Iranian Economic Review, 29(3), 1098-1136
DOI: 10.22059/ier.2024.368725.1007866

RESEARCH PAPER

A Response of Food and Non-Food Price Changes to Global Oil Structural Shocks: Evidence from SVAR to the Iran Economy

Davoud Mahmoudinia[a] , **Mir Hadi Hosseini Kondelaji**[*,b] ,
Seyed Mohammad Mostolizadeh[c]

a. Faculty of Economics and Administrative Sciences, Vali-e-Asr University of Rafsanjan, Rafsanjan, Iran.
b. Faculty of Economics and Administrative Sciences, Arak University, Arak, Iran.
c. Faculty of Economics and Administrative Sciences, Semnan University, Semnan, Iran.
* Corresponding author

Received: 26 November 2023, Revised: 17 January 2024, Accepted: 06 February 2024, Published: 30 September 2025
Publisher: The University of Tehran Press.
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Abstract
This article empirically analyzed the relationship between oil structural shocks and Iran's food and non-food inflation. The study was conducted within the SVAR model framework using monthly data from April 2004 to March 2018. However, the choice of the starting and ending dates was based on the availability of the time series data. The impulse response analysis suggested that oil-specific demand shocks caused by supply disruptions positively affected food and non-food prices in Iran. In addition, the results indicated that in the post-sanction period, one standard deviation of oil-specific demand shock led to an immediate increase in food prices compared to pre-sanction years. This also revealed that oil price volatility shocks played a more pronounced role in food price variability than oil price change. Moreover, given Iran’s economic features, we found that the exchange rate disruptions positively impacted the change in food and nonfood prices. Finally, based on this evidence, the findings offer critical implications for Iran's policymakers.
Keywords: Food Price, Iran Economy, Non-Food Price, Oil Structural Shock, SVAR.
JEL Classification: C01, O53, Q18, Q41.

1. Introduction

Crude oil dominates energy markets. Its price and volatility affect the price dynamics of other commodities (Kilian, 2008; Sadorsky, 2001). Crude oil is considered a vital energy source that affects economic development. It is a significant financial asset. Investors use it to cover risks (Yang et al., 2021). Investigating the fluctuations in the price of this natural resource is essential. This is especially true in recent decades because oil prices have experienced dramatic fluctuations. These are due to crude oil supply shocks (SSs), aggregate demand shocks (DSs), and oil-specific demand shocks (OSs) (Kilian, 2014). Other studies confirmed that oil price fluctuations significantly impacted macroeconomic activities, inequality, financial markets, and other commodity markets (Nademi, 2018; Mo et al., 2019; Meng et al., 2020; Najarzadeh et al., 2021).

Securing access to quality food has many benefits for countries and nations. It boosts economic growth, reduces poverty, and creates jobs. It also increases trade opportunities, enhances global security and stability, and improves health status (Abdul and Ismail, 2019). Over the last decades, the international community has faced many challenges to food security. The most prominent of these could be the sharp upturn in prices (Zmami and Ben-Salha, 2019). More recent data suggest that about 124 million people across 51 countries faced food insecurity in 2017 (Food Security Information Network, 2018). According to the Food and Agriculture Organization of the United Nations (FAO, 2009), the international prices of essential foods reached their highest levels for 30 years in June 2008. In Iran, a developing country, food is essential in households' consumption portfolio (Mahmoudinia, 2021). So, in the late modification, especially in recent times, the food crop prices have been on the high side. The prices of food crops such as rice, wheat, and cassava have been progressively high (Olayungbo, 2021). Rising food prices threaten the macroeconomic stability in countries with poor resources. The fluctuation of petroleum prices makes oil-rich countries more vulnerable to economic shocks (Devesh and Affendi, 2021).

Therefore, researchers have focused on investigating the relationship between the fluctuations of these variables: crude oil price and food price. In recent years, there has been worldwide concern about food and oil price fluctuations (Olayungbo, 2021). The co-movement of crude oil and food commodity prices has significant changes over time. Several measures of time-varying unconditional price change correlations were negative in the 1990s. During the early 2000s, they shifted into positive territory. After 2010, they decreased again (Peersman et al., 2021). The literature shows that fast motility in oil and food prices will hurt the world economy (Hakro and Omezzine, 2010; Alom, 2011; Karakotsios et al., 2021;).

Recent studies highlight that energy price is considered a key variable. It can explain the dynamics of food prices worldwide (Saghaian, 2010; Pal and Mitra, 2020). The increase in food prices has pressured oil-producing countries that import food. This is especially true for developing oil-exporting countries. If economic sanctions target this group of countries, poverty and inequality will spread (Salem et al., 2023, Heydari and Keikha, 2023). For instance, a country like

Egypt is the world's largest wheat importer. On average, it imports 11 million tons of wheat annually (Food and Agriculture Organization (FAOSTAT, 2016). This is followed by Yemen, which imports almost 2 million metric tons of wheat annually (World Bank, 2013). Iran imported 1.18 and 1.1 million tons of wheat and rice in 2020, respectively. Countries like these are more vulnerable to higher food prices. Their food imports mostly rely on unpredictable oil revenues. Unexpected changes in global oil prices influence these revenues.

Another interesting point is that there is a novel transmission channel between crude oil prices and food prices. Since the early 2000s, biofuel production has transformed agricultural commodities into energy carriers. It allows their use as feedstocks for ethanol and biodiesel (e.g., De Gorter and Just, 2009; Serra and Zilberman, 2013). Since then, fuel has been an input and an agricultural production output. It has also become a new way for crude oil prices to affect food prices in industrialized countries (Wang et al., 2013). However, technological progress needs to catch up in developing countries. Biofuels are not available there yet. Thus, the link between crude oil and food needs to be better understood (Nazlioglu and Soytas, 2011). Many scholars attribute the rise in food prices to the increased cost of oil. Oil is an input to food production (Carpio, 2019; Taghizadeh-Hesary et al., 2019). Some studies have also examined the role of transportation costs on food prices (Gholamian and Taghanzadeh, 2017; Shemshadi, 2021).

In general, this study innovates in several ways compared to others. First, previous studies have yet to consider the possible dynamic linkages between oil and food prices in oil-exporting developing countries like Iran. Iran is not only oil-dependent but also a net food importer. This present study, therefore, filled this gap. This gap in the literature is particularly striking as populations in developing countries are much more vulnerable to food crises than those in developed ones (Dalheimer et al., 2021). Second, international sanctions have significantly impacted oil revenues. As a result, inputs, technology, and food imports have been affected. This factor has been the main characteristic of Iran's economy in recent years. Investigating its effect is considered another innovation. This is a distinction from previous studies such as Kohansal and Hezareh (2017) and Jafari Samimi and Farajzadeh (2019). Third, our study has not just focused on a few commodities. For example, we looked not only at agricultural or energy commodities, as done in Shahzad et al. (2018). Instead, we used a food price and nonfood price index in Iran. Finally, we added the effect of exchange rate and money supply shocks to develop other structural equations. These equations model the Inflation of food and nonfood. As far as authors know, no comprehensive work is dedicated to these objectives.

This article is organized into several parts. The second part discusses the theoretical foundations of the relationship between oil and food prices and the research background. The third section analyses the food, nonfood, and oil price data related to Iran's economy. In the fourth section, we consider the methodology and data description. Next, we estimate the model, analyse the results, and link them to the characteristics of Iran's economy. Finally, we present conclusions and suggestions.

2. Literature Review

Oil price shocks significantly affect all economic activities of developing countries (Bala and Chin, 2020). Theoretically, different mechanisms explain how oil price shocks affect different commodities. First, price shocks can affect energy and non-energy goods differently. In the case of agricultural products, oil is an essential complementary commodity. It also plays a vital role in their production function as an input (raw material) (Yang, 2019). Carpio (2019) used a vector error correction with an exogenous variable (VECX) model. He analyzed the effects of oil prices on forecasts for ethanol, gasoline, and sugar prices. The results showed that the forecasts for ethanol and gasoline prices were more sensitive to changes in future oil prices. This was compared to the sugar price forecast. Rising oil prices lead to cost-side Inflation through the effect on corporate output and citizen consumption (Wu et al., 2013). This leads to the devaluation of the domestic currency of oil-importing countries. It does so by deteriorating international payment balances.

The second case, the substitution effect, is related to biofuel production. It leads to changes in oil prices, directly impacting ethanol and biodiesel prices. This has been intensified, especially after the advent of biofuel production in the mid-2000s. Biofuels made it possible to produce fuel through substandard grains and vegetable oils. Therefore, crude oil and some agricultural grains were considered substitutes for fuel production. This leads to an increase in the positive correlation of prices between the two markets. The two commodities are highly substitutable. A shock that changes the price of one commodity will further increase the price of the substitute commodity. Bilgili et al. (2020), using continuous wavelet model estimations, found a significant linkage between biofuel production and food prices in the US for the monthly period 1981–2018. Many studies have concluded that this is the most critical factor in oil-importing countries. However, in the case of oil-rich countries, this factor seems to be less critical.

The third is the cost of transportation for both agricultural inputs and market products. It is affected by fuel prices and, consequently, crude oil. Transportation costs are crucial in increasing agricultural prices in developing countries like Iran. This is because these countries need more rail and maritime transport infrastructure. They rely mainly on costly road transport (Barzelaghi et al., 2012). Gholamian and Taghanzadeh (2017) propose an integrated wheat supply chain planning model. They use different transportation modes in a case study of Iran. This illustrates a significant reduction in transportation costs.

The fourth case is the effect of oil revenues, specific to oil-rich countries. Oil exports comprise many of these countries' revenues (Olayungbo, 2019; Farzanegan, 2011). Therefore, oil shocks significantly affect foreign exchange inflows. This, in turn, affects food imports and related input, resulting in food prices in these countries (Samadi, and Behpour 2013). For example, Najarzadeh et al. (2021) found that a positive oil revenue shock significantly increases the consumption of Iranian households with low education levels. It also reduces consumption inequality among consumers.

Oil, as the most important source of income (Wang et al., 2013), is a very decisive variable in the price changes of food and nonfood goods for these countries (Chen et al., 2020). These countries are more vulnerable to higher food prices. Unpredictable oil revenues primarily finance their food imports. These revenues are affected by unexpected changes in global oil prices (Olayungbo, 2021).

In recent years, supply and demand shocks caused oil prices to fluctuate significantly. This affected economic activities, financial markets, and commodity markets (Kilian, 2014; Latunde et al., 2020). On the other hand, these developing countries have different market characteristics. This is due to imperfect competition between manufacturers and retailers. There is also imperfect substitution between domestic and imported goods (Dillon and Barrett, 2015). Thus, the reaction of the food market to the oil market, in addition to the volume of oil exports or imports, probably depends on the degree of development of an economy and economic sanctions (Shirazi et al., 2016; Adeli et al., 2022).

Figure 1 shows the theoretical relationship between food and crude oil prices. The left part of the chart shows the classified aspect of the crude oil market. It includes three sources for fundamental shocks. Kilian et al. (2009) showed that oil shocks had distinct effects on oil market dynamics. However, few studies have examined the various dimensions of these shocks. Wang et al. (2014), for example, used structural models to test the effects of these oil shock mechanisms on the food market. Expanding the model of Kilian et al. (2009), these researchers found that after 2006, food prices were solely affected by specific oil demand shocks.

In connection with input cost, both the mineral fertilizers used on farms and the fuel consumption of machinery as inputs for agricultural production can be an integral part of farmers' production costs. It, therefore, affects food supply and product prices (Dillon and Barrett, 2015; Serra and Zilberman, 2013; Wang et al., 2014). Input costs describe the traditional relationship between energy prices and food prices. However, this cost type generally plays a minor role in explaining the parallel movement of oil and food prices (Serra and Zilberman, 2013; Kristoufek et al., 2012).

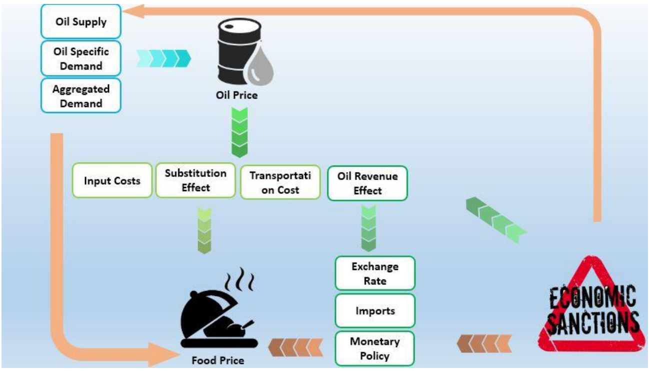

Figure 1. Conceptual Model of the Relationship between Oil Structural Shocks and Food Prices
Source: Research finding.

Currency fluctuations can also be regarded as another important issue affecting food prices. Exchange rate fluctuations and currency crises significantly influence food prices. Various studies have investigated this issue (Reboredo and Ugando, 2014). Many developing countries need help to produce agricultural products (Iddrisu and Alagidede, 2020). Consequently, they spend nearly 41.5% of their total consumption on food. Also, the government allocates subsidies to these products. This is to prevent food price increases and reduce pressure on poor families. Therefore, the government's use of monetary policies for this purpose is inevitable (Kaur, 2021).

The effect of the exchange rate on the price of food can be analysed in two ways. First, an increase in the exchange rate leads to higher prices for imported inputs like seeds, fertilizers, pesticides, and chemicals. This increases the cost of agricultural products (Awan and Imran, 2015). Some products, like rice and wheat, make up many of developing countries' imports, especially in Iran. The increased exchange rate leads to higher import prices for these products. On the other hand, an increase in the exchange rate enhances the cost of energy and fuel. This causes an increase in the cost of transportation and, therefore, food.

Some studies have empirically examined the relationship between oil prices, monetary policy, imports, and exchange rates. For example, Mahmoudinia (2021) used quantile regression analysis to examine the effects of monetary policy, currency crises, and oil prices on food inflation in Iran. Economic sanctions in Iran strongly linked the response of food prices to the price of oil and food inflation. Iddrisu and Alagidede (2020) also found the positive impact of monetary policy, exchange rates, and world food prices on food prices.

3. Empirical Facts of Iran's Economy

According to Figure 2, during the years studied, the Inflation of food products has been higher than that of nonfood products in Iran's economy. Also, the trend of the figures shows that Inflation reached its highest level between 2010 and 2013, which was affected by various issues, including the increase in oil prices during this period.

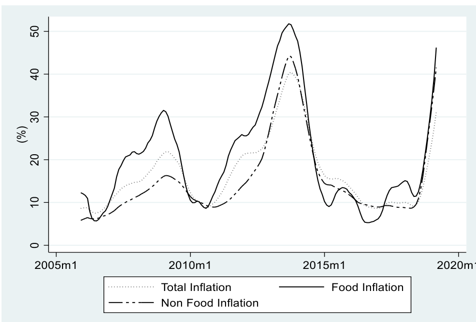

Figure 2. food, Non-Food and Total Inflation
Source: Research finding.

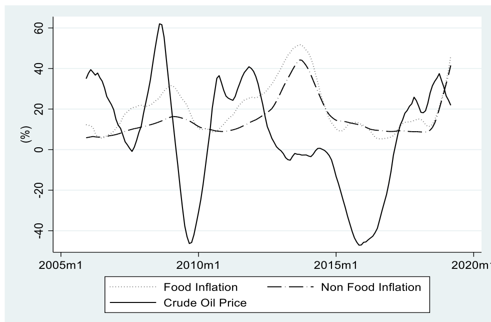

Figure 3. Food, Nonfood Inflation and Crude Oil Change
Source: Research finding.

As can be observed from figure 2, from 2005 to 2013, food inflation was higher than total Inflation; from 2014 to 2016, this trend changed, and the total Inflation exceeded food inflation. The reason for such a change may be the proximity to the presidential elections 2016. A similar thing happened from 2006 to 2007 and from 2010 to 2011. Such manipulations are likely to occur in governments with oil budgets. After that, the food inflation rate again exceeded the total Inflation.

The intensity of Inflation gradually increases. An increase in liquidity, the enhanced severity of sanctions, and a decrease in foreign exchange reserves are the common causes of such a situation. This process is palpable in developing countries that export oil and rely on oil revenues. This is because the increase in food prices exerts much pressure on oil-producing countries that import food.

Iran is not exempted from the rule of oil price fluctuations and has always experienced shocks due to political and economic reasons. Due to the sensitive geopolitical situation of the country and some political issues, Iran's economy has constantly been subjected to cruel sanctions, and this has shown its effects in different dimensions. In addition to impeding financial mechanisms related to getting currency for the sale of oil and its entry into the country, sanctions have also affected its energy infrastructure. On the other hand, as the inflow of foreign currency is restricted, its supply side has faced a shortage, and finally, the exchange rate has increased.

Figure 3 indicates that oil price fluctuations are much higher than food and nonfood price ones; however, the trends of these two sectors are similar, with a lag of almost one year. When the global price of crude oil reached its highest level in July 2008, food prices in Iran were still rising. Also, food prices declined when they hit their lowest point in January 2009. The reason for the low volatility of food products, compared to the fluctuations in oil prices, is the government's supportive policies as a result of the dollars saved during the boom in oil revenues. Similarly, in 2012, the price of oil decreased, and this downward trend continued until 2016. Despite the long period of this period, food prices in Iran did not decrease significantly. The JCPOA agreement, the removal of sanctions during this period, and the increase in Iran's oil production did not increase the government's income much due to the low oil price. The third jump in oil prices coincided with the JCPOA's cancellation and the sanctions' return to Iran's economy.

Figure 4 represents the contribution of different sectors of the household budget, clearly showing that a significant part of Iranian household income is spent on housing, followed by food. In the last decades, the housing sector has experienced a significant price increase; finally, the amount of the rent paid by households has also increased.

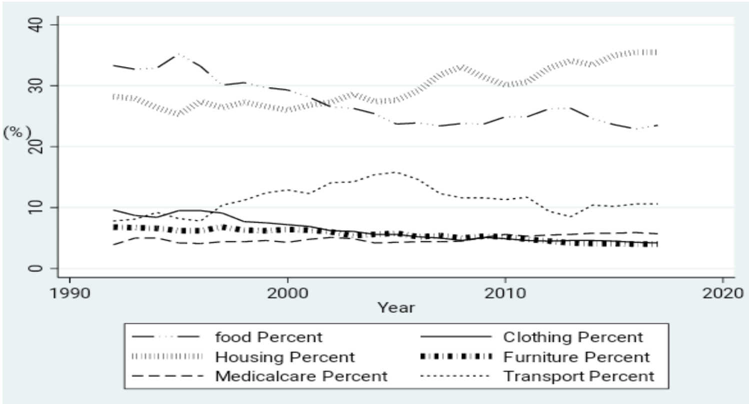

Figure 4. The Contribution of Different Sectors to the Household Budget
Source: Research finding.

4. Methodology and Data Description

4.1 Methodology

In the current study, we employed a structural vector autoregression (SVAR) model for Iran, in line with Kilian (2009), Baumeister and Kilian (2014), and Ahmad Bhat et al. (2018), to analyze the interdependence between oil structure shocks and food and nonfood price changes. In his seminal study, Killian (2009) separated three different oil price shocks based on the framework of the linear structural vector autoregression (SVAR) model; after that, this method was significantly used to study the relationship between oil price fluctuations and macroeconomic variables. Based on that, in the oil market, fluctuations in the actual price of oil can be under the influence of three structural shocks: 1) Oil supply shocks as shocks to the global supply of crude oil, 2) Aggregate demand shocks as shocks to the global demand for all industrial commodities driven by global actual economic activity, and 3) Other oil-specific demand shocks as shock in crude oil prices, which can be modeled, following Kilian (2009), to identify the changes in the precautionary demand for crude oil in response to the increased uncertainty about future oil supply shortages.

Analyzing the reaction of food and nonfood prices to these shocks can help us to find that we can separate the effects of oil factors, such as oil supply shocks and other oil-specific demand shocks, from those of the global factor, including aggregate demand shock, on the commodity market. In the two-step structural vector autoregressive (SVAR) technique, firstly, we utilize the SVAR model to consider the sources of shocks; secondly, we explore the effect of the estimated structural shocks on food and nonfood prices.

The SVAR analytical framework examines all variables and provides conditions for applying restrictions compatible with economic theory; hence, it helps us achieve more accurate, logical, and consistent findings. According to Narayan et al. (2008), the SVAR model is superior to the VAR one in that the reduced form of the latter does not consider the structural relationships between the variables. Therefore, this article will investigate the transmission of crude oil structural shocks onto food and nonfood inflation in Iran using the SVAR model with sign restrictions to know how food and nonfood prices react to structural shocks. However, the SVAR model attempts to solve the traditional identification problem. The structural VAR representation is;

$$A_0 Y_t = a + \sum_{i=1}^{p} B_i Y_{t-i} + \xi_t \tag{1}$$

, where Y_t is a vector of exogenous variables, B_i is the parameter coefficient matrix, P denotes the lag length, and ξ_t is a vector of orthogonal structural shocks. The reduced-form VAR is specified as:

$$Y_t = A_0^{-1} a + \sum_{i=1}^{p} A_0^{-1} B_i Y_{t-i} + \vartheta_t \tag{2}$$

and

$$\vartheta = A_0^{-1} \xi_t \tag{3}$$

where ϑ denotes the reduced-form VAR innovations; also, it can be expressed as the vector of estimated shocks specified by placing restrictions on the A_0^{-1} matrix. However, the covariance matrix for ϑ is specified as follows:

$$\sum\nolimits_{\vartheta} = E(\xi_t \xi_t') = A_0^{-1} E(\vartheta_t \vartheta_t') A_0'^{-1} = A_0^{-1} \sum\nolimits_{\xi} A_0'^{-1} \tag{4}$$

where $\sum_{\xi}$ is the covariance matrix for the shocks and E is the unconditional expectation operator. According to Kilian (2009), we do not use long-term restrictions; we only apply short-term restrictions on contemporary relationships. Based on Equation (3), it is assumed that matrix A_0^{-1} is a lower triangular matrix so that in the baseline mode, the matrix with the restrictions imposed can be seen below:

$$\vartheta \equiv \begin{bmatrix} \vartheta^{OPRO} \\ \vartheta^{GLOB} \\ \vartheta^{OPRI} \\ \vartheta^{FOOD} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} \xi^{oil\ supply\ shock} \\ \xi^{agreggate\ demand\ shock} \\ \xi^{oil-specific\ demand\ shock} \\ \xi^{food\ shock} \end{bmatrix} \tag{5}$$

and

$$\vartheta \equiv \begin{bmatrix} \vartheta^{OPRO} \\ \vartheta^{GLOB} \\ \vartheta^{OPRI} \\ \vartheta^{NFOOD} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} \end{bmatrix} \begin{bmatrix} \xi^{oil\ supply\ shock} \\ \xi^{agreggate\ demand\ shock} \\ \xi^{oil-specific\ demand\ shock} \\ \xi^{non\ food\ shock} \end{bmatrix} \tag{6}$$

where $OPRO$, $GLOB$, $OPRI$, $FOOD$, and $NFOOD$ are global oil supply, global real economic activity extracted from Kilian's index, actual crude oil price, food price index, and nonfood price index, respectively. Some identification assumptions related to the order of variables in the above equations are mentioned here. The first assumption is that global crude oil producers take at least one month to respond to all shocks, including shocks to aggregate demand, global oil prices, and food prices. This restriction is applied by setting all the first rows to zero, except the first column of matrix A_0^{-1}. Based on the second hypothesis, we argue that global economic activity responds simultaneously to oil supply and aggregate demand shocks. In contrast, its response to other shocks, including oil-specific demand shock, takes more than a month. The third row assumes that crude oil price is affected by its shock, oil supply shock, and aggregate demand shock, consistent with the commodity supply and demand principle. In the fourth row, food and nonfood prices receive simultaneous effects from all the remaining variables in the system. Following Kilian and Park (2009), the oil supply shock illustrates a negative one standard deviation shock, while the aggregate demand shock and oil-market specific demand shock display positive shocks, such that all these would tend to increase the food and nonfood prices.

In addition, we developed a structural VAR model by putting structural variables such as money supply and exchange rate as exogenous time series data, which could help us better understand the transmission mechanism of oil price shocks. The order of the variables in A_0^{-1} in equation (3) shows that reduced form innovations, ϑ, can be presented as the linear combinations of the structural innovations, ξ, as follows:

$$\vartheta \equiv \begin{bmatrix} \vartheta^{OPRO} \\ \vartheta^{GLOB} \\ \vartheta^{OPRI} \\ \vartheta^{REXR} \\ \vartheta^{MONP} \\ \vartheta^{FOOD\ (Nonfood)} \end{bmatrix} = \begin{bmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ a_{21} & a_{22} & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & a_{33} & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & a_{44} & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & a_{55} & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & a_{66} \end{bmatrix} \begin{bmatrix} \xi^{oil\ supply\ shock} \\ \xi^{agreggate\ demand\ shock} \\ \xi^{oil-specific\ demand\ shock} \\ \xi^{exchange\ rate\ shock} \\ \xi^{money\ supply\ shock} \\ \xi^{food\ shock\ (Nonfood)} \end{bmatrix} \tag{7}$$

where $REXR$ and $MONP$ are the real exchange rate and money supply. Based on this matrix, we put the real exchange rate before the money supply because the money supply responds immediately to the changes in the real exchange rate; then, the monetary policy can affect the level of Inflation in the economy, including food and nonfood items.

4.2 Data Description

This study aimed to investigate the response of food and nonfood prices to crude oil structural shocks in Iran's economy. Here, we used the sample for the empirical analysis, including 180 monthly observations made in Iran from April 2004 to March 2018. The variables under discussion in this study, based on Wang et al. (2014), Widarjono et al. (2020), Alom et al. (2011), and Baumeister and Kilian (2014), included global oil production, actual economic activity, Brent oil price, food price, nonfood price, real exchange rate, and accurate money supply. Most of the data were obtained from the Central Bank of Iran. At the same time, global crude oil production and actual economic activity index were collected from the US Energy Information Administration and Federal Reserve Bank of Dallas, respectively.

We used global oil production data as a proxy for the global oil supply and actual economic activity index constructed by Kilian (2009) to estimate the scale of global economic activity as a proxy for global demand shocks. Kilian's economic index, extracted at a monthly frequency, has an additional advantage over GDP, calculated yearly. Also, the nominal data of the Brent price index have been utilized as the proxy for world crude oil prices. In addition, we have used the food and nonfood price index calculated by the GDP deflator as the proxy for food and nonfood inflation, respectively. For further sensitivity analysis, we add money supply as the proxy for monetary policy shocks and real effective exchange rate, which can be calculated as the nominal effective exchange rate divided by a price deflator to the baseline model. The selection of the starting and ending dates was based on the availability of the data. Definitions and sources of variables used are provided in Table 1.

Table 1. Definitions and Sources of Variables

Variable	Definition	Source
$OPRO$	Global Crude Oil Production	US Energy Information Administration
$GLOB$	Real Economic Activity Index Constructed by Kilian (2009)	Federal Reserve Bank of Dallas
$OPRI$	Brent Oil Price	CBI
$FOOD$	Food Price Index	CBI
$NFOOD$	Non-Food Price Index	CBI
$REXR$	Real Exchange Rate	CBI and *Author calculated*
$MONP$	Real Money Supply	CBI
$VOLT$	Oil Price Volatility	*Author calculated*

Source: Research finding.

Moreover, the descriptive statistics of all investigated variables in the SVAR model and the distribution and variability of the data for $OPRP$, $GLOB$, $OPRI$, $FOOD$, $NFOOD$, $MONP$, and $REXR$ are presented in Table 2. This study's monthly time series summary statistics revealed that all variables exhibited positive averages. As shown in Table 2, the mean values of food and nonfood prices were 57.4 and 64.9, respectively, and the standard deviation for these time series data was smaller than the mean value.

Table 2. Descriptive Statistics of All Variables

Variable	Mean	Median	Max	Min	Std.dev	Skewness	Kurtosis
$OPRO$	97.02	96.92	104.2	87.23	3.66	-0.0007	2.22
$GLOB$	14.49	-1.24	190.81	-159.4	78.55	0.35	2.29
$OPRI$	75.20	70.10	133.20	30.80	26.08	0.37	1.90
$FOOD$	57.40	36.50	226.0	10.90	45.68	1.09	3.93
$NFOOD$	64.69	44.10	197.0	33.80	36.59	1.36	4.65
$REXR$	10.58	10.57	11.57	10.24	0.22	1.56	7.42
$MONP$	15.04	14.98	16.77	13.18	1.02	-0.02	1.84
Obs	180	180	180	180	180	180	180

Source: Research finding.

5. Empirical Results and Discussion

5.1 Unit Root Analysis

Before we estimate the SVAR model, a preliminary analysis of the data series was performed, as it required all variables to be stationary. Hence, we utilized the augmented Dickey–Fuller (ADF), Phillips- Perron (PP), and the structural break unit root ADF test technique for all variables. The Results of the unit root tests, as shown in Table 3, indicated that all the series (except the Kilian index) were not stationary at the I(0) level, with the rejection of the null of unit root (non-stationarity); however, they were stationary at the first difference I(1), which represented that modeling them in levels could lead to misleading results. Therefore, the first difference of all series, except the global economic activity index, was used to estimate the SVAR model.

Table 3. Results of the Unit Root Test

	ADF		PP		Break Test ADF	
	Level	**First Difference**	**Level**	**First Difference**	**Level**	**First Difference**
OPRO	-3.10 (0.10)	-11.32* (0.00)	-2.74 (0.21)	-11.28* (0.00)	-2.96 (0.34) [2005: 11]	-11.94* (0.01) [2011: 3]
GLOB	-3.89** (0.01)	-10.07* (0.00)	-3.20*** (0.09)	-10.12* (0.00)	-4.66* (0.02) [2010: 5]	-10.51* (0.01) [2009: 2]
OPRI	-2.59 (0.28)	-8.96* (0.00)	-2.36 (0.39)	-8.88* (0.00)	-3.33 (0.49) [2014: 6]	-9.78* (0.01) [2008: 10]
FOOD	-1.57 (0.80)	-5.07* (0.00)	-1.57 (0.79)	-8.51* (0.00)	-0.48 (0.99) [2018: 5]	-9.58* (0.01) [2018: 5]
REXR	-1.08 (0.92)	-6.56* (0.00)	-1.30 (0.88)	-11.02* (0.00)	-3.66 (0.29) [2018: 8]	-11.51* (0.01) [2018: 2]
MONP	-2.68 (0.24)	-4.14* (0.00)	-2.50 (0.32)	-8.07* (0.00)	-2.29 (0.98) [2011: 10]	-8.81* (0.01) [2005: 7]
NFOOD	-0.55 (0.98)	-5.22* (0.00)	-3.63 (0.97)	-5.27* (0.00)	-0.05 (0.99) [2017: 8]	-5.61* (0.01) [2018: 8]

Source: Research finding.

Note: (*) Denotes statistical significance at a 1% level. (**) Denotes statistical significance at the 5% level. (***) Denotes statistical significance at the 10% level. Trend and Intercept were included in all three tests.

5.2 The Baseline Model Results

In this section, to analyze the impacts of the change in oil supply, aggregate demand, and oil price on food and nonfood prices, we specified a vector of four variables as $Y = [OPRO_t,\ GLOB_t,\ OPRI_t,\ FOOD_t(NFOOD_t)]$. From Table 4, the optimal lag lengths selected based on the Schwarz Information Criterion (SIC), AIC, and HQ for food and nonfood models were 1. Hence, we selected $p = 1$ for the VAR model.

Table 4. VAR Lag Order Selection Criteria in Baseline Model

Lag	AIC	SC	HQ
Food Model			
0	14.1	14.2	14.1
1	11.1*	11.6*	11.3*
2	11.2	11.9	11.5
Non-Food Model			
0	13.2	13.3	13.2
1	9.76*	10.1*	9.91*
2	9.77	10.4	10.04

Source: Research finding.

Note: (*) indicates the optimal lag lengths.

In the next stage, we employed roots of the characteristic polynomial index to consider the stability of the estimated VAR model. If the vector autoregression model is unstable, the impulse-response standard errors are unreliable (Lütkepohl, 1991). Table 5 shows that the estimated VAR model in both food and nonfood models is reliable. An estimated VAR model is stable (stationary) if its root reciprocals are less than one when located in the unit circle.

Table 5. Stability of the VAR mode

Roots of Characteristic Polynomial	
Food Model	
Root	**Modulus**
0.95	0.95
0.37-0.05i	0.38
0.37+0.05i	0.38
0.17	0.17
Non-Food Model	
0.96	0.96
0.70	0.70
0.35	0.35
0.16	0.16

Source: Research finding

Note: No root lies outside the unit circle. VAR satisfies the stability condition

We now consider and compare food and nonfood price responses to a shock in oil supply, aggregate demand, and oil-specific demand using impulse response functions (IRF). We represent ten response periods for both short- and long-term effects.

According to Figure 5, among the three demand and supply shocks in the crude oil market, the shock in oil-specific demand caused by supply disruptions positively affects food and nonfood prices in Iran. So, in response to one standard deviation disruption in the oil-specific demand, food price change is gradually increased to about 0.002 index point for the first two months and begins to decline for four months. After that, it returns to its equilibrium. On the other hand, the same trend could be observed for nonfood block, but it is milder; so, the impact of an oil-specific demand shock on the price of nonfood is positive in the short and medium run. For the first two months, nonfood inflation increases to 0.001 index point; after that, it begins a smooth downward trend. This is consistent with the study done by Alom (2011), McPhail et al. (2012), and Hezareh et al. (2016). Due to the extensive energy consumption in the agricultural sector, oil price changes are directly related to the increase in agricultural goods and food prices. When the price of oil rises, the price of agricultural inputs also increases, leading to further growth in the prices of agricultural and food products. According to these outputs, it can be stated that since Iran's economy is dependent on oil and the share of oil in the government budget is high, with the increase in oil price due to other exogenous oil-specific shocks, this share will also increase. Therefore, expansionary policies in the budget lead to more money injection in the market. Hence, the increase in price and the higher oil revenues of the country double the increase in liquidity, causing the problem of excess demand. Although excess demand in itself is not undesirable because there is no necessary movement in the production sector for a proportionate response, excess demand leads to higher food prices.

In contrast, the effects of oil supply disruptions on Iran's food and nonfood inflation are harmful in short periods and continue to be negative at a low level until the sixth and seventh months. Figure 5 indicates that a one-unit standard deviation shock to the oil supply causes a negligible change in food and nonfood by -0.0004% and -0.002 in the short run, respectively; in the long run, this impact, however, disappears. The result, in the long run, is consistent with the finding of Cunado et al. (2015), who stated that in the top oil-consuming Asian economies, oil supply shocks could have limited influence on CPI. In particular, the higher global supply of oil, along with the reduction of oil prices, can lead to a decrease in oil revenues in Iran and less injection of money into the society, which causes Inflation to decline.

More interestingly, food and nonfood prices respond differently to the unanticipated disruptions of aggregate demand driven by economic activity. As shown in Figure 5, innovations to aggregate demand have an immediate positive impact on the price of nonfood; meanwhile, we observed an almost negligible negative impact on the price of food. Following the aggregate demand shock, the price of nonfood reaches its positive maximum in the short term (around 0.008 index point), and these positive effects gradually decrease and enter the negative channel from around the third month. On the other hand, the effect of the aggregate demand hikes on food prices in Iran is minimal. It moves along its long-term equilibrium path, in which an aggregate demand disruption causes a momentary rise in food prices. We will see a smooth and continuous downward trend along the equilibrium path. This result is in line with Kilian and Park (2009) and Wang et al. (2014), who found that the increase in oil prices, caused by the increase in aggregate demand, reduced global economic activity, which partially offset the initial positive effects on food demand.

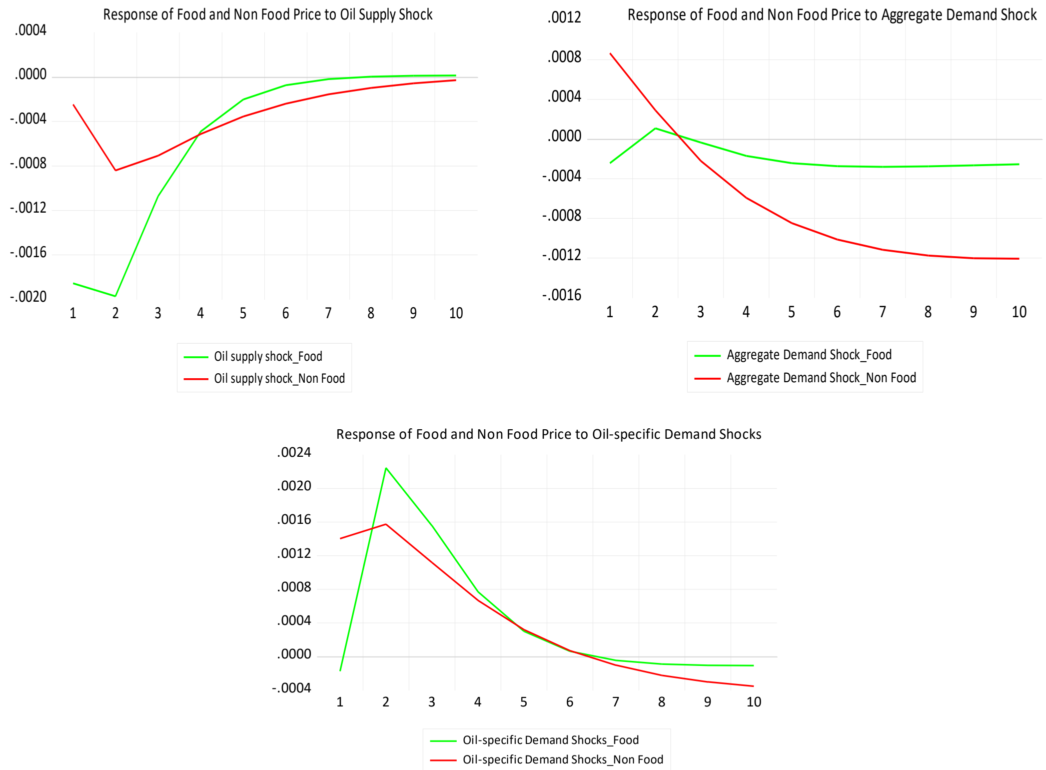

Figure 5. Impulse Response Functions of Food and Nonfood Price to Structural Shocks in the Baseline Model
Source: Research finding.

Figure 6 presents the accumulated response of food and nonfood prices. It could be observed that the oil supply shock leads to a decline in food and nonfood price changes in all periods of disruption. However, in response to the oil-specific demand shock, food and nonfood Inflation began to increase from the first month, reaching a constant level after the fifth month. The evidence presented in Figure 6 proves that the accumulated response of nonfood items in Iran to the identified shocks in aggregate demand driven by economic activity is unstable. In the short term, we see a positive impact, and this impact tends to be harmful after the fourth period. While aggregate demand surprises only have a long-lived negative impact on food prices, their response disappears in the short run.

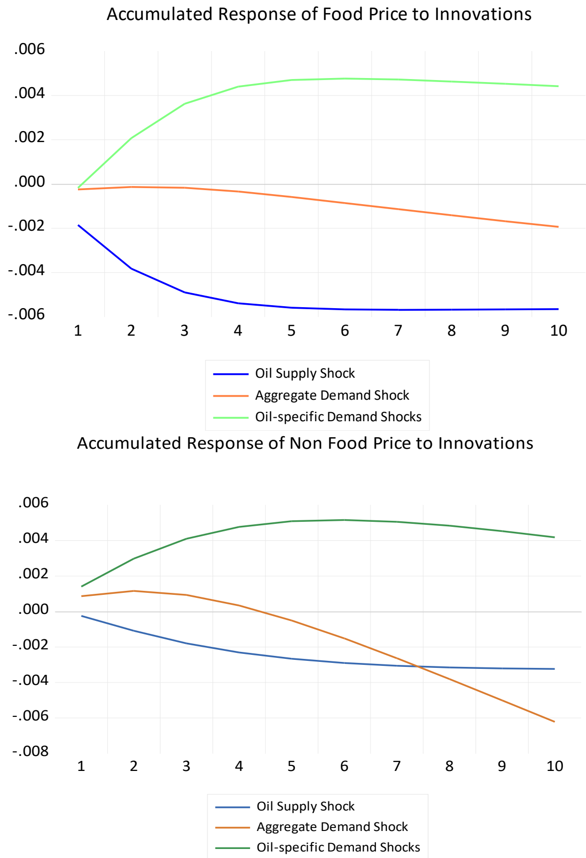

Figure 6. Accumulated Response of Food and Nonfood Prices to Innovations in the Baseline Model
Source: Research finding.

Table 6 displays the variance decomposition (VD) results at the horizons of up to 10 years for food and nonfood models. Food and nonfood blocks explain the most variation, about 97% and 96% for food-nonfood models. It is clear that, in the short run, the effect of these three shocks on food and nonfood blocks is slight. In the first period, less than 1% of the variation in the food market could be explained by the shocks extracted from the global crude oil market, while this value is about 2.3% for the nonfood price. In contrast, in the long run, the three structural shocks can account for about 3% and 6% of the variation in food and nonfood. We also found that the explanatory power of three supply and demand oil shocks for the nonfood model was more substantial than that of food prices for all periods.
However, in the first period, food prices could be explained mainly by oil supply shock, and the power of oil supply for food inflation is approximately 0.6%. In

comparison, other shock rates are lower than 1%. The results indicate that in the three months, oil supply, aggregate demand, and oil-specific demand shocks could account for the movement of food prices by 1.3, 0.01, and 1.17, respectively. Further, VD results for food showed that in the tenth year, $OPRO$ explained around 1.36% of the basic model, whereas $OPRI$ accounted for around 1.27%. For nonfood prices, this analysis was different. In the first period, the proportion of nonfood inflation due to shock to oil supply, aggregate demand, and oil-specific was 0.05%, 0.6, and 1.6, respectively. Specifically, the shock in $OPRO$ relatively had a low contribution to the nonfood price in the first year (about 0.05), but it rose to 0.55 percent in the third year and increased marginally to 0.60 percent in ten years. Over the 10-year horizon, oil-specific demand shock could explain between 1.62 and 2.25% of variation in nonfood prices. In comparison, the aggregate demand shock accounted for 0.61 to 2.93% of variations in nonfood prices from short to long periods.

Table 6. Variance Decomposition of Food and Nonfood in the Baseline Model

Food Model				
Period	$\boldsymbol{OPRO}$	$\boldsymbol{GLOB}$	$\boldsymbol{OPRI}$	$\boldsymbol{FOOD}$
1	0.6662	0.0114	0.0058	99.316
2	1.1832	0.0114	0.8181	97.987
3	1.3267	0.0113	1.1718	97.490
4	1.3568	0.0158	1.2583	97.368
5	1.3618	0.0250	1.2711	97.341
6	1.3623	0.0366	1.2714	97.329
7	1.3621	0.0488	1.2715	97.317
8	1.3619	0.0605	1.2726	97.304
9	1.3618	0.0715	1.2741	97.292
10	1.3616	0.0816	1.2757	97.280
Non-Food Model				
Period	$\boldsymbol{OPRO}$	$\boldsymbol{GLOB}$	$\boldsymbol{OPRI}$	$\boldsymbol{NON-FOOD}$
1	0.050093	0.617393	1.620312	97.71220
2	0.402642	0.437430	2.333928	96.82600
3	0.553684	0.385328	2.488399	96.57259
4	0.610100	0.492025	2.449604	96.44827
5	0.627451	0.739563	2.367005	96.26598
6	0.628923	1.093529	2.295339	95.98221
7	0.624290	1.517767	2.250239	95.60770
8	0.617724	1.981051	2.231853	95.16937
9	0.610960	2.459262	2.235084	94.69469
10	0.604660	2.935203	2.253912	94.20622

Source: Research finding.

5.3 Baseline Model Results by Monetary Policy and Exchange Rate

To further analyze the sensitivity, in this section, we will examine the effects of monetary policy and exchange rate shock on food and nonfood prices in Iran's economy based on the equation (7); the vector of exogenous variables can be written in the form of: (i.e., $OPRO, GLOB, OPRI, NONP, REXC, FOOD$). Figure 7 shows the impulse response of the innovations of symmetric monetary policy and exchange rate disruptions over a ten-year horizon.

To save space, we glance at the response of food and nonfood models to exchange rate and monetary policy shocks and do not focus on the response to oil structural shocks.

In the short run, one standard deviation of monetary policy shock to the food model was negative and continued to be positive in the long run. In other words, the immediate response of food inflation to the unanticipated disruption of the money supply was negative. However, this became positive after the two periods and remained stagnant from the seventh year onwards. This, thus, showed that in a medium and long-term period, the quantity theory of money was confirmed, and it was consistent with what has been proven by Mahmoudinia (2021) for Iran; therefore, the higher central bank's expansionary monetary policy, the higher the food prices.

However, this movement is different for the exchange rate uncertainty; so, in response to one standard deviation shock in the exchange rate, for the first two months, food price gradually increases up to about 0.004 index points, and it continues to decline (with a positive sign)for eight months and finally, it dies. Our result aligns with Iddrisu and Alagidede (2020) and Nazlioglu and Soytas (2012), who confirmed the positive relationship between the exchange rate and food prices.

It has been stated that exchange rate shock through the channel of devaluation and the increase in the price of primary and final imported products can lead to a push-up in the general level of prices, as well as prices in the food market. Also, this is contrary to the finding of Taghizadeh-Hesary et al. (2019), who found that, in the case of eight Asian economies, the response of food prices to any positive shock from the exchange rate was negative.

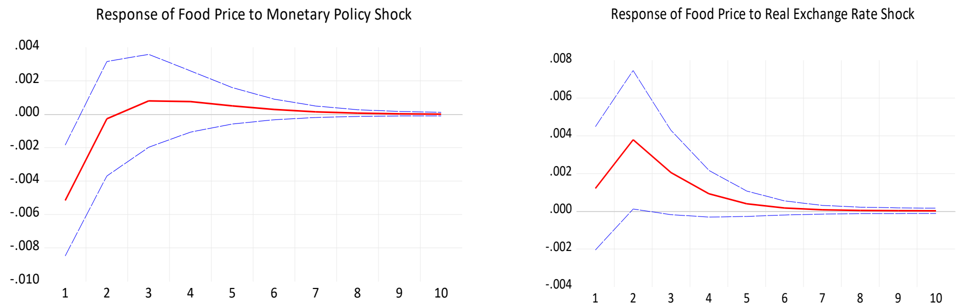

Figure 7. Impulse response functions of food price to structural shocks in the developed model
Source: Research finding

Figure 8 shows that the nonfood model responds negatively to the monetary policy shock. In the second month, it increases, slowly recovering over time and converging towards equilibrium. The response of the nonfood price to the exchange rate shock is similar to that of the food price. Nonfood inflation increased immediately after the exchange rate shock; however, after two months, this positive effect should gradually decrease and slowly die out in the long term. Thus, this analysis shows that exchange rate fluctuations directly affect food and nonfood prices in Iran.

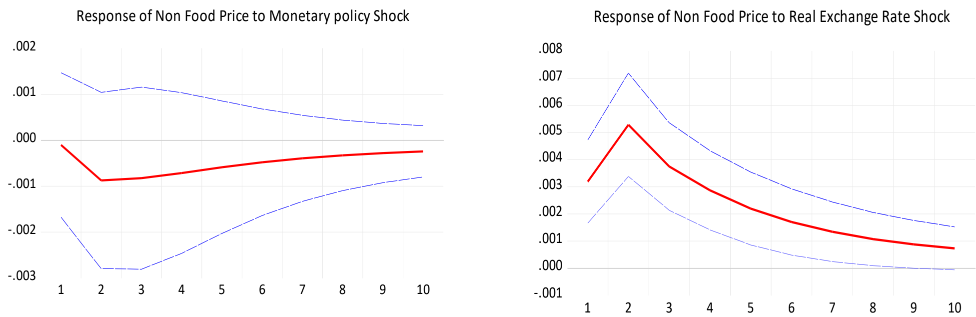

Figure 8. Impulse Response Functions of Nonfood Price to Structural Shocks in the Developed Model
Source: Research finding.

More interestingly, Figure 9 shows the accumulated response of food and nonfood items to oil structural shocks, money supply, and exchange rate disruptions. As can be seen, the exchange rate shock has the most positive effect on food and nonfood prices in Iran's economy. Also, after that, the oil-specific demand shock has the most significant impact on these two variables. On the other hand, the oil supply and monetary policy shock have adverse and long-term sustainability effects.

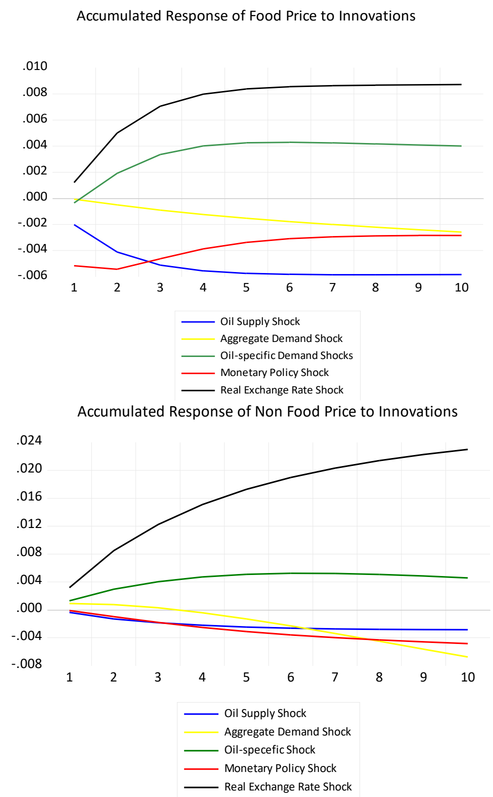

Figure 9. Accumulated Response of Food and Nonfood Prices to Innovations In The Developed Model
Source: Research finding.

Additionally, Table 7 presents the variance decomposition analysis for different periods based on Equation (7). Generally, the most variability in food and nonfood blocks in the whole period can be explained by money supply and exchange rate shocks, respectively. The results, thus, reveal that in the short run, money supply and exchange rate contribute 5% and 0.2 of the total variations in food price, respectively; meanwhile, in the long run, this proportion is about 4.3 and 3.2 percent for money supply and exchange rate, respectively. Moreover, the variation in food prices is mainly explained by monetary policy after its shocks. Table 7 indicates that, in the short and long run, only about 0.8% and 2.7% of the variation in the food price change can be explained by three crude oil shocks, respectively.

On the contrary, Table 7 reveals that money supply in the system explains the variation in nonfood inflation by 0.009 and 1.00 percent in the short and long run, respectively. Also, the variation in nonfood prices can be mainly explained by the exchange rate after its shocks. Over the 10-year horizon, the exchange rate explains between 9.04 and 24.7% of variations in the nonfood price. However, in the short and long run, only about 2.5% and 5.6% of the variation in nonfood price change can be accounted for by extracting from the crude oil market.

Table 7. Variance Decomposition of Food and Nonfood in the Developed Model

Food Model						
Period	***OPRO***	***GLOB***	***OPRI***	***MONP***	***REXR***	***FOOD***
1	0.797	0.000	0.024	5.259	0.289	93.626
2	1.363	0.031	0.852	4.307	2.549	90.896
3	1.465	0.055	1.138	4.237	3.100	90.002
4	1.483	0.072	1.196	4.290	3.206	89.751
5	1.486	0.084	1.202	4.320	3.224	89.681
6	1.486	0.094	1.202	4.331	3.227	89.658
7	1.486	0.102	1.202	4.333	3.227	89.647
8	1.485	0.108	1.203	4.334	3.227	89.640
9	1.485	0.114	1.203	4.333	3.228	89.633
10	1.485	0.119	1.204	4.333	3.228	89.628
Non-Food Model						
	OPRO	***GLOB***	***OPRI***	***MONP***	***REXR***	***NFOOD***
1	0.122	0.733	1.512	0.009	9.043	88.578
2	0.544	0.454	2.370	0.417	20.447	75.765
3	0.572	0.464	2.451	0.643	22.963	72.904
4	0.573	0.623	2.407	0.785	24.051	71.559
5	0.565	0.888	2.329	0.872	24.550	70.792
6	0.556	1.228	2.258	0.927	24.772	70.257
7	0.548	1.614	2.207	0.961	24.848	69.819
8	0.540	2.024	2.178	0.983	24.84	69.427
9	0.534	2.441	2.168	0.998	24.797	69.060
10	0.528	2.851	2.172	1.008	24.728	68.712

Source: Research finding.

In addition, we are interested in examining the exchange rate pass-through into food and nonfood inflation. The degree of exchange rate pass-through refers to the rate of variations of exchange rate changes to price level changes. Based on the arguments of Anh Pham (2019) and Leigh and Rossi (2002), the coefficient of pass-through is extracted by dividing price level change in response to the initial exchange rate shock by the accumulated exchange rate change in response to its shocks. From Table 8, we can conclude that the degree of exchange rate pass-through for nonfood inflation is much higher than for food inflation. For instance, for the first period, the pass-through coefficient for food and nonfood are 0.017 and 0.04, respectively, which means that a 1 percent increase in the exchange rate will cause the price of food and nonfood by 17 and 4 percent, respectively.

Table 8. Exchange Rate Pass-Through into Food and Nonfood Inflation

	Food Model	**Non-Food Model**
1	0.017	0.04
2	0.04	0.06
3	0.02	0.04
4	0.10	0.03
5	0.04	0.02
6	0.01	0.019
7	0.009	0.015
8	0.004	0.012
9	0.003	0.010
10	0.002	0.008

Source: Research finding.

6. Robustness Check

6.1 The Baseline Model After and Before Economic Sanction

Given the importance of economic sanctions in the Iranian economy regarding macroeconomic variables, in this section, we divide the whole sample into the pre-sanction period (April 2004 to December 2011) and the post-sanction period (January 2012 to March 2018) to examine the effect of economic sanctions against Iran. Generally, the results illustrated that an oil structural shock could lead to differential food and nonfood price responses, depending on pre- and post-sanction times.

Figure 10 shows that one standard deviation unit of oil-specific demand shock caused by supply disruptions can lead to an immediate and more significant increase in food prices into the post-sanction period, as compared to the pre-sanction period, which is in line with Esmaeili and Shokoohi (2011), and Pal and Mitra (2018), who found a positive correlation between oil and food prices. Therefore, in oil-dependent countries, if the economy faces unexpected shocks caused by the price of export goods, including oil, it raises income and domestic demand; these, in turn, increase labor demand and wages. In this situation, the production of goods in the non-tradable sector increases, decreasing the profit of the export sectors. Finally, the impact of the oil price impulse leads to a decrease in money supply and an increase in the real exchange rate; this, in turn, increases the total Inflation in the economy, including food and nonfood prices.

The increase in the price of crude oil affects food inflation through another channel. In recent years, the policy of some food-producing countries has been to produce biofuels from agricultural products, especially grains. With the increase in the price of crude oil, these countries reduce the supply of their products to the world markets for fuel production and increase the price of food, which can be transferred from the world markets to the Iranian market.

Additionally, it could be observed from Figure 10 that in the short run, one-unit standard deviation disruptions of the aggregate demand oil shock driven by global activity cause a change in food by -0.001% and 0.001 after and before economic sanction, respectively; in the long run, this impact disappears. Also, in pre-sanction and post-sanction periods, one standard deviation of oil supply unanticipated disruptions of food price is negative in the short run. However, the food price change response to the oil supply shock remains negative for the medium and long term in the post-sanction period, but it becomes favorable for the pre-sanction period.

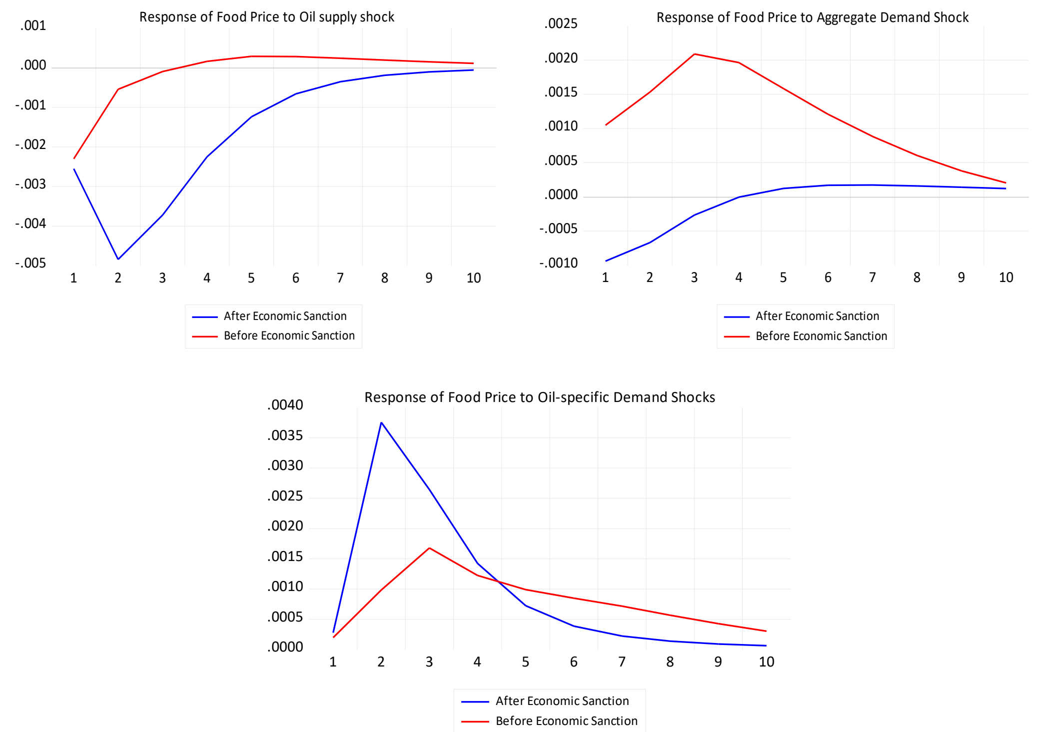

Figure 10. Impulse Response Functions of Food Price to Structural Shocks in Sanction Model
Source: Research finding.

Regarding the nonfood market, we observed that the price of nonfood items to oil supply shock declined in two months, both before and after the economic sanctions. However, these negative impacts were more for the post-sanction period. In the medium and long term, these adverse effects gradually disappear. It is evident from Figure 11 that the response of the nonfood change for the post-sanction duration to one standard deviation shock in oil-specific demand in the initial years is positive and incremental, while this trend decreases from the second month. However, before the economic sanctions, the oil-specific demand shock did not have much effect on the nonfood prices, and it was in its equilibrium almost throughout the ten periods. In addition, one standard deviation of aggregate demand shock to the nonfood price into post-sanction duration rather than pre-sanction year is positive. It continues to be positive in the long run.

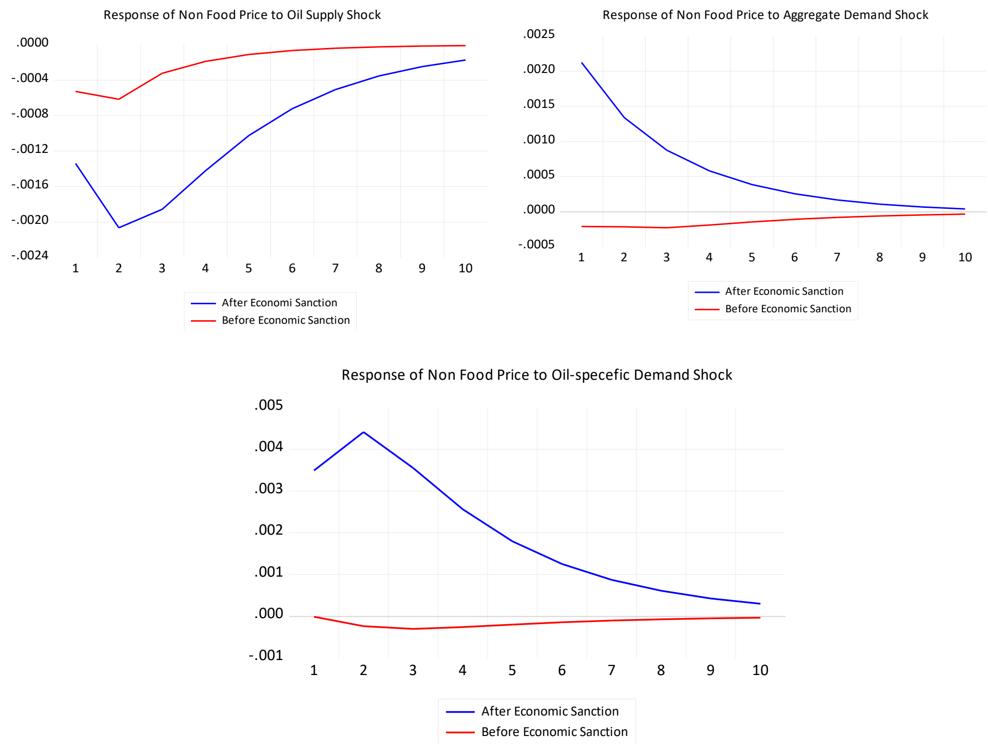

Figure 11. Impulse Response Functions of Nonfood Price to Structural Shocks in Sanction Model
Source: Research finding.

6.2 The Baseline Model by Oil Price Volatility

In the following sensitivity analysis, in line with the studies of Ahmed and Wadud (2011) and Wang et al. (2014), we have used the alternative form of oil price as volatility-adjusted oil price. Using Lee et al. (1995), the oil price volatility is calculated by the generalized autoregressive conditional heteroscedasticity (GARCH) (1,1) model of the oil price, and the AR (1) model has been used as the mean equation. The oil price volatility, based on Lee et al. (1995) in a GARCH (1, 1) framework, is presented as follows:

$$OPRI_t = \alpha + \sum_{i=1}^{K} \beta_i OPRI_{t-i} + u_t \quad (8)$$

$$u_t = e_t\sqrt{h_t} \ \sim N(0,1) \quad (9)$$

$$h_t = \theta_0 + \theta_1 u_{t-1}^2 + \theta_2 h_{t-1} \quad (10)$$

$$VOLO_t = max\left(0, \frac{\hat{u_t}}{\sqrt{h_t}}\right) \quad (11)$$

where $u_{t\ it}$ refers to the residuals of oil price from the VAR model; $h_t$is the conditional variance and $VOLO_t$ shows the oil price volatility. The experimental results of volatility-adjusted oil price estimation can be seen in Table 9. However, the coefficient of AR (1) and GARCH (-1) is significant at the 5% level, while we observed that RESID (-1) ^2 was significant at the 10% significance level.

Table 9. GARCH (1,1) for Crude Oil Price

Variable	Coefficient	z-Statistic	Prob
C	0.35	0.62	0.52
AR (1)	0.17**	1.92	0.05
Variance Equation			
C	9.894548**	1.986970	0.0469
RESID (-1) ^2	0.256325***	1.788248	0.0737
GARCH (-1)	0.463211**	2.260930	0.0238
R^2 = 0.10 D.W= 1.60			

Source: Research finding.

Note: (*) Denotes statistical significance at a 1% level. (**) Denotes statistical significance at the 5% level.
(***) Denotes statistical significance at the 10% level.

According to Figure 12, the most significant fluctuations in oil price volatility occurred between 2008 and 2009 at the same time as the great depression happened.

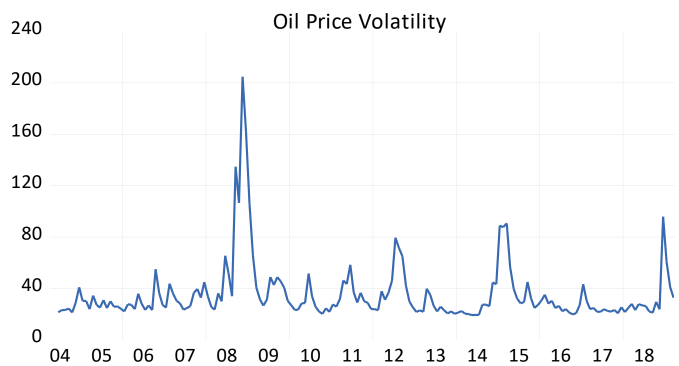

Figure 12. Oil Price Volatility
Source: Research finding

Figure 13 indicates the vector $Y = [OPRO_t, GLOB_t, VOLT_t, FOOD_t(NFOOD_t)]$ impulse response functions to one standard positive innovation to the three structural oil supply and demand cases. The graph of the impulse responses of the food price illustrates that one standard deviation shock to crude oil price volatility tends to increase the Inflation of food in the short run; meanwhile, after two years, a one-time positive shock to oil volatility could have a negative and persistent impact on the food price.

The story is different about the price of nonfood items. Throughout the ten years, the response of the nonfood price to one standard deviation shock in oil volatility is positive. In the short term, these positive effects are weaker; however, in the long term, they are more robust. The findings suggest that a one-time positive shock to the oil supply hurt food and nonfood prices in a short period; in the long run, this effect disappeared. In addition, the graph of the impulse responses of food and nonfood changes shows that one standard deviation disruption to the aggregate demand driven by global activity tends to reduce the food price after five periods and the nonfood price after two years.

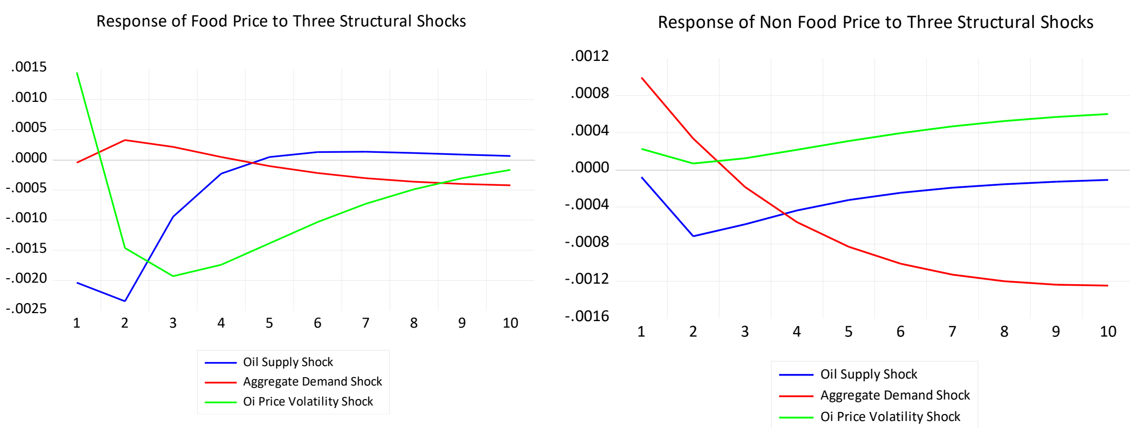

Figure 13. Impulse response functions of food and nonfood prices to structural shocks in the volatility model

Source: Researcher's findings

7. Conclusion and Policy Implications

Considering the importance of food supply in the process of economic development, the issue of food security has always been discussed in developing countries, including Iran, and the variable of food prices, as a key factor affecting the supply and demand for agricultural products, has been the focus of policymakers. In addition, food price changes are one of the most critical challenges facing policymakers because they adversely affect society's welfare, especially the poor and low-income groups. On the other hand, oil price fluctuations are one of the primary sources of economic fluctuations in oil-producing countries, in such a way that a sudden increase in oil revenues leads to an increase in foreign exchange earnings from the sale of crude oil; this, in turn, leads to the

growth of wages and prices. Therefore, in this paper, we used a structural vector autoregression (SVAR) model to estimate the impact of oil structural shock on the price of food in Iran from April 2004 to March 2018. Following Kilian (2009), identified three different structural shocks: oil supply, oil demand, and oil-specific demand shocks. Also, in addition to food responses to oil structural shocks, we were looking at the effects of these disturbances on nonfood prices to compare these two groups.

The empirical evidence derived from estimating a SVAR for Iran's economy indicated that oil-specific demand disruptions positively affect food and nonfood prices in Iran; this effect could be more for food than nonfood in the short and medium term. Additionally, we found that oil supply shock hurt the food and nonfood models, especially in the short period. More interestingly, based on the variance decomposition function results, the explanatory power of three structural oil price shocks on food and nonfood blocks was small in the short run. In contrast, the explanatory power of three supply and demand oil shocks for the nonfood model was more substantial than that of food prices. Moreover, the response of food and nonfood models to one standard deviation shock in the exchange rate was strongly positive, while monetary policy shocks had a different impact. Generally, the results showed that an oil structural shock could lead to differential responses of food and nonfood prices, depending on the pre- and post-sanction times.

The findings revealed that an oil-specific demand shock had an immediate and more significant positive effect on food prices in the post-sanction period as compared to the pre-sanction period. Also, oil price volatility shocks have a much more significant influence on food price change than oil-market-specific demand shocks; meanwhile, this connection is the opposite for nonfood price change.

It is suggested that considering the adverse effects of sanctions on Iran's economy in the short term, in order to reduce the economic access to food, support policies should be used; in the long term, it is possible to allocate part of the oil resources for infrastructure investments and the use of new technologies. In the agricultural sector, it could provide the basis for sustainable and stable food production in the country. Also, consider the effect of money supply and exchange rate on the price of food and nonfood items; therefore, controlling the fluctuations of these two critical variables has a significant impact on inflation control, which should be on the agenda of policymakers. At the level of the economy as a whole, it is possible to control the price of food through the policies of curbing the inflation rate and stabilizing the exchange rate by two independent monetary and financial policymakers, thus ensuring food security in the country. Finally, because the increase in the price of food restricts vulnerable sections of society's access to sufficient food, it is considered a severe threat to society's food security. So, policymakers should be more subtle and careful; in other words, policies should aim to reduce and eliminate dependence on oil income.

Statements and Declarations

- Funding: This work does not receive any funding.
- Conflict of interest: The authors declare that there is no conflict of interest.

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Cite this article: Mahmoudinia, D., Hosseini Kondelaji, M. H., & Mostolizadeh, S. M. (2025). A Response of Food and Non-Food Price Changes to Global Oil Structural Shocks: Evidence from SVAR to the Iran Economy. *Iranian Economic Review, 29*(3), 1098-1136.