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How Oil Prices Drive Inflation in Turkish Economy: Two Different Channels

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Abstract

This study analyzes the impact of changes in oil prices on consumer inflation in Turkey. We compare the effects of the changes in crude oil and gasoline prices on the consumer prices. These effects differ symmetrically and asymmetrically for the period 2009:01-2020:04. For this purpose, inflationary effects are estimated using linear and non-linear ARDL models. According to the findings, changes in both oil and fuel prices have asymmetric effects on inflation in the short run. Both models explain the changes in consumer inflation with the increases in oil prices in the long run. The result indicates that the decreases in oil prices are not taken into account in pricing decisions.

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1. Introduction

The inflationary effects of changes in oil prices mostly result from the structural characteristics of the developing economies. The effect of fluctuations in oil prices on the economy varies according to a country's production structure and sectoral distribution of economic activity, whether the oil is a produced or imported product, and the taxation policy on the petroleum products. Thus, it becomes essential to understand the relationship between changes in oil prices and inflation rates.

The dependency on energy causes changes in energy prices that affect domestic prices as well. Oil prices affect domestic prices directly and indirectly. Oil is widely accepted as a key and valuable input for production as well as for heating and transportation cost based on the distribution cost of goods and services. Sharp raise in oil price can directly increase the cost of production and other business activities use oil and its derivatives. As a result, the final prices of goods and services used by consumers also change. For example, the prices of chemicals and transportation services where oil is a valuable input will be affected by the increase in oil prices. One-off changes in oil prices (direct or indirect) will only create an increase in the price level but will not produce permanent inflationary effects (ECB, 2010). The indirect effects depend on how wages and price setters react to price shock. Real income losses caused by past inflation shocks affect inflation expectations of economic agents and cause higher price and wage-setting behavior. In this way, a temporary price shock becomes permanent, and it becomes costlier to eliminate it. The indirect effects of changes in oil prices are determined by many different factors such as the state of the general economy, the price elasticity of the goods and services, how inflation expectations are formed, and the credibility of the central bank. Finally, the indirect effect reflect that higher oil prices could trigger higher expectations of inflation, which push higher wages as consequences of the direct effects. (Hamilton, 1996; De Gregorio, 2007; Clark and Terry, 2010; Chen, 2009; Kilian and Lewis, 2011; Lacheheb and Sirag, 2019; Mork,1989; Mory, 1993; Davari and Kamalian, 2018; Baumeister and Kilian 2014; Balke et al, 2002; Tang et. al, 2010; Tiwari et. al, 2018).

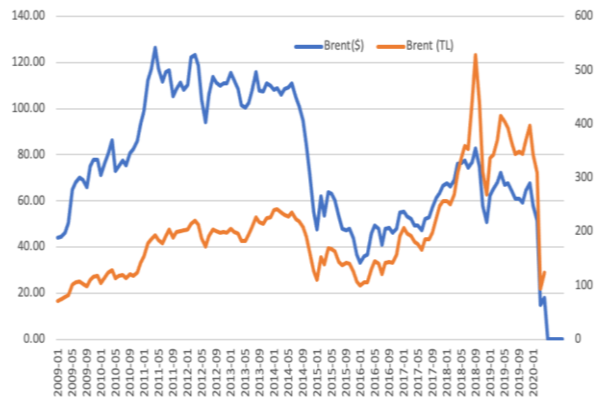
Monetary policy practitioners should monitor inflationary effects/shocks. The changes in oil prices cause cost-push inflation. Therefore, it is crucial to analyze the effect of oil prices on inflation. Our motivation is to research this effect on the Turkish economy. Turkey is a country dependent on oil. The total import of petroleum products has the highest share Turkey's total import, which is about 20%[3]. Changes in oil prices affect the domestic market in two different ways. The first effect stems from changes in global oil prices. Oil prices are determined by global supply and demand conditions. What determines the domestic price of imported oil is the TL/dollar rate in the relevant period. Accordingly, the domestic price of oil may change due to changes in the price of crude oil and the exchange rate. Figure 1 shows dollar and TL per barrel prices of European Brent oil. Due to the high volatility and increasing trend of changes in exchange rates, TL-based crude oil price also differs from international market dynamics.

Petroleum products are used in domestic production for different purposes. One of the most critical usage areas as final goods is its use in automobiles and heating as consumption goods. There price movements in these products are also determined by taxation. Depending on

[3] Calculated from the Ministry of Trade and TURKSTAT data for 2019.

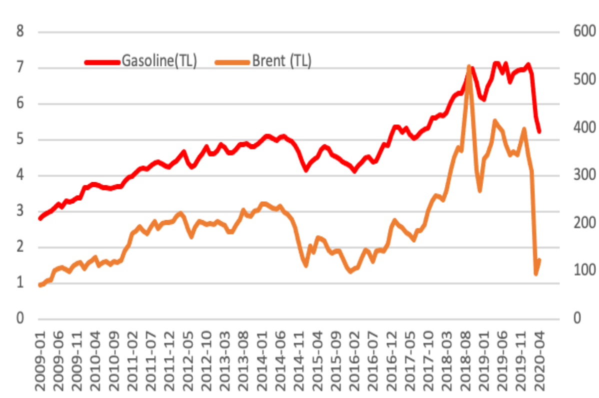
taxation, the change in gasoline prices and the change in crude oil prices differ. In Figure 2, it can be seen that the change in crude oil prices does not fully reflect on the gasoline prices, especially in the downfall of global oil prices. They differs as a result of the automatic taxation mechanism in Turkey.

Figure 1. Brent Oil Prices



Brent ($) on the left axis, Brent (TL) on the right axis.

Figure 2. Gasoline Prices



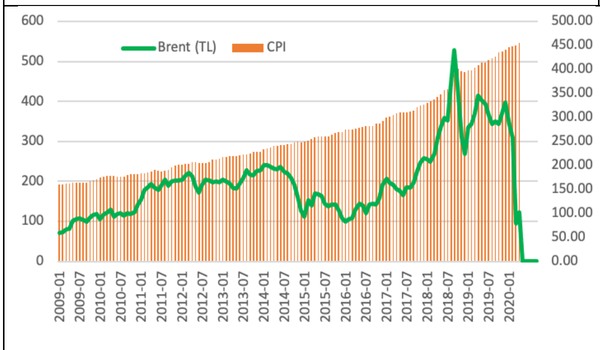
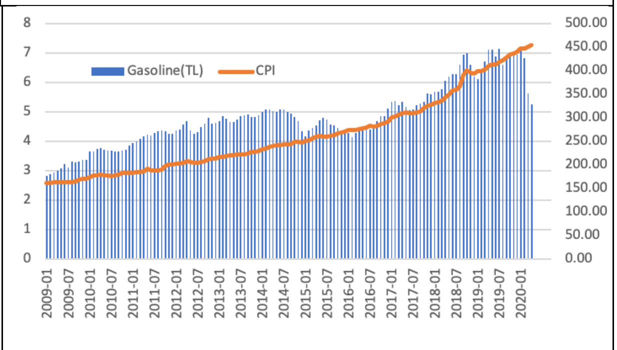
Gasoline (TL) on the left axis, Brent(TL) on the right axis.

Source: Electronic Data Delivery System, CBRT

Depending on the two cases mentioned above, it is essential to analyze the different inflationary impacts of changes in oil prices on the inflation. Changes in crude oil prices have an indirect effect on inflation through production costs. The increase in oil price, which is an imported input in many developing countries or emerging economies, is expected to reflect on prices in proportion to its share in total production. However, the effect on prices may vary depending on market conditions and the competitive environment. Ertug et al. (2018) found that long-term import price and exchange rate pass-through coefficients show significant differences across industry sectors in Turkey. According to the study; while the import price pass-through coefficient can reach up to 70%, the exchange rate pass-through takes a value between 5 % and 107 %. The sector with the highest pass-through coefficients is the manufacture of coking coal and refined petroleum products. This sector is also the sector with the highest use of imported inputs. Another significant result of the study is that the exchange rate pass-through is higher than the rate of imported input use. Kara et al. (2017) state that the exchange rate can also affect inflation through imported inputs (energy and other intermediate goods). The import share of consumption and the share of imported inputs in total production costs affect the exchange rate pass-through: The higher the share of directly imported goods or "imported input-intensive" sectors in the economy, the higher the pass-through is.

On the other hand, gasoline prices have a direct effect on the prices of goods and services. Besides their direct effects on consumer inflation, fuel products also have indirect (cost-side) effects as they are essential inputs in production and transportation. Balkan, Kal, and Tümen (2015) found that the increase in fuel prices increased the wholesale prices of fresh fruits and vegetables through the channel of transport costs. They also stated that this effect could be quite strong, or even more than one (increase in prices of the products more than increase in fuel prices). Atuk et al. (2014) and Ozmen and Sarikaya (2014) show that the CPI basket is not susceptible to a significant portion of the business or credit cycle. Inflation in the respective groups primarily determined by the prices of imports denominated in the Turkish lira. Ertug et al. (2018) show that as imported inputs increase, the exposure level of domestic producer prices to external shocks increases. Their calculations made using input-output tables reflect the increased use of imported inputs in the manufacturing industry in Turkey. Their results indicate that the cost shocks stemming from the exchange rate, and import prices have been felt more over time. High pass-through from producer prices to consumer prices and increases in input costs are rapidly reflected in final prices.

Another factor determining gasoline prices is taxation. In energy pricing, some or all of the prices are determined directly by the government; or in cases where the energy market is fully privatized, it is possible to see that the public has active guidance through the tax policy. A similar situation exists in the Turkey. For example, although fuel oil prices are determined in the free market, tax adjustments have a significant weight on the final sale prices. Figure 3a and Figure 3b show how both effects occur on consumer price inflation. We see that the indirect effects arising from producer prices are weaker than the direct effects arising from gasoline prices.

Figure 3a. Consumer Prices Index and Brent Oil Prices	**Figure 3b. Consumer Prices Index and Gasoline Prices**
	
Brent(TL) on the left axis, CPI on the right axis.	Gasoline(TL) on the left axis, CPI on the right axis.
Source: Electronic Data Delivery System, CBRT	

This study aims to analyze how the changes in oil prices mentioned above affect consumer prices through two different channels. In literature, unlike other studies on Turkey, we focus on the effects of changes in crude oil prices calculated in Turkish Lira. To the best of our knowledge, for the first time, we analyze indirect and direct effects of oil prices on inflation by using gasoline price. The rest of the paper is organized as follow. Section 2 defines data and estimation methodology. Empirical results and discussion are presented in section 3. Finally, section 4 concludes the study, gives main findings and policy recommendations.

2. Literature review

High and persistent inflation is historically one of the leading challenges for policymakers in Turkey. Çatık and Karaçuka (2012) researched the existence of oil pass-through to inflation under different inflation regimes with the help of Markov Regime Switching Vector Autoregressive (MS-VAR) model. The regime dependent impulse-response function posed that crude oil price changes did not affect inflation, whereas refined oil price changes have an impact on inflation. Güney and Hasanov (2013) examined the effects of oil price changes on inflation in Turkey using monthly data for the period 1990:1- 2012:3. The oil price employed in their research is the real oil price, and inflation is consumer price index. They decomposed their data following Hamilton (1996) to account for asymmetric effects. Their results underlined that an increase in oil price has a positive and vital impact on inflation, whereas a decrease in oil price does not have a substantial effect on inflation. Dedeoğlu and Kaya (2014) investigated the relationship between oil price change and domestic prices. They used monthly data covering the period 1990:01- 2012:02, and their variables are average crude oil price, consumer price index, and producer price index. They applied a recursive VAR model on rolling windows. They concluded that firms' cost structure is vulnerable to change in the oil price, and the effects of oil price changes on the producer prices is almost two times higher than the impact on consumer prices.

Gokmenoglu et al. (2015) investigated the relationship between oil price changes and macroeconomic variables in Turkey. Their inflation data is consumer price basis, and their oil price data is collected from OPEC at 2013 constant US$. For this purpose, annual data for the periods between 1961 and 2012 is evaluated with Johansen (1988) co-integration and Granger causality tests. Their tests results confirmed that there was a long-run relationship among employed variables, and there was a unidirectional causality running from oil price to industrial production index. Ozturkler et al. (2015) examined the short and long-run effects of oil prices on inflation using the nonlinear ARDL model for the 2001-2015 period in Turkey. According to their results, oil prices affect inflation in the long run, but not in the short run. They also determined that the long-term effect was symmetrical. Ozata (2019) researched the effects of changes in Europe Brent spot oil prices (Dollars per barrel) using linear and nonlinear ARDL method in Turkey. According to the results, the effects of fluctuations in oil prices on consumer and producer prices are asymmetrical in the long run and symmetrical in the short run. A 10% increase in world oil prices increases the domestic consumer price index (CPI) by 1.30% and the producer price index (PPI) by 1.47%. A 10% decrease in oil prices causes the consumer price index to decrease by 1.12% and the producer price index by 0.72%.

2. Methodology

2.1. Specification of the model and estimation method

We examine the effects of oil price changes on consumer inflation in Turkey for the period of 2009-2020. For this purpose, we use specification of the Phillips curve as in Sek (2017), Baharumshah et al. (2017), and Lacheleb and Sirag (2018):

$$CPI_t = \alpha_0 + \alpha_1 OIL_t + \alpha_2 M2_t + \alpha_3 GAP_t + \epsilon_t \quad (1)$$

where *CPI* is consumer price index, *OIL* is oil price, M2 is money supply, and *GAP* is output gap. α_i is a vector of long-run coefficients. The cost-push effects on the inflation are included in the model with the *OIL* variable and the demand-pull effects with the M2 and GAP variables.

The GAP variable also increase the stability of the estimated models. The specification above is linear and not useful to analyse asymmetric relationship between inflation and oil price.

We respecify the model below to assess asymmetric characteristic of oil price-inflation relationship:

$$CPI_t = \gamma_0 + \gamma_1 OIL_t^+ + \gamma_2 OIL_t^- + \gamma_3 M2_t + \gamma_4 GAP_t + \epsilon_t \tag{2}$$

where γ_i is vector of long-run coefficients. OIL_t^+ and OIL_t^- follows positive and negative changes in oil prices, respectively. These variables are partial sum of positive and negative changes oil prices (OIL_t) defined as below:

$$OIL_t^+ = \sum_{l=1}^{t} \Delta OIL_t^+ = \sum_{l=1}^{t} \max\ (\Delta OIL_l\,, 0)$$

$$OIL_t^- = \sum_{l=1}^{t} \Delta OIL_t^- = \sum_{l=1}^{t} \min\ (\Delta OIL_l\,, 0)$$

In the equation above, γ_1 and γ_2 captures the long-run characteristics of oil price shocks on inflation. Positive oil price shocks are captured by γ_1, meanwhile negative oil price shocks are indicated by γ_2.

We employ linear and nonlinear autoregressive distributed lag models in order to analyze symmetric and asymmetric effects of the independent variables on the dependent variables in the short and long-run. The linear ARDL method is one of the most employed conventional cointegration techniques in the literature because of several advantages. Primarily, the linear ARDL model appears to perform better in the small and finite samples, while other methods involving such as Johansen cointegration method requires larger samples. Besides, though it is compulsory that the variables must be integrated of the same order in the conventional techniques, the ARDL model can be applicable irrespective of variables' integrated. The ARDL method can be utilized when the variables of interest seem to be integrated I (0), I (1), or fractionally integrated I (0), or I (1). On the other hand, this model seems to be invalid when there are variables co-integrated at I (2) (Pesaran et al, 2001). Furthermore, the ARDL method gives more information for the long run because the Error Correction Model (ECM) is achievable by a simple direct transformation integrating long-run adjustment with short-run equilibrium offered by the ARDL model.

The linear ARDL model is analyzed in light of some steps. First, the unit root should be tested to detect variables integrated. The ARDL model is applicable with combinations of I(0) and I(1), but there must be no variable with I(2), or larger. Another compulsory step in constructing the ARDL model is determining the order of the distributed lag function using by information criteria. The process is followed by bounds testing in order to investigate whether there is co-integrating relationship between variables. After a long-run relationship is determined as a result of the bound test, diagnostic tests are applied to understand whether the constructed model is suitable or not. The diagnostic tests include serial correlation (Breusch-Pagan LM test), heteroscedasticity (ARCH test), normality (Jarque-Bera test), functional form (Ramsey Reset test) and stability test (CUSUM and CUSUM of squares).

The traditional linear ARDL (*p, q*) model developed by Pesaran et al. (1997) can be constructed in the following way:

$$y_t = \sum_{j=1}^{p} \vartheta_j y_{t-j} + \sum_{j=1}^{q} \varphi_j x_{t-j} + \epsilon_t$$

where y_t refers the dependent variable; x_t defines vectors of kx1 exogenous variables; δ_j represents coefficient factors of kx1 exogenous variables; ϑ_j defines the vectors of scalars and ϵ_t means disturbance terms associated with mean zero and a finite variance. This equation can be formulated in an error correction format:

$$\Delta y = \theta y_{t-1} + \beta_i x_t + \sum_{j=1}^{p-1} \kappa_j \Delta y_{t-j} + \sum_{j=1}^{q-1} \varphi_j x_{t-j} + \epsilon_t$$

$$\begin{aligned}\Delta lnCPI_t = {} & \chi_0 + \chi_1 lnCPI_{t-1} + \chi_2 lnOIL_{t-1} + \chi_3 lnM2_{t-1} + \chi_4 lnGAP_{t-1} \\ & + \sum_{j=1}^{p} \mu_{1j} \Delta lnCPI_{t-j} \\ & + \sum_{j=1}^{q1} \varphi_j \, \Delta lnOIL_{t-j} + \sum_{j=1}^{q2} \phi_j \, \Delta lnM2_{t-j} + \sum_{j=1}^{q3} \tau_j \, \Delta lnGAP_{t-j} + e_t\end{aligned}$$

We can rewrite the equation in simpler form as below:

$$\Delta y = \theta(y_{t-1} + \omega_i x_t) + \sum_{j=1}^{p-1} \kappa_j \Delta y_{t-j} + \sum_{j=1}^{q-1} \varphi_j x_{t-j} + \epsilon_t$$

where $\omega = -\frac{\beta}{\theta}$ poses the long-run relationship among x_t and y_t. κ_j and φ_j indicate the short-run coefficient for changes in x_t and y_t' lagged term sequentially. Finally, ω shows the error-correction coefficient defining the speed of adjustment of x_t in converging to its long-run equilibrium as y_t changes and this parameter should be the negative value to guarantee convergence in the long-run relationship.

Furthermore, Shin et al. (2013) developed the nonlinear or asymmetric ARDL model which is improved through asymmetric expansion on the conventional linear ARDL model. The asymmetric error correction model can be achieved through the asymmetric effects adding to the linear ARDL model:

$$\begin{aligned}\Delta lnCPI_t = {} & \rho_0 + \rho_1 lnCPI_{t-1} + \rho_2 lnOIL^{+}_{t-1} + \rho_3 lnOIL^{-}_{t-1} + \rho_4 lnM2_{t-1} + \rho_5 lnGAP_{t-1} \\ & + \sum_{j=1}^{p} \psi_{1j} \Delta lnCPI_{t-j} \\ & + \sum_{j=1}^{a} \psi_{2j} \Delta lnOIL^{+}_{t-j} \\ & + \sum_{j=1}^{b} \psi_{3j} \Delta lnOIL^{-}_{t-j} + \sum_{j=1}^{c} \psi_{4j} \, \Delta lnM2_{t-j} + \sum_{j=1}^{d} \psi_{5j} \, \Delta lnGAP_{t-j} + e_t\end{aligned}$$

where a, b, c, d, and p represent lag order. Positive and negative effects of oil price changes on the consumer inflation in the long-run are captured by $\gamma_1 = -{}^{\rho_2}/_{\rho_1}$ and $\gamma_2 = -{}^{\rho_3}/_{\rho_1}$. In the short run, these positive and negative effects are measured by $\sum_{j=1}^{b} \psi_{3j}$ and $\sum_{j=1}^{b} \psi_{4j}$, respectively. Nonlinear ARDL model allows for us to analyze asymmetric relationship between inflation and oil price both in the short-run and in the long-run. As in the linear ARDL model, the nonlinear ARDL model follows the same process step involving the unit root test, model specifications, and detecting the cointegration relationship by analyzing the bound analysis and finally diagnostic checking for residuals.

2.2. Data Set

Our monthly data set for the period of 2009:01- 2020:04 contains consumer price index (CPI), oil prices index (OIL) denominated in TL, gasoline prices (GAS), industial production index, and money supply (M2). All data except gasoline prices were collected from Electronic Data Delivery System of Central Bank of Rebuplic of Turkey. Gasoline prices data set was developed by authors using arithmetic average of five fuel oil retailer's prices[4]. Oil price index was also calculated by authors[5]. Industrial production index is proxy for GDP and the data is seasonally adjusted and output gap (GAP) was calculated using HP filter.

3. Empirical Results

Before estimation, we begin with determining the order of the series with double check. We employ unit root tests such as the Augmented Dickey Fuller (ADF) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) to determine order of integration. I (0) and I (1) types of series could be used in ARDL model. If the series are I (2), then we could not use them.

Table 1. ADF and KPSS unit root test results

	Level		First Difference	
	ADF	KPSS	ADF	KPSS
lnCPI	2.331 (1.000)	0.300 (0.146)**	-6.596 (0.000)	0.475 (0.739)*
lnOIL	-2.141 (0.517)	0.132 (0.146)**	-11.066 (0.000)	0.241 (0.463)**
lnGAS	-2.499 (0.328)	0.148 (0.146)**	-8.306 (0.000)	0.252 (0.463)**
lnM2	1.809 (0.998)	1.464 (0.146)**	-10.589 (0.000)	0.367 (0.463)**
lnGAP	-2.927 (0.157)	0.084 (0.146)**	-7.161 (0.000)	0.273 (0.463)**

Note: Probability values for ADF test and asymptotic crticial values for KPSS test are shown between parentheses
*, ** specifies significance level at 1% and 5%, respectively.

[4] Although there are regional differences in fuel oil prices, the retailer's prices in the same region are close to each other. The average price of gasoline in Ankara-Cankaya as a reprensentative of oil prices in Turkey was obtained from the retailers: Türkiye Petrolleri, Opet, BP, Shell, Petrol Ofisi

[5] This index was obtained in TL by multiplying the average TL/USD rate of the relevant month with the Europe crude oil price of the relevant month.

Table 1 presents unit root test results. All series in logarithmic form were made stationary after they converted to first difference. We used logarithmic transformation to stabilize variance of the series. The variables are I (1) and we could employ them to estimate linear and nonlinear ARDL models.

We estimate the models in the Eq.1 and Eq.2 using OLS (Ordinary Least Squares) method. The lag length of the variables in the models are selected by some criterions like Akaike information criterion (AIC) and Schwarz criterion (SC). We also tested whether there is a long-run relationship among variables for linear and nonlinear model. For that purpose, we employ bounds test for cointegration as in Pesaran et al. (2001) and Shin et al. (2013).

The null hypothesis of no cointegration for both model:

Linear : $\chi_1 = \chi_2 = \chi_3 = \chi_4$

Nonlinear : $\rho_1 = \rho_2 = \rho_3 = \rho_4 = \rho_5$

The alternative hypothesis of cointegration for both model:

Linear : $\chi_1 \neq \chi_2 \neq \chi_3 \neq \chi_4$

Nonlinear : $\rho_1 \neq \rho_2 \neq \rho_3 \neq \rho_4 \neq \rho_5$

In the ARDL model, the null hypothesis in the F-test indicates that the cointegration among the variables does not exist. In contrast, the alternative hypothesis poses that there is a long-run relationship between variables. The critical values developed by Pesaran et al. (2001) are utilized in corresponding to the values of the F-test to detect whether there is cointegration between variables or not. When the value of the F-test is higher than the upper bound values acquired from the Pesaran's F table, it means that the null hypothesis should be rejected. In other words, there is a long-run relationship. In contrast, if the estimated value is lower than the tabulated value, the null hypothesis should be accepted. That's, the cointegration between the variables does not exist. When the F-test values are located between the lower and upper bound, it can be said that the result is indecisive.

Table 2. Bounds test results for cointegration

Model specification	F-Statistics	Lower bound	Upper bound	Conclusion
Linear (CPI-OIL)	7.115	2.37	3.2	Cointegration
Linear (CPI-GAS)	6.399	2.79	3.67	Cointegration
Nonlinear (CPI-OIL)	6.517	2.56	3.87	Cointegration
Nonlinear (CPI-GAS)	1.994	2.56	3.49	No Cointegration

Note: Critical values are valid signifacence level at 5%.

The results for cointegration are shown Table 2. F-statistic value is greater than the upper critical bound at 5% the first three model specifications. It states the existence of the long-run relation relationship. For the nonlinear (CPI-GAS) model, there is no long-run relationship between consumer and gasoline prices, because F-statistic value less than the lower critical bound.

We examine separately the symmetric and asymmetric effects of changes in gasoline and oil prices on consumer inflation. This approach enables us to compare two different channels. First, we estimated Eq.1 for oil price in linear form. The results are illustrated in Table 3.

Table 3. Estimation results for linear models

	Linear ARDL (4,0,0,2) Model (CPI-OIL)	**Linear ARDL (4,1,2,0) Model (CPI-GAS)**
Variable	**Coefficient**	**Coefficient**
Short-run		
C	0.258 [0.000]	-0.351 [0.015]
CPI (-1)	1.228 [0.000]	1.213 [0.000]
CPI (-2)	-0.492 [0.000]	- 0.452 [0.000]
CPI (-3)	0.353 [0.006]	0.357 [0.005]
CPI (-4)	-0.157 [0.051]	-0.177 [0.026]
OIL	0.007 [0.005]	-
GAS	-	0.054 [0.012]
GAS (-1)	-	0.005 [0.880]
GAS (-2)	-	-0.046 [0.063]
GAP	-0.011 [0.517]	-0.025 [0.171]
M2	0.017 [0.658]	0.016 [0.662]
M2 (-1)	0.175 [0.001]	0.158 [0.003]
M2 (-2)	-0.153 [0.000]	-0.143 [0.000]
Long-run		
OIL	0.102 [0.012]	-
GAS	-	0.221 [0.122]
M2	0.554 [0.000]	0.535 [0.000]
GAP	-0.160 [0.501]	-0.429 [0.181]
C	-6.451 [0.000]	-5.954 [0.000]
R- squared	0.9993	0.9994
Serial Correlation LM (1)	0.341	0.155
Serial Correlation LM (2)	0.603	0.336
Heteroskedasticity ARCH (1)	0.386	0.377
Heteroskedasticity ARCH (2)	0.449	0.483
Normality Jarque-Bera	0.230	0.129
Ramsey RESET	0.229	0.335

Note: The lag order for coefficients are shown in parenteheses.
The probability values are shown in parenteheses next to coefficient.

The results for short-run estimations show persistency ofinflation in both models. Economic units take past inflation into account in their pricing decisions. While the effect of crude oil prices on consumer inflation is very low, the effect of gasoline prices is more powerful in the short term. The output gap does not have a significant effect on either model. However, the lagged values of the money supply show a positive effect after one period and a negative effect after two periods on consumer prices. In the long run, the inflationary effect of the money supply is robust. The existence of approximately the same coefficients in both models confirms this effect. Accordingly, a 10% increase in the money supply increases the consumer price index by about 5.5%. Again, crude oil prices have a significant effect on inflation in the long run. The effect of a 10% increase in crude oil prices on the consumer price index is approximately 1%.

The high R^2 values of estimated models indicate that the explanatory variables used to explain the variable consumer price index changes are sufficient. The results of the LM and ARCH also show that there is no autocorrelation and heteroscedasticity problem. Jargue-Bera and Ramsey RESET tests verify that the error terms follow a normal distribution, and the model is defined correctly. CUSUM and CUSUM square graphs also confirm the stability of the coefficients in the model (see Appendix A). We also consider asymmetric effects of oil and gas prices on inflation by estimating Eq.2 in nonlinear form for both variables. Table 4 present the estimation results for nonlinear models.

Table 4. Estimation results for nonlinear models

	Nonlinear ARDL (4,0,2,0,2) Model (CPI-OIL)	**Nonlinear ARDL (4,2,0,0,2) Model (CPI-GAS)**
Variable	**Coefficient**	**Coefficient**
Short-run		
C	0.329 [0.014]	1.057 [0.000]
CPI (-1)	1.178 [0.000]	1.214 [0.000]
CPI (-2)	-0.480 [0.001]	-0.457 [0.000]
CPI (-3)	0.382 [0.003]	0.343 [0.007]
CPI (-4)	-0.201 [0.014]	-0.159 [0.047]
OIL^+	0.014 [0.002]	-
OIL^-	-0.000 [0.002]	-
OIL^- (-1)	0.024 [0.059]	-
OIL^- (-2)	-0.019 [0.068]	-
GAS^+	-	0.103 [0.011]
GAS^+ (-1)	-	-0.022 [0.684]
GAS^+ (-2)	-	-0.072 [0.075]
GAS^-	-	0.022 [0.083]
GAP	-0.047 [0.065]	-0.012 [0.445]
M2	0.015 [0.698]	0.012 [0.751]
M2 (-1)	0.158 [0.003]	0.161 [0.003]
M2 (-2)	-0.136 [0.001]	-0.130 [0.002]
Long-run		
OIL^+	0.498 [0.000]	-
OIL^-	0.033 [0.243]	-
GAS^+	-	-
GAS^-	-	-
M2	0.309 [0.001]	-
GAP	0.297 [0.073]	-
C	4.986 [0.000]	-

R- squared	0.9994	0.9994
Serial Correlation LM (1)	0.117	0.197
Serial Correlation LM (2)	0.282	0.360
Heteroskedasticity ARCH (1)	0.581	0.430
Heteroskedasticity ARCH (2)	0.803	0.602
Normality Jarque-Bera	0.062	0.063
Ramsey RESET	0.299	0.087
Note: The lag order for coefficients are shown in parentheses. The probability values are shown in parenteheses next to coefficient.		

The findings of asymmetric models emphasize persistency of inflation, as in linear models. The effects of changes in the money supply are similar. A 10% increase in crude oil prices in the short term has an effect of 1.4% on consumer inflation, while the effect of a 10% increase in gasoline price is 10.3%. The two-period lagged effect on crude oil prices is statistically significant at 10%. While the delayed effect of a 10% decrease in crude oil prices on consumer inflation is 1.9%, it is 7.2% on gasoline price. In this case, we deduce that gasoline prices are more determinant on inflation in the short run, and this relationship comes along asymmetrically. There is an asymmetrical relationship between crude oil prices and consumer inflation in the long run. The combined effects of the increases in crude oil prices and the exchange rate lead to stronger inflationary effects. However, the output gap and money supply also have effect on inflation in the asymmetric model at 10% significance level.

The high R^2 value of the estimated asymmetric models indicates that the selected variables have a high explanation power for inflation. There is no autocorrelation problem in the models, and residuals have constant variance over time. Error terms follow a normal distribution, and the both models are settled correctly. The stability test results confirm the stability of the models (see Appendix A).

Figure 4. Multiplier impacts of changes in oil prices

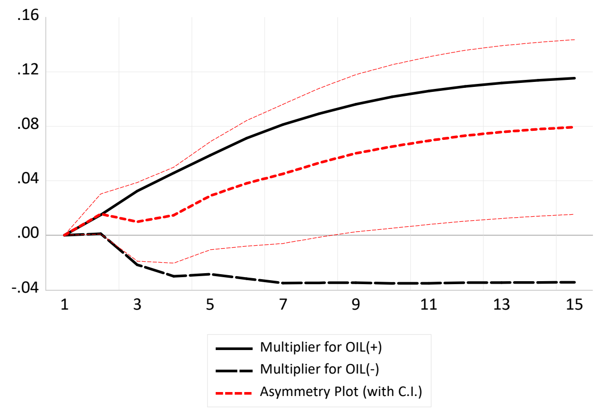
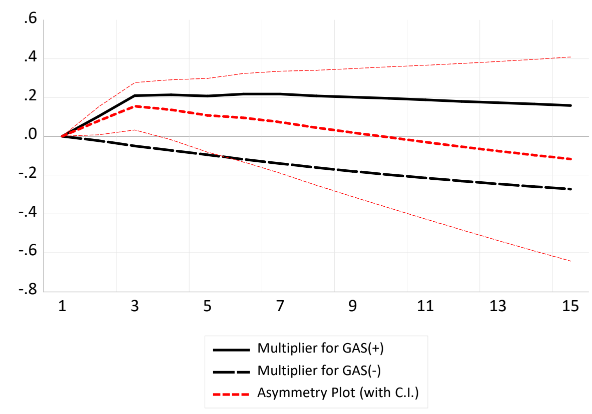


Figure 5. Multiplier impacts of changes in gasoline prices



Figures 5 and 6 show cumulative multiplier impacts of changes in oil and gasoline prices on consumer price index in the short-run. The effects of the increase in oil prices are continuous over a year. This situation can be explained by the continuing effects of the increase in exchange rates on producer prices. The effects of the decrease in oil prices occur with a lag and converge with the long-term coefficient after 7 months. Due to the absence of a long-run asymmetric relationship between gasoline prices and inflation, we look at the effect of price increases based on the symmetrical model. This effect is compatible with the coefficient values we obtained in the short-run model. In the short term, the increases in gasoline prices fade after having an immediate impact on inflation.

4. Conclusion

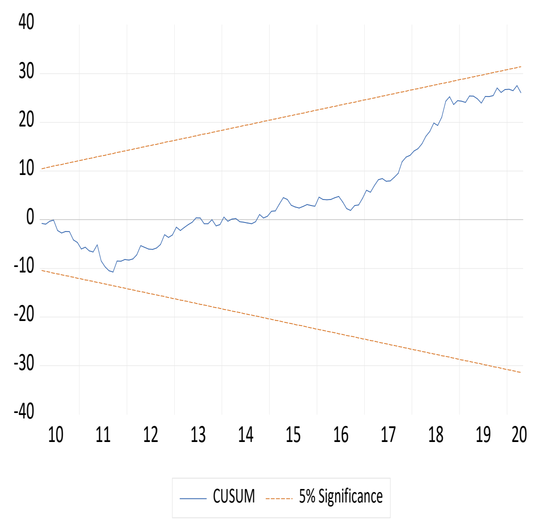
The examination of oil price-inflation relationship has been received considerable attention by the political, the business, and the academic environment. The primary goal of the monetary policy is to ensure price stability, and they are to deal with and examine macroeconomic shocks that impact the implementation of their responsibility. Many studies and historical data reported that the relationship between oil price and its effects on the economy could be classified as symmetric and asymmetric. Briefly, the asymmetries approach proposed by Shin et al. (2013) implies that the impact is supposed to differentiate between a positive and negative change in oil prices. In other words, the asymmetric model can be applied to define whether the variables responses more to increase (decrease) than to decrease (increase) in the oil price. In contrast, the effect of positive and negative change oil price is identical in the symmetric approach. The symmetric effects are operated through the supply and demand side transmission mechanism, and its sign depends on the importance of the oil industry in the overall economy, the length of the lag in the oil production process, and the productivity spillover between oil and non-oil sectors. In other words, the symmetric effect depends on the share of oil expenditure in total energy expenditure. The indirect channel plays a significant role in the asymmetric approach, and the powers of the indirect channel are associated with sectoral reallocation, precautionary saving and uncertainty, and monetary responses.

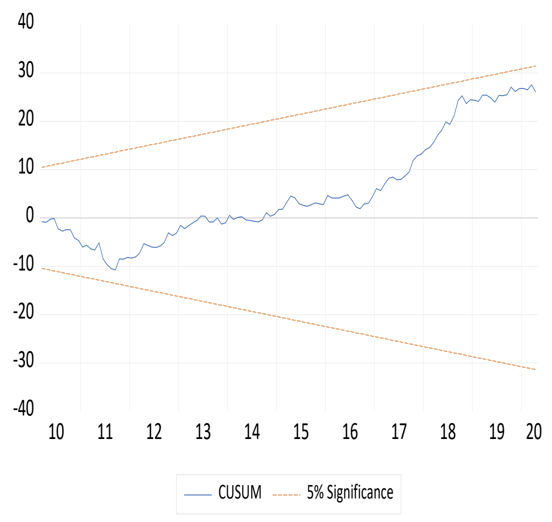
In this study, we examine the effects of oil price changes on consumer inflation through two different channels. Channel one shows the effects of changes in domestic crude oil prices. Here, we focus on crude oil price changes in TL, as they also show the exchange rate effect. The second channel shows the effects of the change in gasoline prices. Along with the exchange rate effect, the effects of automatic taxation also determine changes in gasoline prices. The results show that both oil prices have asymmetrical effects on consumer inflation in the short run. However, the effects of the decrease in oil prices are limited compared to the increase. There are symmetrical effects in the long run, and the inflationary effect of gasoline prices is more robust than the oil prices.

From a policy perspective, our paper underlines two structural problems of the Turkish economy. These are the dependency on oil and the high pass-through effect arising from increases in exchange rates, respectively. Leaving aside the first, a stable exchange rate is needed to solve the second problem. This mainly depends on reducing the total savings deficit (current account deficit) and increasing the foreign exchange reserves. Besides, taxes on gasoline generate significant revenue for the government budget in Turkey. It limits the effect of decreases in oil prices on gasoline prices at the same rate. This effect can be mitigated by increasing the share of direct taxes in the financing of government. Both the tax and the exchange rate effect directly or indirectly cause cost-push inflation. The central bank has control over the money supply or aggregate demand (output gap). The strength of monetary policy is shrinking in the face of cost-push inflation resulting from structural problems. Therefore, effective monetary policy and price stability may come to the fore in the absence of these structural problems. Policy attention should primarily focus on solving these structural problems.

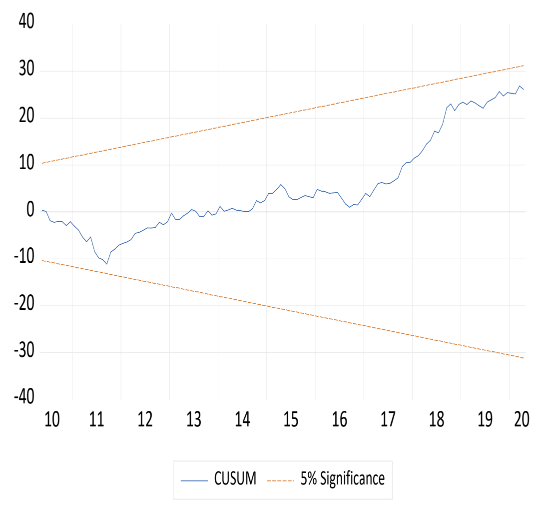
Appendix A. Stability Test Results (CUSUM and CUSUM of Squares)

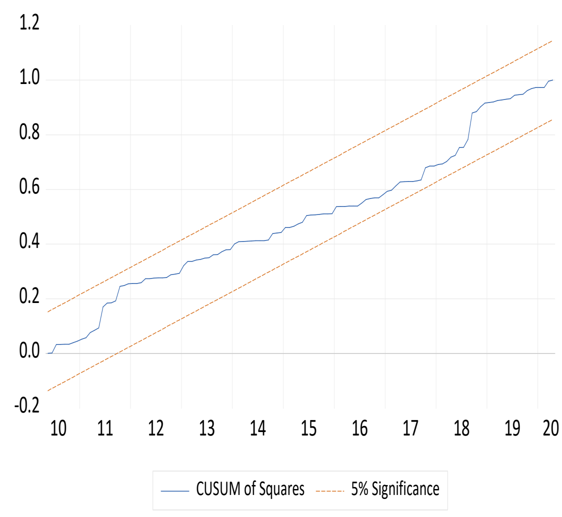
Linear ARDL (4,0,0,2) Model (CPI-OIL)



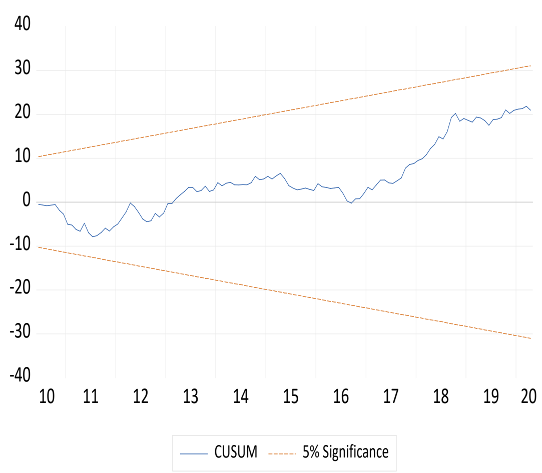


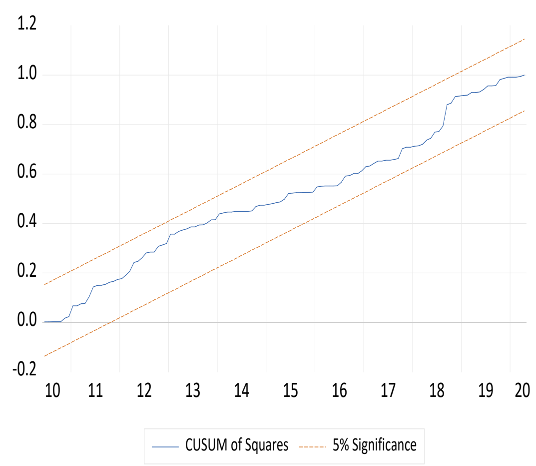
Linear ARDL (4,1,2,0) Model (CPI-GAS)



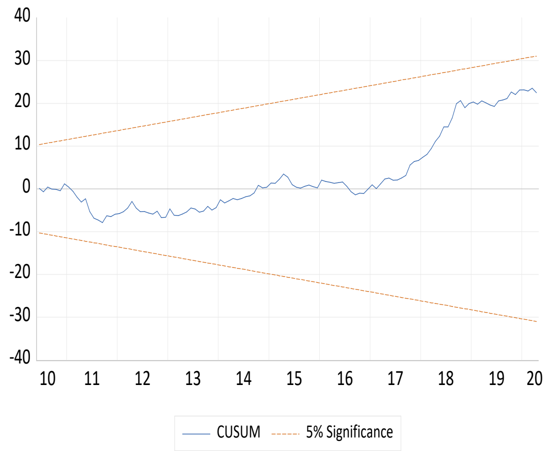


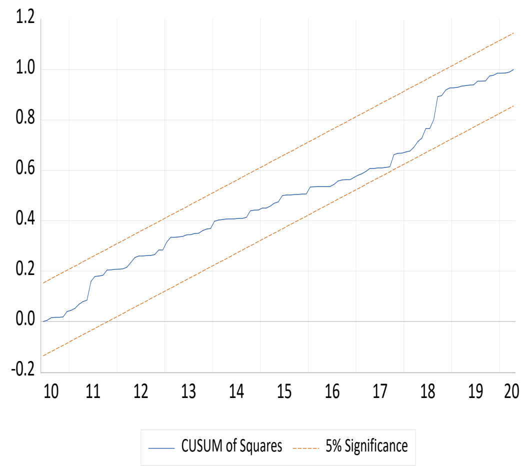
Nonlinear ARDL (4,0,2,0,2) Model (CPI-OIL)





Nonlinear ARDL (4,2,0,0,2) Model (CPI-GAS)





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