymmetrical effects confirm the relationship between oil prices and inflation. The fall in oil prices significantly reduces inflation, while inflation does not have a sufficient effect due to an increase in oil prices. This result suggests that the dynamics of Iranian inflation are more responsible for the decline in oil prices than an increase in oil prices, which corresponds to the principles of price rigidity and asymmetrical price adjustment. A potential interpretation is that during the autumn in oil prices, production costs are reduced, and companies adjust prices due to low entry costs. However, as oil prices increase, the effect of inflation can be taught due to state intervention, import grants or demand for low consumer. In addition, GDP growth shows a strong deflation effect on inflation, and strengthens the importance of economic expansion in stabilizing prices over time.

In order to ensure the reliability of the estimated model, a series of diagnostic tests were performed. Jarque-Bera test confirms that residuals are normally distributed, indicating that the model is properly specified. Breusch-Godfrey LM test shows no evidence of autocorrelation, ensuring that the conditions of the error over time are independent, which is important for unbiased and consistent parameter estimates. In addition, the ARCH tests suggests that the variance of residuals remains constant, suggests that the model does not suffer from volatility clustering. These diagnostic tests together confirm the strength of the approximate NARDL model, and strengthen the validity of the results and their implications for economic policy.

4.4 Structural stability tests

Results of Cusum and Cusumsq tests

Cusum test **Cusum of Squares**



Given the presence of structural breaks in the dataset, it is necessary to assess the stability of the estimated coefficient over time. The CUSUM and CUSUMSQ tests were used to check if the model shows

any signal of instability. The results suggest that the coefficients remain stable throughout the study period, as the test figures fall inside the critical bounds. This suggests that the underlying the oil prices, GDP growth and inflation is consistent over time, which is suitable for model forecasts and policy analysis. The stability test of the model confirms the reliability of the estimated parameters and confirms that the conclusions do not change with temporary shocks or random ups and downs.

5. CONCLUSION

The empirical conclusions of this study provide strong evidence of asymmetrical effects of changes in oil prices on inflation in Iran. The significant result is that there is a significant decline in the increase in the fall in oil prices, not the effect of remarkable inflation in rising oil prices. This asymmetry can be attributed to government intervention, valuable and combination of economic transfer system that increase oil prices for domestic inflation. In addition, GDP growth plays an important role in reducing inflation, highlighting the importance of continuous economic growth.

From a policy point of view, these findings suggest that monetary and fiscal authorities should be responsible for asymmetrical inflation reactions when formulating economic policy. Given that the fall in oil prices has a strong deflation effect, decision makers should take counter -cyclical measures to stabilize demand during the decline in oil revenues and prevent economic low -cycle. In addition, limited inflation effects of rising oil prices suggest that the removal of grants or improvement in market efficiency can increase responsibility and reduce the deformities of the economy.\

Overall, this study contributes to literature on the dynamics of oil price growth in oil exporting countries by demonstrating the importance of non-linear modeling techniques such as NARDL in capturing asymmetrical conditions. Future research can detect the role of exchange rates, fiscal reactions and the role of global economic conditions in the formulation of inflation effects of oil price movements in Iran.

REFERENCES

[1]. Ball, L., and Mankiw NG (1994). Asymmetric Price Adjustment and Economic Fluctuations, The Economic Journal, Volume 104, Issue 423, 1 March 1994, Pages 247–261, https://doi.org/10.2307/2234746
[2]. Farzanegan, M. R., and Markwardt, G. (2009). The effects of oil price shocks on the Iranian economy, Energy Economics, 31 (1), 134–151.
[3]. Hamilton, J. D. (1983). Oil and macroeconomy since World War II. Journal of Political Economy, 91 (2), 228-248. https://doi.org/10.1086/261140
[4]. Kapetanios, G & Shin, Y (2008), "GLS detrending-based unit root tests in nonlinear STAR and SETAR models," Economics Letters, Elsevier, vol. 100(3), pages 377-380.
[5]. Kilian L (2009), Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market, American Economic Review. vol. 99, 1053-69
[6]. Mohammadi H & Jahan-Parvar M (2012), "Oil prices and exchange rates in oil-exporting countries: evidence from TAR and M-TAR models," Journal of Economics and Finance, Springer;Academy of Economics and Finance, vol. 36(3), 766-779.
[7]. Pesaran, M.H., Shin, Y. and Smith, R.J. (2001) Bounds Testing Approaches to the Analysis of Level Relationships. Journal of Applied Econometrics, 16, 289-326.
[8]. Shin, Y., Yu, B., & Greenwood-Nimo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. Festschrift in Honor of Peter Schmidt, 281–314. https://doi.org/10.1007/978-1-4899-8008-3_9
[9]. World Bank Database, https://data.worldbank.org/
[10]. Zivot, E. and Andrews, D.W.K. (1992) Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis. Journal of Business and Economic Statistics, 10, 251-270. http://dx.doi.org/10.2307/1391541.