The Open Access Journal of

Resistive Economics

www.oajre.ir

Volume 10, Issue 4, 2022

ORIGINAL RESEARCH PAPER Pages: 1-9

The effect of transitory and permanent shocks to oil on inflation of Iran: The application of the Blanchard-Quah

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Received: *29 April 2022* ***Revised:*** *29 May 2022* ***Accepted:*** *17 June 2022*

ABSTRACT

Crude oil is one of the most significant and invaluable substances and reserves of nature. Given the facts that the oil price market has always been unstable due to the international economic-political and military developments and that Iran's economy is strongly dependent on oil revenues, so Iran's economy is subject to the shocks induced by sudden fluctuations of oil price. The present study aimed to explore the impact of oil shocks on Iran's inflation over the period 1991-2016. To this end, oil shocks are decomposed to permanent and transitory components by the Blanchard-Quah technique. Then, a structural vector autoregressive model is employed to investigate the effect of permanent and transitory shocks to oil on inflation in Iran. The results of model estimation reveal that temporary shock to oil price has a long-term impact on inflation. Price changes due to permanent shocks to oil price are reflected in a <1% increase in inflation.

KEYWORDS: Shock, Oil, Inflation, Blanchard-Quah

How to Cite This Article: Babajani Baboli, M. (2022). "The effect of transitory and permanent shocks to oil on inflation of Iran: The application of the Blanchard-Quah". *The Open Access Journal of Resisitive Economics*, 10(4): 1-9.

1. Introduction

Oil price volatility is a major cause of many economic crises and fluctuations. Concerns for the impact of oil price shocks on macroeconomy were raised by the crises of the 1970s that stroke the economy of the US and some European nations (Hamdi & Sbia, 2013). Most economic activities are based on crude oil, and the price of crude oil affects other energy markets. So, oil price shocks affect not only energy market but also all economic sectors (Gomez-Loscos et al., 2012). Oil price shocks emanate from sudden decreases in the production and refinery capacity of crude oil, changes in petroleum reserves, changes in production capacity by OPEC, global economic crises, and geographic risks (Tansuchat et al., 2010). Following the 1973 oil shock and the petroleum sanction of Israel-supporting western nations by oil-exporting Arabian countries, energy was considered by economists as one of the most important economic inputs (Heidari and Saeedpour, 2001). So, its price changes in the long and short run will have diverse impacts on real economic sector and inflation in oil exporting and importing countries. As Komijani et al. (2012) analyzed, oil, money, inflation, and production in Iran are interwoven complicatedly. In most oil-exporting countries, income promotion is not resulted from technological progress; rather, it is caused by the increased incomes of oil export. The theory of resource curse, presented by Auty in 1993, maintains an inverse relationship between the abundance of natural resources and economic growth and development (Asadi et al., 2013). Oil price shocks affect macroeconomic variables via different channels. Oil price volatilities directly determine price levels in an economy. Oil shocks tend to increase the price levels in economies in general.

Oil shocks drive up production costs, which in turn induce inflation. To safeguard economic stability, it is imperative to investigate the precise impacts of oil price shocks on inflation. Undoubtedly, Iran's economy is suffering from the single-commodity economy and overreliance on petroleum incomes. Accordingly, this study mainly tries to answer the question as to whether permanent and temporary oil shocks have significant impacts on inflation. To answer the question, the paper is organized as below. First, the problem is explained. Then, a review of the literature comes in the next section. Then, the research model is presented. The next section deals with the results and analysis of research findings. Finally comes some concluding points. Given the significance and various mechanisms by which income or oil price shocks affect economies, they have been subject to extensive studies.

2. Theoretical framework

Some argue that the only cause of the recession of the 1970s was the rise of oil price, but more importantly is the impact of oil price on macroeconomic stability and the welfare and development of human communities (Garcia et al., 2003). Numerous studies by energy economists have dealt with oil shocks. Farzanegan and Markwardt (2009) examined the dynamic relationship between imbalanced oil price shocks and macroeconomic variables using the VAR approach for the data of Iran. They reported that positive and negative shocks increased inflation significantly. As well, they found a strong positive and significant relationship between oil price volatility and the growth of industrial production (Naifar&Dohaimon,2013) explored the non-linear relationship of oil price, interest rate, and inflation rate before and after a crisis period. The results showed that the structural interdependence of inflation rate and crude oil price was asymmetric. In addition, there was a distinctive significant relationship between crude oil price and short-term interest rate during the crisis period. Cologni and Manera (2013) used a DSGE model in the context of a real business cycle model to explore the impact of oil price shocks and expansionary fiscal policies on the economy of oil exporting countries that were the members of the Gulf Corporation Council. The results revealed the crowding-out effect of the public sector on the private sector and the reduction of non-oil production due to the increase in oil incomes. Babajani et al. (2018) investigated the impact of shocks to the exchange rate and oil price on inflation by the vector autoregressive (VAR) method over the 1991-2016 period. They reported that high dependence of exchange rate on foreign exchange incomes resulting from oil price could induce a rapid rise of the prices in the country and that the impact of shock showed an ascending trend over time. Also, the sanctions of 2012 did not push down oil price but it influenced the exchange rate and inflation.

Permeh (2005) used a social accounting matrix to explore the inflationary impact of the price rise of energy carriers (petroleum products, electricity, and natural gas) on price levels. It was found that the increase in the price of petroleum products, natural gas, and electricity to a global level would increase the mean price index of the economy by 19.52, 11.07, and 4.83 percent, respectively. The increase in domestic prices to boundary price levels of all energy carriers would also push up average price indices by 35.4 percent. Using monthly data for the 1973-2007 period and a structural VAR method, Bahrami and Nasiri (2011) decomposed structural shocks to oil price into five shocks. Then, they employed separate regression equations and the OLS method based on annual data of Iran’s economy to analyze the impact of individual structural shocks on key variables. The results indicated that how shocks to oil price would affect Iran’s economy largely depended on the government’s performance after getting into the shock. Using a Markov-switching vector error correction model for the 1997-2007 period, Qanbari et al. (2011) examined the asymmetric impacts of shocks to crude oil markets on Iran’s economy. Their results revealed the asymmetric behavior of the model variables with respect to real oil price volatilities in different regimes of Iran’s industrial sector so that with the movement from recession phase to the severe upswing of the industrial sector, the negative mechanisms by which oil price rise would influence Iran’s economy were increased. Abunouri and Rajaei (2011) used a dynamic stochastic general equilibrium model to assess the impacts of energy price shocks on macroeconomic variables in Iran. The results implied that shocks arising from the rise of energy price deviated the variables of production, investment, labor supply, and inflation from their long-term growth trend and increased inflation, but other variables were decreased. Jafari Samimi et al. (2014) employed a new Keynesian dynamic stochastic general equilibrium model in open economy conditions to assess the impact of monetary and non-monetary shocks on Iran’s economy. According to the results, the initial impacts of oil income shocks were positive on non-oil production and inflation. Esnaashari et al. (2016) used the model proposed by Qu and Perron (2007) to investigate the effect of oil price shocks on inflation, growth, and money in Iran’s economy over the period from March 1961 to February 2012. They identified five structural shocks in August-September 1973, July-August 1979, May-June 1990, July-August 1994, and May-June 2006. The highest coefficients of the impact of oil price on production, inflation and money growth were recorded in the first, first and fifth regimes, respectively. Also, the highest impact periods of oil price on production, inflation, and money growth were related to the fourth, second, and fifth regimes, respectively.

3. Methodology

Blanchard and Quah (1989) proposed a method to decompose a time series, like gross domestic product, into its transitory and permanent components. In fact, this method is based on defining a constraint in accordance with the economy theory. To this end, they first established a vector autoregressive (VAR) model. The main advantage of the model lies in its capability to explore the dynamic relationships of the variables. The VAR model developed by Sims (1980) is composed of a system of equations in which all variables are considered to be exogenous and each variable is written as a linear combination of values with their own lag and other variables of the system. The general form of the bivariate VAR model is as below:

$$X_t = A(L)X_{t-1} + u_t \quad (1)$$

in which X_t represents the column vector of the values of Yt and C_t, $A(L)$ denotes a 2×2 matrix whose elements are constituted by $A_{ij}(L)$ polynomials, u_t is a 2 × 1 column vector of the values of $u_{1,t}$ and $u_{2,t}$ that are invisible. To better understand the problem, the following bivariate systems is a bivariate moving average (BMA) representation of the sequences P_{OILt} and P_t assuming the lack of a constant (Enders, 2012).

$$P_{OILt} = \sum_{i=0}^{\infty} C_{11}(i)\varepsilon_{1t-i} + \sum_{i=0}^{\infty} C_{12}(i)\varepsilon_{2t-i} \quad (2)$$

$$P_t = \sum_{i=0}^{\infty} C_{21}(i)\varepsilon_{1t-k} + \sum_{i=0}^{\infty} C_{22}(i)\varepsilon_{2t-i} \quad (3)$$

This system can be described more briefly as below:

$$\begin{bmatrix} P_{OILt} \\ P_t \end{bmatrix} = \begin{bmatrix} c_{11}(L) & c_{12}(L) \\ c_{21}(L) & c_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \end{bmatrix} \quad (4)$$

in which $C_{ij}(L)$ is polynomials in terms of the lag operator L. The coefficients of this polynomial are represented by $C_{ij}(i)$. Here, the key fact is that the residuals of the VAR model, i.e. $u_{1,t}$ and $u_{2,t}$, are a combination of pure noises ε_{1t} and ε_{2t}, whose independent white noise disturbances and the variance of are constant. The compressive impact of a unit change in ε_{1t} on P_t is as $C_{12}(L) = \frac{dP_t}{d\varepsilon_{1t}}$, and the overall impact of a shock to ε_{1t} on the sequence P_t is expressed by the following equation:

$$\sum_{i=0}^{\infty} \frac{dP_{t+i}}{d\varepsilon_{1t}} = \sum_{i=0}^{\infty} c_{21}(L) \quad (5)$$

The premise of this method, according to which transitory shocks have a long-term impact on the sequence, helps to determine structural disturbances in a VAR model so that the equation can be solved to obtain the coefficients $C_{ij}(i)$. This premise means that the cumulative impact and so the long-term impact of ε_{1t} on P_t is equal to zero. Thus, the coefficients $C_{12}(i)$ are equal to zero.

$$\sum_{i=0}^{\infty} c_{12}(i) = 0 \quad (6)$$

The values derived for the sequence ε_{2t} is used as below to examine the permanent changes in the sequence P_t (Enders, 2012).

$$\Delta P_t = \sum_{i=0}^{\infty} c_{22}(i)\varepsilon_{2t-i} \quad (7)$$

To identify invisible structural shocks, identification constraints should be applied in the VAR model. In an unconstrained VAR model with n variables, the relevant matrix has $\left(n^2 - n/2\right)$ elements that form an equations system with n equations. This constraint is formed like a triangular matrix in which the element $C_{12}(L) = 0$. By applying this constraint and using the Cholesky decomposition technique based on the weight covariance matrix, the structural VAR (SVAR) model can be distinguished from the reduced-form VAR model. Then, the sequences ε_{1t} and ε_{2t} in the model can be used to analyze impulse response functions and variance analysis.

So far, several empirical studies have employed this technique to explore the permanent and transitory impacts of different shocks. Keating (2013), Ahmad and Pentecost (2012), and Bashar (2012) are the most important studies on decomposing the impact of demand-side and supply-side shocks on production. In Iran, this technique has been used by Akbarifard and Koushesh (2009) to study the effect of income shocks on trade balance and by Baniasadi and Mohseni (2014) to study the impact of productivity shocks on energy use.

The advantage of the Blanchard-Quah method is associated with the fact that there is no single method to decompose a variable into its permanent and transitory components. But, Blanchard and Quah (1989) showed that the use of a bivariate VAR model rendered it possible to decompose a variable into its permanent and transitory components. In this method, the variables should be so selected that at least one of them be non-stationary because the $I(0)$ variables lack a permanent component. This method cannot be applied if both variables are stationary. However, in case of the use of this technique, both variables will eventually emerge in the model as stationary.

Assessment of estimation model

The present study aimed to explore the effect of permanent and transitory shocks on inflation in Iran over the period 1991-2016 using the Blanchard-Quah method and the structural vector autoregressive (SVAR) model in the Eviews software package. At the first step, since the studied data were of a time-series type, their stationarity was checked. Here, we used the augmented Dickey-Fuller (ADF) test.

Table 1. The results of Augmented Dickey-Fuller unit root test for model variables

Variable	Level				First-order differencing			
	with *y*-intercept		with *y*-intercept and trend		with *y*-intercept		with *y*-intercept and trend	
	Calculate d statistic	Critical statistic	Calculate d statistic	Critical statistic	Calculate d statistic	Critical statistic	Calculate d statistic	Critical statistic
Inflation	1.39	-2.58	-*.94	-3.02	-2.09	-1.94	-3.40	-3.02
Oil price	-1.30	-1.94	-2.78	-3.02	-8.04	-1.94	-7.98	-3.02

Source: Computer appendix (the output of Eviews)
Note: critical values at the 5% level

The results show that the logarithms of the time series variables included in the model are non-stationary at the data level and that the t-values calculated by AFD are smaller than Mackinnon critical value at the 1%, 5%, and 10% levels. So, the null hypothesis of having a unit root is not reputed and it is accepted that the variables are non-stationary. So, they should be subject to first-order differencing. Since the variables are found to be non-stationary, we can use the Blanchard-Quah method. The second step is to determine the optimal lag of the model. This was done by Akaike information criterion (AIC), Schwarz-Bayesian criterion (SBC), and Hannan Quinn criterion (HQ).

According to t Table 2. The determination of the optimal lag length

Lag	Schwarz-Bayesian criterion (SBC)	Akaike information criterion (AIC)	Hannan Quinn criterion (HQ)
0	20.49549	20.44206	20.46366
1	11.49352	11.33325	11.39804
2	10.93054*	10.63342*	10.77139*
3	11.06304	10.68908	10.84024
4	11.11437	10.67356	10.82791
5	11.25528	10.66762	10.90516
6	11.40351	10.70900	10.98973
7	11.45797	10.65661	10.98054
8	11.60830	10.70010	11.06721

Source: Research findings.
hese criteria that are reported in Table 2, the optimal lag is found to be 2.

The third step is to check the co-integration relationship. We used the Johansen-Juselius co-integration test to determine the number of long-run relationships between the variables. The number of co-integration vectors was specified by two statistics: maximum eigenvalue test (λ_{max}) and impact test (λ_{trace}). The results that are presented in Table 3 show the absence of any long-run convergence vectors.

These results support the assumption of the Blanchard-Quah technique that holds the lack of co-integration.

Table 3. The results of the Johansen convergence test

Johansen convergence test (trace test)				
Number of H_0 convergence vector	Number of opposite hypothesis convergence vector	Test statistic	Critical values at level	Probability level
r ≤ 0	r = 1	6.952307	15.49471	0.5832
r ≤ 1	r = 2	0.000565	3.841466	0.9828
Johansen convergence test (max-eigen test)				
Number of H_0 convergence vector	Number of opposite hypothesis convergence vector	Test statistic	Critical values at level	Probability level
r ≤ 0	r = 1	6.951743	14.26460	0.4949
r ≤ 1	r = 2	0.000565	3.841466	0.9828

At the fourth step, the SVAR model is employed using the Blanchard-Quah technique. Figure 1 depicts the response of the price index to one unit non-structural shock to oil price.

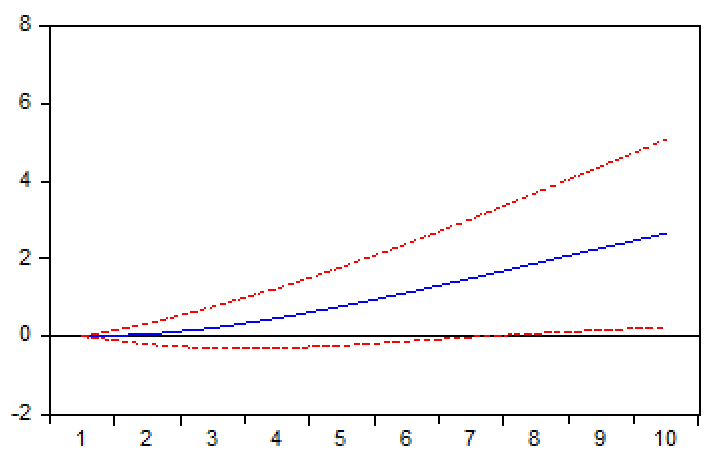

Figure 1. The response of price index variations to one unit change in non-structural shock to oil price

Figure 1 illustrates that one unit change in the shock to the oil price with 1 lag increases the prices by 2.37 units. This implies the increase in inflation by the rise of the oil price and that the oil price shock was increased by 5 units in the 10th period. Figures 2 and 3 display the decomposition of permanent and transitory shocks to the oil price on price changes.

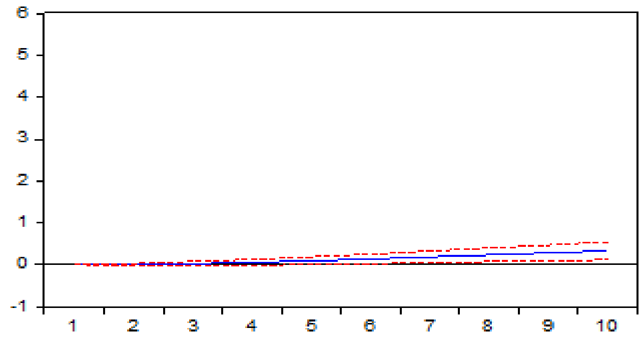

Figure 2. The response of price index variations to one unit change in temporary shock to oil price

According to Figure 2, the permanent shock to the oil price has a long-term impact on the price index so that price changes respond to this permanent shock by a less than 1% increase in inflation.

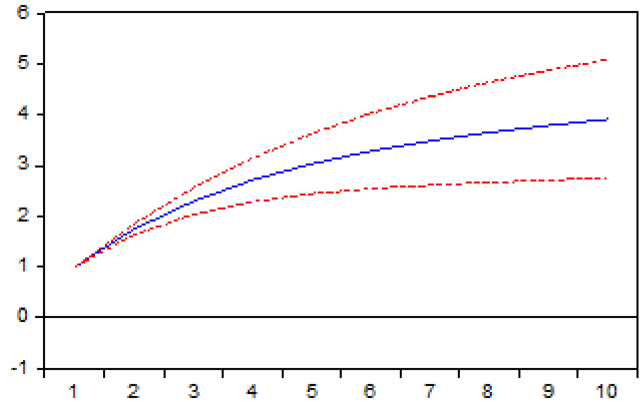

Figure 3. The response of price index variations to one unit change in transitory shock to oil price

As well, Figure 3 illustrates that the oil price has a long-term impact of the price index so that price changes respond to the transitory shock to the oil price by a 1.74% increase in inflation at first, and then this sharp rise of the prices that is induced by the long-term shock to the exchange rate keeps going on until the 10th period and increases inflation by 3.91%.

4. Analysis of variance

Analysis of variance is a major tool to check the dynamic performance among variables. By the analysis of forecast error variance, one can measure the impact of a certain variable on other variables over time. In sum, it should be noted that variance analysis, along with impulse response that is sometimes called shocks accounting, is an important way to explore the relationships between variables. The results of the variance analysis of the model are given in Table 4. Accordingly, it can be concluded that the main factor responsible for inflation fluctuations is permanent shocks to price so that in the first period, permanent shocks to oil price account for 87.60 percent of inflation variations but transitory shocks capture only 12.39 percent. In the 10th period, transitory and permanent shocks to oil price account for 17.23 and 82.76 percent of inflation variance, respectively.

Table 4. Analysis of variance

Period	Transitory shock	Permanent shock

1	12.39073	87.60927
2	12.60643	87.39357
3	12.98209	87.01791
4	13.45290	86.54710
5	13.98869	86.01131
6	14.57293	85.42707
7	15.19549	84.80451
8	15.84955	84.15045
9	16.53015	83.46985
10	17.23344	82.76656

Source: Research findings.

5. Conclusions

The present study employed the VAR model to investigate the impact of permanent and transitory shocks to oil on inflation of Iran over the period 1991-2016. We aimed to answer the question as to if oil shocks are influential on inflation. It was first found that the variables were not stationary using the AFD test. So, everything was ready to use the model and the Blanchard-Quah technique. After the model was estimated and the functions of response shock and the method of variance analysis were established, it was revealed that price variations induced by transitory shock to oil price firstly entailed a 1.74% increase in inflation and this increase in price due to long-term oil shock was kept going on until the 10^{th} period, resulting in a 3.91% increase in inflation. When oil price is changed, the incomes of oil export are changed too. So, the incomes of a government that emanate from oil revenues become unstable. In the economy of Iran, there is a relationship between the oil sector and the other sectors. When oil revenues are increased, maximum care should be given to the conversion of foreign exchange earnings from oil sales in order to supply budget expenditures because when foreign exchange is converted to domestic currency and more money is supplied, demand is pushed up resulting in the rise of inflation. This has impaired the stability of our economy. It is recommended to reduce our dependence on oil as the main source of revenues. The government should rely on taxes to meet its expenditures and should attempt to avoid imposing shocks to the oil market and to the management and substitution with other commodities.

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ACKNOWLEDGMENTS

The current study has not received any grant, fund or contribution from private or government institutions. Also, the authors declare that there is no conflict of interests

ETHICAL CONSIDERATION

Authenticity of the texts, honesty and fidelity has been observed.

CONFLICT OF INTEREST

Author/s confirmed no conflict of interest.