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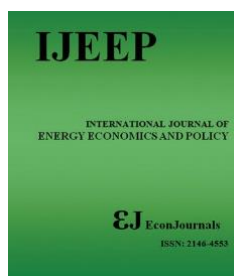
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Empirical Analysis of the Reflection of Oil Prices on Inflation in Türkiye

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ABSTRACT

Changes experienced during the globalization process also have an impact on oil prices. As a matter of fact, the change in oil prices also affects the increase in the general levels of prices. It is inevitable that we will see the measurement of these price changes in the countries most dependent on imports. In this context, Turkey, which is the sample country discussed within the framework of this study, is a country dependent on imports in terms of oil, making increases in the general levels of inflation in this country inevitable. Considered from this framework, the study investigated the relationship between oil prices and inflation for the 2004-2022 period through causality analysis. As a result of the analysis, a positive relationship was determined from oil prices to inflation. In addition, according to the results of the Granger causality test, it was determined that inflation was not the Granger cause of oil prices. In other words, within the framework of this country, the relationship between both variables is one-sided.

Keywords: Macroeconomy, Oil Price, Inflation, Granger Causality, Türkiye

JEL Classifications: O13, Q43, E31

1. INTRODUCTION

Today, the world is facing problems in coping with the impact of oil prices, the increasing use of energy resources in both domestic and commercial activities, and changes in economic growth and inflation rates (Kamber and Wong, 2020; Kehagias and Riotto, 2018). The increase in human needs also affects the increase in production. Production requires energy resources to meet human needs. For a long time, people have been dependent on traditional energy sources, leading to depletion. Capitalists' risk perception is significantly affected by oil price fluctuations. An increase in oil prices can increase the costs of companies operating in energy-intensive sectors in particular, thus narrowing their profit margins. This situation strengthens investors' risk perception and creates uncertainty in capital flows. Foreign investors are hesitant to invest in places that are uncertain and risky, but they are also eager to invest in nations that have political and economic stability (Akbulaev et al., 2020).

Economic growth can slow down due to high energy prices, as consumers' spending habits change, and rising production costs slow down economic activity. In addition, oil price fluctuations can have indirect effects, especially in non-energy sectors, as high energy costs can negatively affect consumer demand and thus slow down the pace of growth. Economic growth, which is a key indication of a nation's growing economic share, is a key factor for any nation. Economic growth is a term that is often used to refer to the increase in gross domestic product (GDP) (Huseynli, 2022a, b). Considering such uncertainties, investors may adopt more cautious investment strategies, which may lead to increased volatility in the markets (Bernanke, Gertler, & Watson, 1997).

It is the aggregate demand-aggregate supply (AD-AS) model that explains the relationship between the overall demand and supply of goods and services in an economy. An increase in aggregate demand or a decrease in aggregate supply can lead to higher levels of inflation

due to excess demand and resource scarcity. This model emphasizes the importance of managing the balance between supply and demand to maintain price stability and economic growth (Mankiw, 2014).

Husaini and Lean (2021) argue that the impact of hydrocarbon prices on the price level differs depending on the net exporter and importer and the trade volume. Small amounts of hydrocarbon revenue may appreciate the local currency, thus ultimately reducing inflation (Fisher and Huh, 2002). On the contrary, a higher amount of hydropower revenue allows the economy to adopt expansionary fiscal and monetary policy; thus, it can increase the price index (Kim and Roubini, 2008). According to macroeconomic theory, domestic inflation and local currency value are inversely proportional (Uzoma et al., 2012).

Changes in energy prices and other macroeconomic variables can affect inflation expectations (Goetz et al., 2021), which in turn can affect real inflation rates (Alstadheim et al., 2021). Changes in oil prices have an important place in determining economic performance. Price stability and low inflation are also key policy objectives that policymakers aim for.

The heavy dependence on oil and fossil fuels for energy consumption in many countries (Shahbaz et al., 2018a and b) further complicates matters. Factors such as suppressed demand for oil and services, base effects on annual inflation growth rates, and disruption of supply chains due to COVID-19 have led to expectations that inflation rates will increase (Ahmed et al., 2023).

There are also many studies investigating the effect of oil prices on inflation. As a result of the studies, it has been revealed that oil prices have both a positive and negative relationship with inflation. Ahmed and Wadud (2011) found that the relationship between oil prices and inflation is negative. In this regard, Iwayemi and Fowowe (2011) and Roeger (2005) found in their studies that there is no relationship between oil prices and inflation. Cologni and Manera (2008) found the effect of oil prices on inflation.

Considering the above facts, it is vital to investigate the links between inflation and the macroeconomy through oil prices in recent crises (e.g., COVID-19) (Ahmed et al., 2023). Considering that inflation has been at its highest levels in Turkey in recent years, it is important to examine the causal relationship between inflation and oil prices.

2. LITERATURE REVIEW

2.1. Oil Prices

Every country in the world feels the impact of changes in crude oil prices. The impact of oil prices is especially effective because the economies of developing countries are not financially stable and are vulnerable to the effects of external shocks. One of the main effects of changes in oil prices is the inflation rate (Sek et al., 2015). Oil prices have a significant impact on exchange rates (Akram, 2004; Charfeddine and Barkat, 2020). In a study by Akram (2004), the increase in oil prices is associated with the appreciation of exchange rates in oil-exporting countries (e.g., Russia). However, as oil and gas revenues increase in Qatar, the

real exchange rate decreases (Charfeddine and Barkat, 2020).

Crude oil forecasts are important in making any fundamental macroeconomic decision. It is also an important financial outcome in managing options, risks, and portfolios. Numerous models exist to predict crude oil prices and volatilities (Haque and Shaik, 2021). Oil price shocks have been examined from the perspectives of both oil exporters and oil importers in various studies (Baek and Yoon, 2022; Lawal et al., 2020; Mohsin et al., 2021; Nasir et al., 2018; Nguyen and Nasir, 2021; Wang et al., 2020; Wu et al., 2018). For instance, higher oil prices lead to a decrease in total income in oil-importing countries and a decline in foreign demand for oil produced in oil-exporting countries. The impact of oil revenues on the economy in countries rich in natural resources is unclear (Shahin et al., 2021).

2.2. Inflation

Inflation has always been a concern for economists. Since inflation affects both economic and social development, economic actors make most of their decisions based on inflation expectations (Bernoth and Ider, 2021; Salisu et al., 2017). Both renewable energy and non-renewable energy sources are responsible for the fluctuation in the inflation rate, but non-renewable energy sources are more likely to trigger the inflation rate (Talha et al., 2021).

A country's economic growth rate also affects its inflation rate. Both high and low economic growth in a country bring about fluctuations in the inflation rate (Sun et al., 2020). The increase in investments is necessary for the purposes of economic growth, limiting inflation and unemployment, and creating new jobs (Guliyeva and Rzayeva, 2017). Fluctuations in inflation or price levels can also lead to economic changes that will affect economic performance overall. For this reason, the inflation rate is seen as the main economic indicator that shows the economic situation and performance (Sek et al., 2015).

2.3. Literature Review

Hooker (2002) examined the relationship between oil prices and inflation in the sample years 1962-1980 and 1981-2000 and showed that oil prices had a significant effect on inflation in the first sample period but did not have this effect in the following period. Cunado and De-Gracia (2005) found that oil prices have a permanent effect on inflation in the short term and that oil prices have an asymmetric effect on the production index. Using data from 1985 to 2011, Chen and Wen (2011) find that oil price shocks have no effect on trend inflation, but the effect is temporary through the headline or core.

Chou and Tseng (2011) investigated the pass-through of oil prices on CPI inflation in a group of developing Asian countries. Ibrahim (2015) investigated the relationship between food and oil prices in Malaysia using a non-linear ARDL model. Rehman et al. (2019) found that the impact of the oil price on the inflation rate is different from the cost of credit, which affects the real inflation rate as well as economic growth. Rostin et al. (2019) investigated the impact of crude oil prices on inflation, interest rates, and economic growth in Indonesia during the period 2001-2017.

Qiang et al. (2019) investigated oil prices and the inflation rate in Algeria and determined the relationship between the two. They collected data on the inflation rate and oil price volatility through a time series from 1970 to 2014. Qiang et al. (2019) As a result of the study conducted in Algeria, a significant relationship was found between the decrease in oil prices and the inflation rate. The result of the study by Alekhina and Yoshino (2019) revealed that the relationship between oil prices and the inflation rate has a more significant impact in IT countries than in non-IT countries. Nouria et al. (2019) examined how oil prices support inflation by monitoring the volatility note. Alekhina and Yoshino (2019) examined inflation targets and systematics in oil prices.

Wang et al. (2019) suggested that upper-middle-income countries with growing urban populations (e.g., Albania, Brazil, Cuba, and Malaysia) should be aware that high energy consumption could lead to tightening of monetary conditions, increased global inflation, and an economic slowdown. Galadima and Aminu (2019) revealed that changes in real GDP and money supply affect natural gas consumption in both the short and long term, while changes in inflation affect it more in the short term. Talha et al. The study by (2021) examined the impact of oil prices, energy consumption, and economic growth on the inflation rate in Malaysia. Chandrarin et al. (2022) measured the volatility spread using Indonesia's daily data from 2002 to 2021.

The study by Amor (2023) analyzed the effect of the change in exchange rates on inflation in Indonesia in the period 2000-2020. Ahmed et al. (2023), using monthly data from the United Kingdom from January 2010 to June 2022, examined the connection between inflation and macroeconomic factors such as production, trade balance, and unemployment reflected in crude oil prices.

3. RESEARCH METHODOLOGY

3.1. Purpose of the Study and Data Set

In the study where the relationship between inflation and oil prices was discussed with the 2004-2022 annual data of the Turkish economy, the data for both variables were obtained from the World Bank database. The values of oil prices are included in the analysis with their logarithmic results.

3.2. Analysis Method

If there is a time-delayed relationship between two variables, one of the tests used to statistically determine the direction of causality of the relationship is the Granger causality test. Granger's definition of operational causality is based on the following assumptions.

The future cannot be the cause of the past. Strict causality is only possible if the past causes the present or the future. The cause always occurs before the effect. This necessitates a time delay between cause and effect. Causality can only be determined for a group of stochastic processes. It is not possible to know causality between two deterministic processes. Granger (1969) developed a relatively simple test that identifies causality between variables. Granger causality test, in which there are two variables such as Y_t and X_t , is required as the first step of estimating the VAR model

below. Error terms are a clean sequence process with no correlation between them.

4. ANALYSES AND RESULTS

Time Series Techniques were used in this study. In this context, the characteristic features of the series are examined, and the stationarity structure indicators of the series are revealed by the ADF test. Then, the relationship between the variables according to their stationarity structures is examined with cointegration techniques (Cointegration analysis, Engel-Granger) and the equation showing their relationships is obtained. Granger causality test was used to reveal the causality relationship between variables. The variables used in the analysis and the model of the variables are included in Equation 1.

$$Y = f(\text{Inflation, Oil price}) \quad (1)$$

When the function is revised, the following equation is finally obtained (Equation 2).

$$Y = \beta_0 + \beta_1 \text{inf} + \beta_2 \text{Logoilprices} \quad (2)$$

Logarithmic values of oil prices included in the analysis are included in the analysis. Then, the analysis was started step by step. First, it was tested whether the variables were stationary at their level values. The results of the test are given in Table 1.

As can be seen from Table 1, our variables are not stationary in level. For this purpose, the variables were tested again to measure the degree to which they were stationary. According to the ADF test results in Table 2, it is seen that both variables are second-order stationary.

The outcomes of the empirical model are greatly influenced by the stationarity of the series that are employed in econometric models.

Table 1: Level values of series

ADF test result	Inflation		Oil price	
	t-statistics	Possibility	t-statistics	Possibility
ADF testing statistics	2.187748	1.0000	-2.547776	0.1216
Test critical values				
1%	-3.959148		-3.857386	
5%	-3.081002		-3.040391	
10%	-2.681330		-2.660551	

Table 2: Stationarity level of second order series

ADF test result	Inflation		Oil price	
	t-statistics	Possibility	t-statistics	Possibility
ADF testing statistics	-2.762762	0.0146	-4.489666	0.0038
Test critical values				
1%	-2.540613		-3.959148	
5%	-1.968430		-3.081002	
10%	-1.604392		-2.681330	

Table 3: Appropriate delay length

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-48.46019	NA	8.068451	7.763107	7.850022	7.745242
1	-38.87677	14.74373	3.473958	6.904118	7.164864	6.850523
2	-36.31955	3.147352	4.635429	7.126084	7.560660	7.036759
3	-30.63220	5.249860	4.241162	6.866492	7.474899	6.741437
4	-10.26327	12.53472*	0.502936*	4.348196	5.130434	4.187411
5	-0.305028	3.064076	0.517361	3.431543	4.387611	3.235028
6	669.2592	0.000000	NA	-98.96296*	-97.83306*	-99.19520*

*Indicates the appropriate lag length for the relevant test

Table 4: Granger causality test

Hypotheses	F-value	Probability value (P)	Decision at 1% significance level
The change in oil prices is the reason for the change in the inflation rate.	22.257448	0.0092	Acceptable
The change in inflation rates is the reason for the change in oil prices.	0.832695	0.6595	Rejected

In other words, whether or not the series being analyzed are stationary has a considerable impact on the results. When the series remain stationary, there is no lasting impact from any shock, and the series moves around a set long-term average (Huseynli, 2023). In this research, analysis began when stationarity was reached.

After determining the stationarity levels of the variables, an attempt was made to determine the appropriate lag length. As can be seen in Table 3, the appropriate delay length was determined as six.

Before moving on to causality analysis, important assumption tests were carried out. Later, Granger analysis was put into practice. Granger analysis results are given in Table 4. As can be seen from the table, there is a unilateral effect between the variables. As a result, the H_1 hypothesis is accepted, as the changes in oil prices have a positive effect on inflation. In other words, the change in oil prices in this country actually increases inflation rates. However, otherwise, it has been concluded that inflation rates do not affect oil prices. In this case, the H_1 hypothesis is rejected and the H_0 hypothesis is accepted.

5. DISCUSSION AND CONCLUSION

Chou and Tseng (2011) found evidence of a long-term pass-through effect of oil on CPI inflation in most countries, but the short-term results were not significant. Jiranyakul (2015) also could not detect the long-term effect of oil price shocks on consumer prices in the Thailand example. Ibrahim (2015) found a long-term relationship between increases in oil prices and food prices.

Rostin et al. (2019), as a result of the study, revealed that crude oil prices do not have long-term and short-term effects on inflation, but crude oil prices have long-term and short-term effects on the interest rate. As a result of the study conducted by Noura et al. (2019) using data obtained from 19 different industrialized

countries, it was found that high or lower oil prices affect inflation in national and international industrial markets. During extreme market volatility, Chandrarin et al. (2022) established a link between foreign exchange and inflation, as they rise together.

Ahmed et al. The result of the study conducted by (2023) reveals that other economic indicators initially decrease in cases of inflation shocks. However, Brent crude oil shocks were the fastest to respond to rising inflation compared to other indicators, rising to a positive level in just 1 month. In addition, the impact of inflation shocks is strong in the first quarter and decreases in the long term.

Among energy resources, oil ranks first in terms of consumption. Therefore, an increase in oil prices has direct or indirect effects on a country's economy. More than 90% of Turkey's crude oil needs depend on imports. Accordingly, socio-political, and socio-economic events that affect oil prices in general also directly and indirectly affect inflation rates in Turkey. At the same time, the high tax rates applied to petroleum products in Turkey also cause oil prices to affect inflation.

In this study, the effect of the change in oil prices on inflation in Turkey is tried to be examined; Annual data for the periods 2004-2022 were examined. As a result of the analysis, results compatible with the general theory were obtained. Namely, the increase in crude oil prices in Turkey has a triggering effect on inflation.

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