

# The Asymmetric Effect of Oil Prices on Consumer Prices: Asymmetric ARDL (NARDL) Method

Rümeysa Erkan

Bursa Uludag University, Department of Economics, Bursa, Turkey

[rumeysaerkan@uludag.edu.tr](mailto:rumeysaerkan@uludag.edu.tr)

Received: 9 November 2020; Accepted: 15 May 2026.

**Summary:** The aim of this study is to examine the asymmetric effects of oil prices and exchange rates on consumer prices in the Turkish economy. Using the NARDL method and covering the period 1987:Q3–2025:Q1, the study analyzes whether price movements affect consumer prices differently depending on their direction. The results show that increases in exchange rates and oil prices have a stronger effect on inflation than decreases do. In other words, there is an asymmetric relationship between oil prices, exchange rates and consumer prices. In light of these findings, the diversification of energy supply and the promotion of domestic production of intermediate goods are highly important for reducing cost-push inflationary pressures. In addition, adopting a flexible taxation structure, enhancing market competition, and increasing price transparency can improve downward price flexibility. Finally, maintaining a credible monetary policy framework and implementing an effective communication strategy are crucial for keeping inflation expectations under control.

**Keywords:** Oil price, Consumer prices, Exchange rate, Asymmetric effect, NARDL model

**JEL:** C32, E31, F31, N70

Oil has been the most important source of energy since the past century and accounted for approximately one-third of global energy consumption in 2024. According to current data, 79.2% of the world's total oil reserves are held by OPEC member countries, and 91.7% of these reserves are concentrated in six countries: Venezuela (24.4%), Saudi Arabia (21.5%), Iran (16.8%), Iraq (11.7%), the United Arab Emirates (9.1%), and Kuwait (8.2%). Moreover, the ten largest oil-consuming countries—the United States, China, India, Saudi Arabia, Russia, Japan, South Korea, Brazil, Canada, and Germany—accounted for 61% of global oil consumption in 2024 (OPEC Annual Statistical Bulletin 2025; BP Statistical Review of World Energy 2025). Owing to increasing oil consumption, many countries—both producers and consumers—are significantly affected by movements in crude oil prices. Therefore, understanding oil price movements is crucial for the effective management of both energy markets and economic policy as a whole.

This study investigates the asymmetric effects of oil prices and exchange rates on consumer prices in Turkey using the NARDL model. The results show that a 1% increase in oil prices increases consumer prices by 0.555% (0.114%) in the long term

(short term), whereas a 1% decrease in oil prices decreases consumer prices by 0.206% (0.071%) in the long term (short term). On the other hand, a 1% increase in the exchange rate increases consumer prices by 0.686% (0.313%) in the long term (short term), whereas a 1% decrease in the exchange rate decreases consumer prices by 0.279% (0.093%) in the long term (short term). These findings reveal an asymmetric relationship between oil prices, exchange rates, and consumer prices, contributing to the understanding of inflation dynamics in Turkey.

This study consists of five sections, which are organized as follows: The first section presents the theoretical background of the pass-through effect from oil prices to consumer prices; the second section reviews the relevant literature; the third section explains the dataset and methodology; the fourth section presents the empirical analysis; and finally, the fifth section presents the conclusions and evaluation.

## **1. Oil Price Movements**

As the most important source of energy for the global economy, oil has the ability to directly influence the global economy through its price movements in the market. Therefore, analyzing the dynamics of oil price fluctuations is highly important for both economic policymakers and investors. Supply, demand and geopolitical developments are the most important determinants of oil price fluctuations. First, developments on the supply side have a direct effect on oil prices. Political instability, conflicts and attacks on production infrastructure in oil-producing countries lead to supply disruptions. This is particularly evident since the 2000s, with internal conflicts and production disruptions in countries such as Nigeria, Venezuela, Iraq and Iran serving as examples. Moreover, events such as the drone attack on Saudi Aramco in 2019, which temporarily reduced the country's production by almost half, also directly affect the global supply. In addition, the production restriction decisions made by the OPEC+ member countries are another important factor limiting the supply of oil and contributing to price increases. For example, while OPEC+ members accounted for 53% of global oil production in 2016, this share decreased to 47% in 2024 ([www.eia.gov](http://www.eia.gov)). On the demand side, the energy requirements of fast-growing economies in particular are exerting upward pressure on oil prices. Industrialization and economic growth in emerging countries such as China and India in particular are increasing their demand for oil and exerting upward pressure on global market prices. Conversely, a global economic slowdown can reduce demand and lead to lower prices. For example, global demand for petroleum products fell by 9% year-on-year in 2020 because of the impact of the COVID-19 pandemic ([www.eia.gov](http://www.eia.gov)). Finally, geopolitical events can also cause uncertainty in the oil market and lead to price fluctuations. The Arab Spring that emerged in 2011 and subsequent crises—particularly the conflicts in Syria, Libya and Yemen—have raised serious concerns about the security of oil supplies in the region. The withdrawal of the United States from the nuclear agreement with Iran in 2018 further exacerbated tensions in the region and led to supply shortages. In addition, the war between Russia and Ukraine, which began in 2022, has affected global energy supplies and led to sharp increases in prices.

In addition, factors such as natural disasters (especially hurricanes, tsunamis, etc.), speculative movements by investors in the oil market and technological advances in alternative energy sources that could reduce the demand for fossil fuels have an impact on the price of oil.

The effects of oil prices on consumer prices can be direct or indirect. The direct effect of high oil prices is that the prices of all energy products, such as household fuels, gasoline, diesel, gas and electricity, increase, and the intensity of energy use throughout the economy decreases (Edward A. Hudson and Dale W. Jorgenson 1978). This can lead to households and companies changing their spending habits and cause a significant change in the demand structure. The indirect effect of oil prices occurs through the prices of other goods that are close substitutes for energy consumption. As producers can pass on production costs to consumers, an increase in these costs can lead to changes in the prices of various goods and services. High oil prices can, for example, increase transportation and production costs, which can then be passed on to consumers. This can lead to higher prices for food, transportation and other consumer goods. However, the extent to which oil price increases are passed on to consumers depends on how important oil is for the production of a good or service and whether the oil price increase is permanent or temporary. On the other hand, according to Benjamin Hunt, Peter Isard and Douglas Laxton (2002), a rise in oil prices leads to a transfer of income from oil-importing countries to oil-exporting countries, which then leads to a decline in global demand. This is because the decline in demand in oil-importing countries is greater than the increase in demand in oil-exporting countries. As a result, this situation can exert indirect pressure on consumer prices.

## **2. Literature Review**

Oil prices play a critical role in sustainable economic growth for both developed and developing countries. Building on this, the core literature on the relationship between oil prices and consumer prices is based on the work of James D. Hamilton (1983). Hamilton (1983) argued that most recessions in the United States after World War II were caused by increases in oil prices. Therefore, the rise in oil prices is among the main reasons for recessions in the U.S. Following Hamilton (1983), Alessandro Cologni and Matteo Manera (2008) used a VAR analysis to examine the impact of the 1990 oil shock on inflation in the G7 countries. According to their results, the increase in inflation rates after one quarter was 0.39% for Canada, 0.01% for France, 0.01% for Germany, 0.2% for Italy, 0.39% for Japan, 0.24% for the United Kingdom and 0.6% for the United States. According to Weigi Tang, Libo Wu and ZhongXiang Zhang (2009), who analyzed data for China from 1998–2008 using the SVAR method, an increase in oil prices has a positive effect on inflation. According to Shahriyar Mukhtarov, Jeyhun Mammadov and Fariz Ahmadov (2019), who analyzed data for Azerbaijan from 1995 to 2017 using the Johansen cointegration and VECM methods, a 1% increase in oil prices increases inflation by 0.58%. Using VAR and MFDL estimators to analyze data for the United States from 1991 to 2017, Alexander Chudik and Georgios Georgiadis (2021) examined the pass-through of crude oil price increases

to gasoline prices. According to their results, approximately 12% of the increase in crude oil prices is passed on to gasoline prices on the day of the shock, approximately 23% within five business days and approximately 48% within twenty business days after the shock. According to Lutz Kilian and Xiaoqing Zhou (2023), who analyzed data for the United States from 1990 to 2023 using the VAR model, gasoline price shocks account for 69% of the changes in the monthly headline inflation rate, whereas they explain only 9% of the changes in the core inflation rate. According to Andrianady Andrianady Ravahiny J., H. Yves Razanajatovo and M. Fabienne Ravelomanantsoa (2024), who analyzed data for Madagascar from 1991 to 2020 using the ARDL model, an increase in oil prices of one unit leads to an increase in inflation of 9.21 units. Additionally, Knut A. Mork (1989), Pierro Perron (1989), Kiseok Lee, Shawn Ni, and Ronald A. Ratti (1995), Rebeca Jiménez-Rodríguez and Marcelo Sánchez (2005), and Juncal Cuñado and Fernando P. Gracia (2005) argued that there is a positive relationship between oil prices and inflation for various countries.

However, some authors have argued against the stability of this relationship. Examples of these studies are the works of James D. Hamilton (1996), Mark A. Hooker (2002), Olivier J. Blanchard and Jordi Galí (2008), Shiu-Sheng Chen (2009), Paul Segal (2011), and Victor Valcarcel and Mark Wohar (2013). The common conclusion of these studies is that the strong relationship between oil prices and inflation observed in the early 1970s weakened from the mid-1980s onward. This situation can be explained by the level of consumer prices in response to the shocks of the 1970s. For example, the price of oil rose from 3 dollars before the 1973 oil crisis to 40 dollars during the 1979 oil crisis. During this period, when the positive relationship between oil prices and consumer prices was evident, the consumer price index increased from 15.42 in 1972 to 65.54 in 1979 as a result of rising oil prices. After the mid-1980s, however, the relationship between oil prices and consumer prices began to weaken. In contrast, according to Patricia Renou-Maissant (2019), who analyzed data for the United States, Canada, Japan, Australia, Germany, France, Italy and the United Kingdom from 1991 to 2016 using the Phillips curve, the pass-through of oil prices to inflation increased significantly in all countries except Germany from the early 2000s until the global financial crisis. Similarly, Emin Erturk and Rumeysa Erkan (2021), who analyzed data for Turkey from 1980 to 2018 using the traditional Phillips curve and the SVAR method, found that the pass-through effect of oil prices on consumer prices increased in the period after 2002 compared with the previous period. However, this effect dissipated more quickly than it did before 2002. On the other hand, according to Saban Nazlıoğlu and Ugur Soytas (2011), who analyzed data for Turkey from 1994 to 2010 using the Toda–Yamamoto causality test, there is no relationship between oil prices and agricultural commodity prices.

According to James D. Hamilton (1988), oil shocks primarily affect the macroeconomy by suppressing demand for essential consumption and investment goods. If this is indeed the mechanism through which oil shocks affect the economy, then a decrease in oil prices would have no positive effect on the economy, whereas an increase in oil prices would have negative consequences. Therefore, the nonlinear relationship between oil prices and consumer prices is important. Studies have focused

on the asymmetric relationship between oil prices and consumer prices. The first of these studies, conducted by Javier F. Mory (1993) for the period 1951–1990 in the United States, showed that positive changes in oil prices have a greater effect on consumer prices, whereas the effect of negative changes in oil prices is close to zero. Similarly, according to Mark A. Hooker (2002), positive and negative oil price shocks have different effects on core inflation. According to Mohammad R. Farzanegan and Gunther Markwardt (2009), who used the VAR method to analyze data for Iran from 1975 to 2006, both positive and negative oil price shocks increase inflation rates. However, the effect of negative oil price shocks on inflation is greater. According to Huson J.A. Ahmed and IKM Muhtarul Wadud (2011), who analyzed data for Malaysia from 1986 to 2009 using the EGARCH method, oil price shocks have an asymmetric effect on industrial production and inflation in Malaysia. According to Mansor H. Ibrahim (2015), who analyzed data for Malaysia from 1971 to 2012 using the NARDL method, there is an asymmetric relationship between food prices and oil prices in both the short term and long term. The study showed that an increase in oil prices leads to an increase in food prices, whereas the reverse is not statistically significant. According to Sangyup Choi et al. (2017), who analyzed data from 1970 to 2015 for 72 developed and developing countries, a 10% increase in global oil prices increases domestic inflation by approximately 0.4 percentage points, and this effect disappears after two years. In addition, positive oil price shocks have greater effects than negative shocks do. According to Umar Bala and Lee Chin (2018), who analyzed data for Algeria, Angola, Libya, and Nigeria from 1975 to 2015 using the NARDL method, both increases and decreases in oil prices increase the inflation rate. However, the impact of a decrease in oil prices on inflation is greater than that of an increase. According to Siok Kun Sek (2019), who analyzed data for India, Japan, Korea, Singapore and the United States from 1965 to 2014 using the NARDL method, domestic prices in oil-exporting countries react more strongly to declines in oil prices, whereas domestic prices in oil-importing countries react more strongly to increases in oil prices. According to Sani Bawa et al. (2020), who examined data for Nigeria from 1999 to 2018 using the NARDL model, an increase in oil prices leads to an increase in inflation, whereas a decrease in oil prices leads to more moderate inflation. According to Hakan Yilmazkuday (2021), who analyzed data for the United States from 2008 to 2015 using the SVAR method, 13% of the effect of oil prices on consumer prices occurs after one week (0.5%), 37% after three months (1.5%) and the remaining 50% in the long term (4.2%). According to Ankita Sarmah and Debi Prasad Bal (2021), who analyzed data for India from 1997 to 2016 using the SVAR method, increases in oil prices have a positive effect on inflation, whereas decreases have a negative effect. According to Leila Ben Salem, Ridha Nouira and Christophe Rault (2024), who analyzed data for five oil-exporting countries (Russia, Canada, Norway, Brazil and Mexico) and five oil-importing countries (China, the U.S., South Korea, Germany and the Netherlands) from 2009 to 2021 using the NARDL model, an increase in oil prices generally has a positive effect on sectoral inflation, whereas a decrease in oil prices has a weak effect on sectoral inflation. In addition, China was found to be the country that was the most sensitive to changes in oil prices.

On the other hand, few studies have examined the asymmetric relationship between oil prices and consumer prices in Turkey. According to Sefa Erkus and Huseyin Karamelikli (2016), who analyzed data for Turkey from 2003 to 2015 using the NARDL method, an increase in oil prices has a positive effect on consumer prices, whereas the effect of a decrease in oil prices on consumer prices is not statistically significant. According to Halil Altıntaş (2016), who analyzed data for Turkey from 2000 to 2013 using the NARDL method, a 1% increase in oil prices leads to a 0.47% increase in food prices, and a 1% decrease in oil prices leads to a 0.19% decrease in food prices. According to Utku Utkulu and Ramazan Ekinçi (2016), who analyzed data for Turkey from 2003 to 2015 using the NARDL method, a 1% increase in oil prices leads to a 0.8% increase in food prices, whereas a 1% decrease in oil prices leads to a 0.1% decrease in food prices. According to Bilgin Bari and Zafer Adali (2020), who analyzed data for Turkey from 2009 to 2020 using the NARDL method, changes in consumer prices can be explained only by oil price increases, as the effects of oil price decreases are much more limited than those of oil price increases. According to Haydar Karadag (2021), who analyzed data for Turkey from 2010 to 2020 using the Phillips–Ouliaris cointegration test and the Granger and Bootstrap causality tests, increases in oil prices lead to higher production costs in industry, which in turn leads to an increase in the consumer price index. According to Nezir Kose and Emre Unal (2021), who analyzed data for Turkey from 1988 to 2019 using the SVAR method, the effect of oil prices on inflation is limited in the first few months but leads to an increase in the following months.

Looking at the literature as a whole, there is a general consensus that there is an asymmetric relationship between oil prices and inflation rates, despite the differences between time periods. However, oil prices can have different effects in each country because of various factors, such as verbal agreements, different tax structures and regulations or the country's position as a net importer or exporter of oil. In addition, similar results have been observed in studies conducted in Turkey. However, the sample periods of these studies end at the beginning of 2020. Therefore, there are no studies examining the asymmetric effects of oil prices on consumer prices during the postpandemic period. Starting from this gap in the literature, the main research question of this study is whether the impact of oil prices on consumer prices is asymmetric in a sample covering the period after the COVID-19 crisis and the conflict between Russia and Ukraine.

### **3. Data and Methodology**

#### **3.1 Data**

In this study, in which the asymmetric relationship between oil prices and consumer prices is examined, quarterly data consisting of 151 observations from 1987:Q3 to 2025:Q1 are used. The relevant period is selected on the basis of data availability. The model consists of Brent crude oil prices (OIL), which are important determinants of global oil prices, the consumer price index (CPI) and the nominal exchange rate (EXC). Brent crude oil prices are measured in Turkish lira (TL) per

barrel, while the exchange rate is expressed as the TL equivalent of one U.S. dollar (USD). Therefore, an increase in the exchange rate indicates a depreciation of the Turkish lira and an appreciation of the U.S. dollar. Additionally, the nominal exchange rate variable used in the model is the average of the buying and selling exchange rates. The consumer price index variable is seasonally adjusted using the Tramo/Seats method. In addition, all the variables in the study are expressed in logarithmic form. Information on the relevant variables is presented in Table 1.

**Table 1** Variables used in the model and their descriptions

Abbreviation	Description	Source
OIL	Brent Crude Oil Price (TL per barrel)	U.S. Energy Information Administration (EIA)
CPI	Consumer Price Index (2003=100)	CBRT
EXC	Nominal Exchange Rate (USD/TL)	CBRT

Source: Author's elaboration.

Oil prices have both direct and indirect effects on consumer prices. The direct effect can be explained by the inclusion of energy prices in the consumer basket, whereas the indirect effect occurs through increases in production costs. An increase in oil prices increases costs in many sectors, particularly in the transportation and energy sectors, which in turn is reflected in the prices of end products and thus increases inflationary pressure. On the other hand, the exchange rate is another important variable that influences consumer prices. The pass-through of the exchange rate to consumer prices occurs through direct and indirect mechanisms. According to the direct pass-through mechanism, exchange rate fluctuations have a direct effect on consumer prices through possible changes in the prices of imported final goods, intermediate goods and inputs. The indirect pass-through mechanism is explained by the fact that movements in the exchange rate affect aggregate demand and wage levels. For example, a depreciation of the national currency can stimulate production by increasing domestic demand for substitute goods and exports. This can lead to an increase in labor demand, followed by wage increases and ultimately higher consumer prices.

The course of the series used in the study is shown together in Figure 1.

[Figure 1]

Examining the period from 1987 to 2025 as shown in Figure 1, it can be seen that the exchange rate and the consumer price index in Turkey increased together and steadily (especially in the periods following the 2001 and 2018 crises, when exchange rate shocks increased inflationary pressures). In addition, there were significant

fluctuations in Brent oil prices during the same period because of the effects of the COVID-19 pandemic. In particular, oil prices in TL, which were relatively low until 2008, increased significantly because of the instability of the exchange rate following the global financial crisis in 2008. Although there was a short-term decline in the second quarter of 2020 because of a sharp decrease in global energy demand as a result of the pandemic, there was a sharp increase during 2021–2022, which was due to both global recovery and geopolitical developments such as the war between Russia and Ukraine. The simultaneous increase in the exchange rate during this period made the course of oil prices in TL even steeper. This finding shows that when the exchange rate and the oil price are considered together, both factors have a significant effect on consumer prices. On this basis, it can be seen that both the exchange rate and the oil price significantly influence consumer prices.

### 3.2. Methodology

In this study, a nonlinear approach was used to test whether the effects of oil price increases and decreases on consumer prices are symmetric. Accordingly, the nonlinear autoregressive distributed lag (NARDL) model was favored, as it allows for the separate examination of positive and negative shocks in both the short and long term. In addition to analyzing asymmetric relationships, the main reasons for choosing this model are its ability to take into account variables that are stationary at different levels of integration and its ability to distinguish between short-term and long-term effects. Moreover, although the model is not novel, it is widely used in the relevant literature. Therefore, in line with approaches in studies such as Ibrahim (2015), Bala and Chin (2018), Siok Kun Sek (2019), Bawa et al. (2020), and Bari and Adalı (2020), the NARDL model was also applied in this study.

The NARDL model proposed by Yongcheol Shin, Byungchul Yu, and Matthew Greenwood-Nimmo (2014) is based on the ARDL bounds testing approach developed by M. Hashem Pesaran, Yongcheol Shin, and Richard J. Smith (2001). However, unlike the ARDL model, this approach uses the cumulative sums of the positive and negative shocks to the independent variable, and the long-term asymmetric relationship is expressed as shown in Equation (1):

$$\ln CPI = \beta_1^+ \ln OIL_t^+ + \beta_1^- \ln OIL_t^- + \beta_2^+ \ln EXC_t^+ + \beta_2^- \ln EXC_t^- + u_t \quad (1)$$

where  $\beta_1^+$ ,  $\beta_1^-$ ,  $\beta_2^+$  and  $\beta_2^-$  are long-term asymmetric parameters.  $\ln OIL_t^+$ ,  $\ln OIL_t^-$ ,  $\ln EXC_t^+$  and  $\ln EXC_t^-$  are positive and negative changes in  $\ln OIL_t$  and  $\ln EXC_t$ , respectively. These are represented as follows:

$$\begin{aligned}
\ln OIL_t^+ &= \sum_{j=1}^t \Delta \ln OIL_j^+ = \sum_{j=1}^t \max(\Delta \ln OIL_j, 0) \\
\ln OIL_t^- &= \sum_{j=1}^t \Delta \ln OIL_j^- = \sum_{j=1}^t \min(\Delta \ln OIL_j, 0) \\
\ln EXC_t^+ &= \sum_{j=1}^t \Delta \ln EXC_j^+ = \sum_{j=1}^t \max(\Delta \ln EXC_j, 0) \\
\ln EXC_t^- &= \sum_{j=1}^t \Delta \ln EXC_j^- = \sum_{j=1}^t \min(\Delta \ln EXC_j, 0)
\end{aligned}$$

The asymmetric effects of oil prices ( $\ln OIL_t^+$  vs.  $\ln OIL_t^-$ ) and the exchange rate ( $\ln EXC_t^+$  vs.  $\ln EXC_t^-$ ) on consumer prices ( $\ln CPI_t$ ) are estimated using the NARDL (p, q, q) model, as shown in Equation (2):

$$\begin{aligned}
\Delta \ln CPI_t &= \rho \ln CPI_{t-1} + \theta_1^+ \ln OIL_{t-1}^+ + \theta_1^- \ln OIL_{t-1}^- + \theta_2^+ \ln EXC_{t-1}^+ + \theta_2^- \ln EXC_{t-1}^- \\
&+ \sum_{i=1}^{p-1} \varphi_i \Delta \ln CPI_{t-i} \\
&+ \sum_{i=0}^{q-1} (\pi_1^+ \Delta \ln OIL_{t-i}^+ + \pi_1^- \Delta \ln OIL_{t-i}^-) + \sum_{i=0}^{q-1} (\pi_2^+ \Delta \ln EXC_{t-i}^+ \\
&+ \pi_2^- \Delta \ln EXC_{t-i}^-) + e_t
\end{aligned} \tag{2}$$

$$\text{where } \theta_1^+ = -\rho\beta_1^+, \theta_1^- = -\rho\beta_1^-, \theta_2^+ = -\rho\beta_2^+, \theta_2^- = -\rho\beta_2^-$$

### *Stages of the NARDL model*

The stages of the nonlinear ARDL model (NARDL) are as follows:

- The main advantage of the ARDL model is that it can be applied regardless of whether the variables included in the analysis are I(0) or I(1) (Pesaran et al., 2001; Paresh K. Narayan, 2005). Similarly, the NARDL method, which accounts for asymmetric effects, also allows for cointegration analysis regardless of whether the variables of order zero or one are integrated (Shin et al., 2014). Therefore, the NARDL method can be conducted without the need for a unit root test. However, if the variables become stationary when the second difference is taken, there are no critical table values for this situation. Therefore, a unit root test must be performed to prove that the variables included in the analysis are not I(2). On this basis, a unit root test is performed in the first stage of the NARDL model to determine the degrees of integration of the variables.

• In the second stage, Equation (2) is estimated using the ordinary least squares (OLS) method.

• Next, the asymmetric long-term relationships among  $\ln CPI_t$ ,  $\ln OIL_t^+$ ,  $\ln OIL_t^-$ ,  $\ln EXC_t^+$  and  $\ln EXC_t^-$  are tested. For this purpose, the null hypothesis  $H_0: p = \theta^+ = \theta^- = 0$  is tested against the alternative hypothesis  $H_1: p \neq \theta^+ \neq \theta^- \neq 0$  using the F test ( $F_{PSS}$ ) developed by Pesaran et al. (2001). The test statistics obtained are then compared with the critical table values provided in the study by Pesaran et al. (2001) to determine whether the series are cointegrated.

• Finally, the existence of a symmetrical relationship in the short and long term is tested with the Wald test. The long-term symmetrical relationship is tested with the hypothesis  $H_0: \theta^+ = \theta^-$  or  $(W_{LR}: \theta_1^+ = \theta_1^-, \theta_2^+ = \theta_2^-)$ , whereas the short-term symmetrical relationship is tested with the hypothesis  $H_0: \pi_i^+ = \pi_i^-$  or  $(W_{SR}: \sum_{i=0}^{q-1} \pi_i^+ = \sum_{i=0}^{q-1} \pi_i^-)$ . The alternative hypotheses, which correspond to the null hypotheses, represent asymmetrical relationships. The long-term positive and negative coefficients are calculated as follows:  $\ln OIL^+ = -(\theta_1^+/\rho)$ ,  $\ln EXC^+ = -(\theta_2^+/\rho)$ ,  $\ln OIL^- = -(\theta_1^-/\rho)$  and  $\ln EXC^- = -(\theta_2^-/\rho)$ . On the other hand, the coefficients for the short term are calculated as  $\sum_{i=0}^{q-1} \pi_i^+$  and  $\sum_{i=0}^{q-1} \pi_i^-$ .

#### 4. Empirical Findings

In the study examining the asymmetric effects of oil prices and exchange rates on consumer prices, Augmented Dickey–Fuller (ADF), Phillips–Perron (PP), Kwiatkowski–Phillips–Schmidt–Shin (KPSS), and Lee–Strazicich (LS-2003) unit root tests were used to determine whether each variable is stationary and, if so, at which level it is stationary. According to the test results in Tables 2 and 3, all the variables have a unit root at their level values but become stationary at their first differences. Therefore, the fact that all the variables are I(1) indicates that the application of the NARDL model is technically appropriate.

[Tables 2 and 3 here]

After the stationarity tests, Equation (2) is estimated using the ordinary least squares (OLS) method, and the results are shown in Tables 4a and 4b.

**Table 4a** NARDL model results

$C$	-0.1007 ** (0.0490)	$\Delta \ln OIL_t^+$	0.0445 ** (0.0202)
$\ln CPI_{t-1}$	0.0423 *** (0.0162)	$\Delta \ln OIL_{t-1}^+$	0.0153 (0.0169)
$\ln OIL_{t-1}^+$	-0.0235 ** (0.0093)	$\Delta \ln OIL_{t-2}^+$	0.0155 (0.0161)
$\ln OIL_{t-1}^-$	0.0087 * (0.0052)	$\Delta \ln OIL_{t-3}^+$	0.0389 ** (0.0152)
$\ln EXC_{t-1}^+$	-0.0290 * (0.0167)	$\Delta \ln OIL_t^-$	-0.0711 *** (0.0026)

$\ln EXC_{t-1}^-$	0.0118 * (0.0070)	$\Delta \ln EXC_t^+$	0.3133 *** (0.0289)
$\Delta \ln CPI_{t-1}$	0.1420 ** (0.0671)	$\Delta \ln EXC_t^-$	0.0068 (0.0118)
$\Delta \ln CPI_{t-2}$	0.2804 *** (0.0655)	$\Delta \ln EXC_{t-1}^-$	-0.0994 ** (0.0405)
$\Delta \ln CPI_{t-3}$	0.1179 * (0.0641)		

\*, \*\* and \*\*\* indicate the rejection of the null hypothesis at the 0.10, 0.05 and 0.01 significance levels, respectively, whereas the values in parentheses represent the standard errors. In determining the optimal NARDL model, the maximum lag length is set to four, and following Shin et al. (2014), a general-to-specific approach is chosen by eliminating insignificant lags from the model.

Source: Author's calculation.

Table 4b NARDL model results

	Short-term coefficients	Long-term coefficients	
$\ln OIL^+$	0.114*	0.555***	
$\ln OIL^-$	-0.071***	-0.206***	
$\ln EXC^+$	0.313***	0.686***	
$\ln EXC^-$	-0.093*	-0.279***	
$ECM_{t-1}$	-0.0932*** [0.000]	$W_{LR}$	4.012** [0.0211]
$\chi_{LM}^2$	3.105 [0.5404]	$W_{SR}$	4.722** [0.0105]
$\chi_{BP}^2$	10.340 [0.5810]	$F_{PSS}$	6.724***
$\chi_{JB}^2$	3.375 [0.1850]		

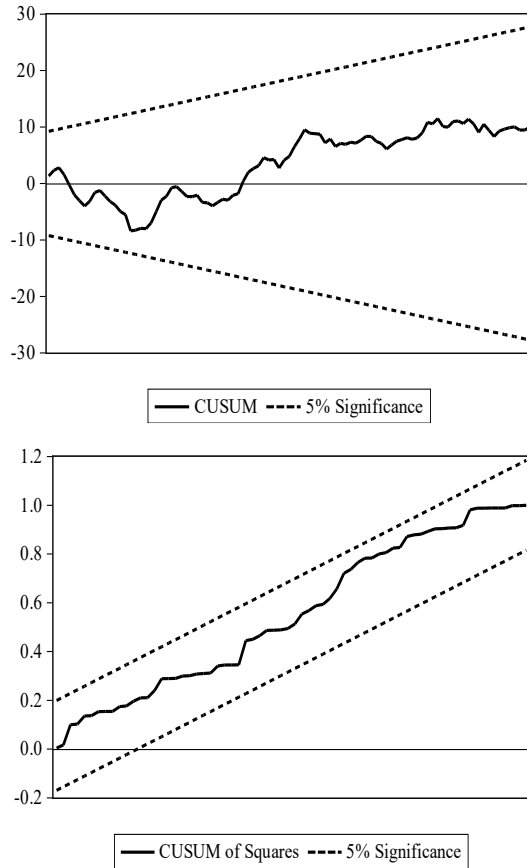
\*, \*\* and \*\*\* indicate the rejection of the null hypothesis at the 0.10, 0.05 and 0.01 significance levels, respectively, whereas the values in square brackets represent the p values.  $\chi_{LM}^2$  denotes the Breusch–Godfrey serial correlation LM test,  $\chi_{BP}^2$  denotes the Breusch–Pagan–Godfrey test, and  $\chi_{JB}^2$  denotes the Jarque–Bera normality test. The critical values for the  $F_{PSS}$  statistic are taken from the Table CI in the study by Pesaran et al. (2001). The lower and upper critical values for the significance levels of 0.01, 0.05, and 0.10 are 3.29–4.37, 2.56–3.49, and 2.20–3.09, respectively.

Source: Author's calculation.

According to the results of the NARDL model, which assumes an asymmetric relationship in both the long and short term, a 1% increase in oil prices, i.e., a positive shock, increases consumer prices by 0.555% (0.114%) in the long term (short term), whereas a 1% decrease in oil prices, i.e., a negative shock, decreases consumer prices by 0.206% (0.071%) in the long term (short term). On the other hand, a 1% increase in the exchange rate increases consumer prices by 0.686% (0.313%) in the long term (short term), whereas a 1% decrease in the exchange rate decreases consumer prices by 0.279% (0.093%) in the long term (short term). In other words, an increase in oil prices and exchange rates leads to higher consumer prices in both periods, whereas a

decrease in oil prices and exchange rates leads to lower consumer prices. Moreover, these coefficients are statistically significant.

According to the results of the Breusch–Godfrey LM test, there is no autocorrelation; according to the results of the Breusch–Pagan–Godfrey test, there is no issue of heteroscedasticity, and according to the results of the Jarque–Bera test, the error term follows a normal distribution. Accordingly, the model satisfies the stability conditions. In addition, since the  $F_{PSS}$  statistic exceeds the critical values provided by Pesaran et al. (2001), the null hypothesis is rejected, indicating the existence of a long-term cointegration relationship between oil prices, exchange rates, and consumer prices. On the other hand, the results of the Wald test ( $W_{LR}$  and  $W_{SR}$ ) indicate that the relationships among oil prices, exchange rates and consumer prices are asymmetric in both the short and long term. In addition, the negative and statistically significant error correction coefficient ( $ECM_{t-1}$ ) (-0.0932) in the corresponding model indicates that a short-term shock is fully absorbed after approximately 11 quarters or three years and converges to equilibrium in the long term. Finally, as shown in Figure 2, when the CUSUM and CUSUM of the squares plots of the estimated model are examined, the test statistics remain within the critical boundaries at the 5% significance level. This finding indicates that the coefficients in the model are stable. The results support the findings of studies by Bari and Adali (2020), Karadag (2021) and Kose and Unal (2021), who conducted analyses in Turkey.



**Figure 2** CUSUM and CUSUM of squares plots.

**Source:** Author's calculations.

## 5. Results and Discussion

In this study, the asymmetric effect of oil prices and the exchange rate on consumer prices for Turkey (1987:Q3–2025:Q1) is analyzed using the NARDL method. For the analysis, stationarity tests are first carried out using the ADF, PP, KPSS and LS (2003) unit root tests, and then the asymmetric relationship between the variables is examined using the NARDL method. According to the results, there is an asymmetric relationship between oil prices, exchange rates and consumer prices in both the short term and long term. According to the analysis results, a 1% increase in oil prices increases consumer prices by 0.555% (0.114%) in the long term (short term), whereas a 1% decrease in oil prices decreases consumer prices by 0.206% (0.071%) in the long term (short term). On the other hand, a 1% increase in the exchange rate increases consumer prices by 0.686% (0.313%) in the long term (short term), whereas

a 1% decrease in the exchange rate decreases consumer prices by 0.279% (0.093%) in the long term (short term).

The results of this study reveal that an increase in the exchange rate and oil price has a greater effect on inflation than a decrease does. In the Turkish economy, this asymmetric pass-through means that costs are passed on to the end consumer prices to a considerable extent. In particular, the increase in external cost factors such as energy and exchange rates has both direct and indirect effects on consumer prices because of the import-dependent production structure. Furthermore, the positive and statistically significant coefficient of the one-period lagged CPI in the model suggests that past inflation has a significant effect on current inflation. This situation shows that firms base their pricing behavior on past inflation and that expectations can be formed in a way that is indexed to past inflation. On the other hand, the limited effect of decreases in oil prices and exchange rates on consumer prices suggests that downward price flexibility in Turkey is weak. This situation is explained by the fact that final prices, especially for energy and fuel, are largely subject to a fixed tax structure (e.g., the application of the special excise tax per liter), by the reluctance of firms to pass on cost reductions to prices, by the expectation that the fall in the currency could only be temporary, and by the prevailing uncertainty in the market. In this context, the results suggest that Turkey, with a history of high inflation and an import-dependent production structure, has asymmetric inflation dynamics, with upward pass-through effects being more dominant in consumer prices.

On the basis of the results of this study, several policy recommendations are made to reduce the asymmetric effects of exchange rate and oil price changes on inflation in the Turkish economy. In this context, the adoption of a more flexible tax structure can facilitate the downward adjustment of prices. In response to the strong impact of exchange rate increases on consumer prices, supporting the domestic production of intermediate goods and promoting the diversification of energy supply—for example, through alternative energy sources—can help to mitigate the impact of exchange rate-related cost shocks on inflation. This situation will not only protect the local economy from fluctuations in international oil prices and inflationary pressures but also contribute to achieving sustainable environmental goals aimed at reducing oil consumption. It is also believed that the lack of competition in the market limits the downward flexibility of prices. In this context, regulations should be introduced to promote competition and increase transparency in pricing. Finally, given the influence of inflation expectations on price behavior, controlling these expectations through reliable monetary policy practices and effective communication strategies is crucial.

Finally, the NARDL model is a widely used method in many studies and is particularly effective at examining asymmetric relationships between economic variables. However, this study, which starts from the year 1987, makes a unique contribution to the literature by also focusing on the period after COVID-19 and the Russia–Ukraine war, as no study has considered this period for Turkey. Therefore, this study fills an important gap in this field. Furthermore, since this study was conducted exclusively in the context of the Turkish economy and during a specific time period, the results cannot be generalized to other countries or the results of alternative

methods. Additionally, the effects of structural breaks are excluded from the scope of this work. However, considering the effects of such structural breaks in future studies could add more depth to the findings.

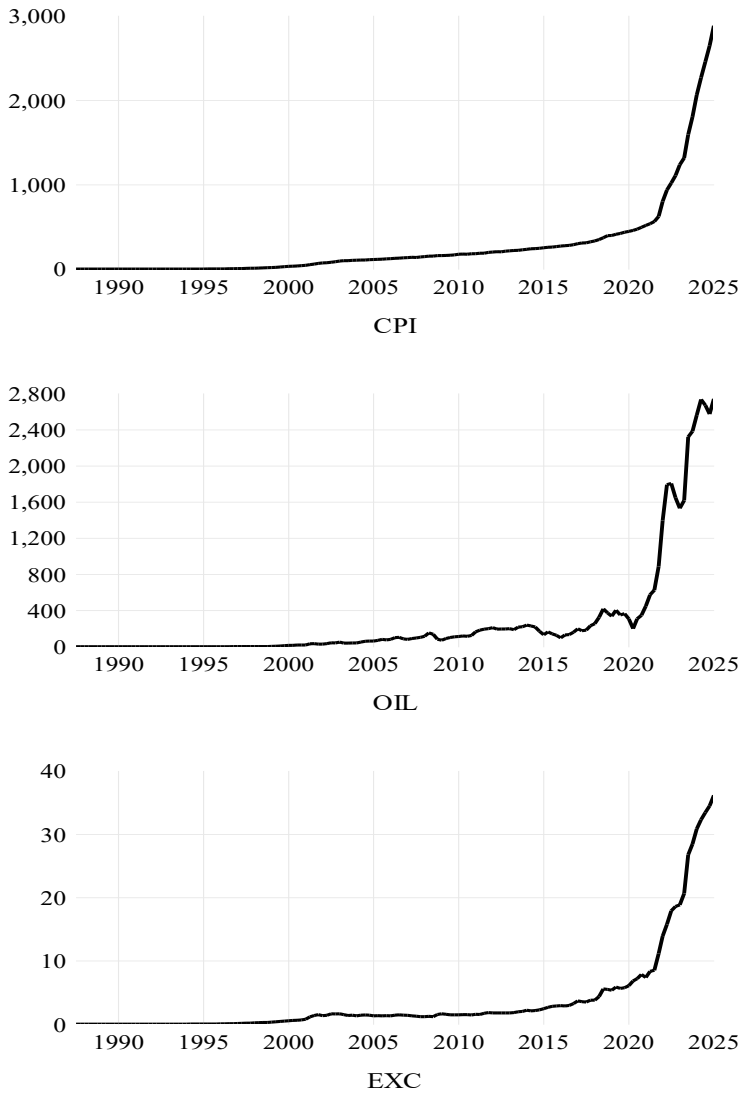
## References

- Ahmed, Huson J.A., and I.K.M. Muhtarul Wadud.** 2011. "Role of Oil Price Shocks on Macroeconomic Activities: An SVAR Approach to the Malaysian Economy and Monetary Responses." *Energy Policy*, 39(12): 8062-8069. <https://doi.org/10.1016/j.enpol.2011.09.067>
- Altıntaş, Halil.** 2016. "Petrol Fiyatlarının Gıda Fiyatlarına Asimetrik Etkisi: Türkiye İçin NARDL Modeli Uygulaması." *Yönetim ve Ekonomi Araştırmaları Dergisi*, 14(4): 1-24. <https://doi.org/10.11611/yead.234720>
- Andrianady Ravahiny J., H. Yves Razanajatovo, and M. Fabienne Ravelomanantsoa.** 2024. "Unraveling the Nexus: Oil Price Dynamics and Inflation in Madagascar." *MPRA Paper 120686*, 1-9. <https://doi.org/10.21428/3b2160cd.3067d6c6>
- Bala, Umar, and Lee Chin.** 2018. "Asymmetric Impacts of Oil Price on Inflation: An Empirical Study of African OPEC Member Countries." *Energies*, 11(3017): 1-21. <https://doi.org/10.3390/en11113017>
- Bari, Bilgin, and Zafer Adali.** 2020. "How Oil Prices Drive Inflation in Turkish Economy: Two Different Channels." *Fiscaoeconomia*, 4(3): 705-721. <https://doi.org/10.25295/fsecon.786956>
- Bawa, Sani, Ismaila S. Abdullahi, Danladi S. Tukur, Sani I. Barda, and Yusuf J. Adams.** 2020. "Asymmetric Impact of Oil Price on Inflation in Nigeria." *CBN Journal of Applied Statistics*, 11(2): 85-113. <https://doi.org/10.33429/Cjas.11220.4/8>
- Blanchard, Olivier J., and Jordi Galí.** 2008. "The Macroeconomic Effects of Oil Price Shocks: Why Are The 2000s So Different From The 1970s?" National Bureau of Economic Research WP 13368: 1-75. <http://dx.doi.org/10.2139/ssrn.1008395>
- BP Statistical Review of World Energy.** 2025.
- Chen, Shiu-Sheng.** 2009. "Oil Price Pass-Through Into Inflation." *Energy Economics*, 31: 126-133. <https://doi.org/10.1016/j.eneco.2008.08.006>
- Choi, Sangyup, Davide Furceri, Prakash Loungani, Saurabh Mishra and Marcos Poplawski-Ribeiro.** 2017. "Oil Prices and Inflation Dynamics: Evidence from Advanced and Developing Economies." *Journal of International Money and Finance*, 82: 71-96. <https://doi.org/10.1016/j.jimonfin.2017.12.004>
- Chudik, Alexander, and Georgios Georgiadis.** 2021. "Estimation of Impulse Response Functions When Shocks Are Observed at a Higher Frequency Than Outcome Variables." *Journal of Business & Economic Statistics*, 40(3): 965-979. <https://doi.org/10.1080/07350015.2021.1889567>
- Cologni, Alessandro, and Matteo Manera.** 2008. "Oil Prices, Inflation and Interest Rates in a Structural Cointegrated VAR Model for the G-7 Countries." *Energy Economics*, 30(3): 856-888. <http://dx.doi.org/10.2139/ssrn.843505>
- Cuñado, Juncal, and Fernando P. Gracia.** 2005. "Do Oil Price Shocks Matter? Evidence for Some European Countries." *Energy Economics*, 25(2). 137-154. [https://doi.org/10.1016/S0140-9883\(02\)00099-3](https://doi.org/10.1016/S0140-9883(02)00099-3)
- Erturk, Emin, and Rumeysa Erkan.** 2021. "Petrol Fiyatlarından Enflasyona Geçiş Etkisi: Geleneksel Phillips Eğrisi Yöntemi ve SVAR Analizi." *Ankara Üniversitesi SBF Dergisi*, 76(1): 103-127. <https://doi.org/10.33630/ausbf.809279>

- Erkus, Sefa, and Huseyin Karamelikli.** 2016. "‘Türkiye’de Tüketici Fiyatları ile Ham Petrol Fiyatları Arasındaki İlişkinin Asimetrik Analizi", *ECBE*, IV, 1-14.
- Farzanegan, Mohammad R., and Gunther Markwardt.** 2009. "The Effects of Oil Price Shocks on the Iranian Economy." *Energy Economics*, 31. 134-151. <https://doi.org/10.1016/j.eneco.2008.09.003>
- Hamilton, James D.** 1983. "Oil and the Macroeconomy Since World War II." *The Journal of Political Economy*, 91(2). 228-248. <https://doi.org/10.1086/261140>
- Hamilton, James D.** 1988. "A Neoclassical Model of Unemployment and the Business Cycle." *Journal of Political Economy*. 96. 593-617. <https://doi.org/10.1086/261553>
- Hamilton, James D.** 1996. "This is What Happened to the Oil Price-Macroeconomy Relationship." *Journal of Monetary Economics*, 38. 215-220. [https://doi.org/10.1016/S0304-3932\(96\)01282-2](https://doi.org/10.1016/S0304-3932(96)01282-2)
- Hooker, Mark A.** 2002. "Are Oil Shocks Inflationary? Asymmetric and Nonlinear Specifications versus Changes in Regime", *Journal of Money, Credit and Banking*, 34(2): 540-561. <http://dx.doi.org/10.2139/ssrn.208890>
- Hudson, Edward A., and Dale W. Jorgenson.** 1978. "Energy Prices and the U.S. Economy, 1972-1976." *Natural Resources Journal*, 18: 877-897. [https://doi.org/10.1016/0165-0572\(78\)90005-1](https://doi.org/10.1016/0165-0572(78)90005-1)
- Hunt, Benjamin, Peter Isard, and Douglas Laxton.** 2002. "The Macroeconomic Effects of Higher Oil Prices." *National Institute Economic Review*, 179: 87-103. <https://doi.org/10.1177/002795010217900111>
- Ibrahim, Mansor H.** 2015. "Oil and Food Prices in Malaysia: A Nonlinear ARDL Analysis." *Agricultural and Food Economics*, 3(2), 1-14. <https://doi.org/10.1186/s40100-014-0020-3>
- Jiménez-Rodríguez, Rebeca, and Marcelo Sánchez.** 2005. "Oil Price Shocks and Real GDP Growth: Empirical Evidence for Some OECD Countries." *Applied Economics*, 37(2). 201-228. <https://doi.org/10.1080/0003684042000281561>
- Karadag, Haydar.** 2021. "The Relationship Between Industrial Production Index, Oil Prices and Consumer Price Index in The Turkish Economy." *Journal of Economic Policy Researches*, 8(2): 211-223. <https://doi.org/10.26650/JEPR913986>
- Kilian, Lutz, and Xiaoqing Zhou.** 2023. "Oil Price Shocks and Inflation." *Federal Reserve Bank of Dallas WP 2312*, 1-34. <https://doi.org/10.24149/wp2312>
- Kose, Nezir, and Emre Unal.** 2021. "The Effects of The Oil Price and Oil Price Volatility on Inflation in Turkey." *Energy*, 226: 1-12. <https://doi.org/10.1016/j.energy.2021.120392>
- Lee, Kiseok, Shawn Ni, and Ronald A., Ratti.** 1995. "Oil Shocks and the Macroeconomy: The Role of Price Variability." *Energy Journal*, 16: 39-56. <https://doi.org/10.5547/ISSN0195-6574-EJ-Vol16-No4-2>
- Mork, Knut A.** 1989. "Oil and the Macroeconomy When Prices Go Up and Down: An Extension of Hamilton’s Results." *Journal of Political Economy*, 97(3): 740-744. <https://doi.org/10.1086/261625>
- Mory, Javier F.** 1993. "Oil Prices and Economic Activity: Is the Relationship Symmetric?" *Energy Journal*, 14(4): 151-162. <https://doi.org/10.5547/ISSN0195-6574-EJ-Vol14-No4-10>

- Mukhtarov, Shahriyar, Jeyhun Mammadov, and Fariz Ahmadov.** 2019. “The Impact of Oil Prices on Inflation: The Case of Azerbaijan.” *International Journal of Energy Economics and Policy*, 9(4): 97-102. <https://doi.org/10.32479/ijeeep.7712>
- Narayan, Paresh K.** 2005. “The Saving and Investment Nexus for China: Evidence From Cointegration Tests.” *Applied Economics*, 37(17): 1979-1990. <http://dx.doi.org/10.1080/00036840500278103>
- Nazhoglu, Saban, and Ugur Soytas.** 2011. “World Oil Prices and Agricultural Commodity Prices: Evidence From an Emerging Market.” *Energy Economics*, 33: 488-496. <https://doi.org/10.1016/j.eneco.2010.11.012>
- OPEC Annual Statistical Bulletin.** 2025.
- Perron, Pierre.** 1989. “The Great Crash, the Oil Price Shock, and the Unit Root Hypothesis.” *Econometrica*, 57(6): 1361-1401. <https://doi.org/10.2307/1913712>
- Pesaran M. Hashem, Yongcheol Shin, and Richard J. Smith.** 2001. “Bounds Testing Approaches to The Analysis of Level Relationships.” *Journal of Applied Econometrics*, 16(3): 289-326. <https://doi.org/10.1002/jae.616>
- Renou-Maissant, Patricia.** 2019. “Is Oil Price Still Driving Inflation?” *The Energy Journal*, 40(6): 199- 220. <https://doi.org/10.5547/01956574.40.6.pren>
- Salem, Leila B., Ridha Nouira, and Christophe Rault.** 2024. “On the Impact of Oil Prices on Sectoral Inflation: Evidence from the World’s Top Oil Exporters and Importers.” *Journal of Energy and Development*, 49(2):163-209. <https://doi.org/10.56476/jed.v49i2.23>
- Sarmah, Ankita, and Debi Prasad Bal.** 2021. “Does Crude Oil Price Affect the Inflation Rate and Economic Growth in India? A New Insight Based on Structural VAR Framework.” *The Indian Economic Journal*, 69(1): 123-139. <https://doi.org/10.1177/0019466221998838>
- Segal, Paul.** 2011. “Oil Price Shocks and the Macroeconomy.” *Oxford Review of Economic Policy*, 27(1), 169-185. <https://doi.org/10.1093/oxrep/grr001>
- Sek, Siok K.** 2019. “Effect of Oil Price Pass-Through on Domestic Price Inflation: Evidence from Nonlinear ARDL Models.” *Panoeconomicus*, 66(1): 69-91. <https://doi.org/10.2298/PAN160511021S>
- Shin, Yongcheol, Byungchul Yu, and Matthew Greenwood-Nimmo.** 2014. “Modelling Asymmetric Cointegration and Dynamic Multipliers in an ARDL Framework.” *SSRN Electronic Journal*, 1-44. <https://doi.org/10.2139/ssrn.1807745>
- Tang, Weigi, Libo Wu, and ZhongXiang Zhang.** 2009. “Oil Price Shocks and Their Short-and Long-Term Effects on the Chinese Economy.” *Energy Economics*. 32(1): 1-28. <https://doi.org/10.1016/j.eneco.2010.01.002>
- Utkulu, Utku, and Ramazan Ekinci.** 2016. “Uluslararası Petrol ve Gıda Fiyatlarından İç Fiyatlara Asimetrik ve Doğrusal Olmayan Fiyat Geçişkenliği: Türkiye İçin NARDL Modeli Bulguları.” *Finans Politik & Ekonomik Yorumlar*, 53(617): 9-22.
- Valcarcel, Victor J. and Mark E. Wohar.** 2013. “Changes in the Oil Price-Inflation Pass-Through.” *Journal of Economics and Business*, 68: 24- 42. <https://doi.org/10.1016/j.jeconbus.2013.03.001>
- Yilmazkuday, Hakan.** 2021. “Oil Price Pass-Through Into Consumer Prices: Evidence from U.S. Weekly Data.” *Journal of International Money and Finance*, 119: 1-13. <https://doi.org/10.1016/j.jimonfin.2021.102494>
- www.eia.gov**

## Appendix



**Figure 1** Brent crude oil prices, the consumer price index and the nominal exchange rate series.

Source: CBRT and EIA.

**Table 2** ADF, PP and KPSS unit root test results

Var.	ADF test		PP test		KPSS test	
	<i>Intercept</i>	<i>Trend &amp; Intercept</i>	<i>Intercept</i>	<i>Trend &amp; Intercept</i>	<i>Intercept</i>	<i>Trend &amp; Intercept</i>
<b>lnCPI</b>	-1.829 (0.365)	-1.756 (0.721)	-3.908*** (0.002)	-2.340 (0.409)	1.308*** [0.739]	0.335*** [0.216]
<b>lnOIL</b>	-2.298 (0.174)	-1.567 (0.802)	-2.192 (0.210)	-1.566 (0.802)	1.350*** [0.739]	0.329*** [0.216]
<b>lnEXC</b>	-2.918** (0.046)	-2.050 (0.569)	-2.877* (0.050)	-1.951 (0.623)	1.289*** [0.739]	0.295*** [0.216]
<b>ΔlnCPI</b>	-3.070** (0.031)	-3.185* (0.091)	-	-4.865*** (0.000)	0.223 [0.739]	0.140 [0.216]
<b>ΔlnOIL</b>	-10.264*** (0.000)	-10.459*** (0.000)	-10.264*** (0.000)	-10.398*** (0.000)	0.493 [0.739]	0.141 [0.216]
<b>ΔlnEXC</b>	-	-8.442*** (0.000)	-	-8.509*** (0.000)	0.119 [0.739]	0.116 [0.216]

The Akaike information criterion was used for the ADF test, and the Newey–West information criterion was used for the PP and KPSS tests. The values in parentheses indicate the p values for the ADF and PP tests, whereas the values in square brackets represent the critical values for the KPSS test at the 0.01 significance level. In addition, \*, \*\*, and \*\*\* indicate rejection of the null hypothesis at the 0.10, 0.05, and 0.01 significance levels, respectively.

**Table 3** LS (2003) unit root test results

Var.	Model	Breaking Point	LM-stat.	Critical Values
<b>lnCPI</b>	Model A	2005:Q1 2020:Q1	-2.789	-4.545
	Model C	1999:Q1 2014:Q2	-4.716	-6.33
<b>lnOIL</b>	Model A	1994:Q1 2020:Q3	-1.335	-4.545
	Model C	2000:Q4 2015:Q4	-4.674	-6.42
<b>lnEXC</b>	Model A	2005:Q1 2008:Q3	-1.807	-4.545
	Model C	1998:Q3 2009:Q2	-3.762	-6.41
<b>ΔlnCPI</b>	Model A	1993:Q3 1994:Q2	-6.568***	-4.545
	Model C	2000:Q4 2011:Q3	-11.960***	-6.45
<b>ΔlnOIL</b>	Model A	1999:Q3 2020:Q3	-9.766***	-4.545
	Model C	2019:Q2 2020:Q2	-10.366***	-6.32
<b>ΔlnEXC</b>	Model A	1994:Q4 2002:Q2	-7.710	-4.545
	Model C	2001:Q2 2002:Q2	-8.480	-6.16

\*, \*\* and \*\*\* indicate the rejection of the null hypothesis at the 0.10, 0.05 and 0.01 significance levels, respectively.

Source: Author's calculation.