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Asymmetric Relationships Between Natural Gas Price Inflation and Macroeconomic Factors: The Case of Turkey

Doğalgaz Fiyat Enflasyonu ve Makroekonomik Faktörler Arasındaki İlişki: Türkiye Örneği

İlkay GÜLER[1]

Abstract

Energy inflation is one of the main factors affecting macroeconomic indicators. The price inflation of natural gas, which is the basic input of electricity generation, housing, industry and service sectors and causes less CO_2 emissions than other fossil fuel energy types, is the focus of this study. Natural gas, like other fossil fuels, is a scarce energy source and is not evenly distributed around the world. For this reason, some countries export natural gas, while others import natural gas. Countries that are foreign-dependent in natural gas are affected by the political, geographical and economic conjuncture of the countries they import from. In this context, Turkey was affected by Russia-Ukraine war and natural gas prices increased accordingly. The study aims to determine the asymmetric relationships between natural gas price inflation and macroeconomic factors in Turkey. For this purpose, autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) models were used for Turkey's 1998Q1-2023Q2 data. As a result of the analysis, it was determined that there was an asymmetric relationship between natural gas inflation and producer price index, gross domestic product, balance of payments. The results obtained showed the importance of natural gas found in the Black Sea and natural gas pipelines passing through Turkey (TANAP etc.), and an ecopolitical evaluation was made in this context.

Jel Codes: *Q43, O40, E31*
Keywords: *Natural Gas Price Inflation, Current Account Deficit, Inflation, Economic Growth, Energy Economy*

[1] Assist. Prof. Dr., Ankara Hacı Bayram Veli University, School of Land Registry and Cadastre, Department of Land Registry and Cadastre, Ankara, TURKEY, ilkay.guler@hbv.edu.tr, ORCID: 0000-0003-1289-6652

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Öz

Enerji enflasyonu, makroekonomik göstergeleri etkileyen temel faktörlerden biridir. Elektrik üretimi, konutlar, sanayi, hizmet sektörlerinin temel girdisi olan ve diğer fosil yakıtlı enerji türlerine göre daha az CO_2 emisyonuna neden olan doğalgazın, fiyat enflasyonu, bu çalışmanın odak noktasını oluşturmaktadır. Doğalgaz diğer fosil kaynaklı yakıtlar gibi kıt bir enerji kaynağı olup Dünya'ya eşit dağılmamıştır. Bu nedenle bazı ülkeler doğalgaz ihraç ederken, bazıları da doğalgaz ithal etmektedir. Doğalgazda dışa bağımlı ülkeler, ithalat yaptıkları ülkelerin siyasi, coğrafi ve ekonomik konjonktüründen etkilenmektedir. Bu bağlamda Türkiye, Rusya-Ukrayna savaşından etkilendi ve buna bağlı olarak doğalgaz fiyatları yükselmiştir. Çalışmanın amacı, doğalgaz fiyat enflasyonu ile makroekonomik faktörler arasındaki asimetrik ilişkileri tespit etmektir. Bu amaçla, Türkiye'nin 1998Q1-2023Q2 verileri için gecikmesi dağıtılmış otoregresif (ARDL) and doğrusal olmayan gecikmesi dağıtılmış otoregresif (NARDL) modelleri kullanılmıştır. Analiz sonucunda, doğalgaz enflasyonu ve üretici fiyat endeksi, gayri safi yurt içi hasıla ödemeler dengesi arasında asimetrik ilişki olduğu belirlenmiştir. Elde edilen sonuçlar, Karadeniz'de bulunan doğalgaz ve güzergahı Türkiye'den geçen doğalgaz boru hatlarının (TANAP vb.) önemini göstermiş, bu çerçevede ekopolitik bir değerlendirme yapılmıştır.

Jel Kodları: *Q43, O40, E31*
Anahtar Kelimeler: *Doğalgaz Fiyat Enflasyonu, Cari Açık, Enflasyon, Ekonomik Büyüme, Enerji Ekonomisi*

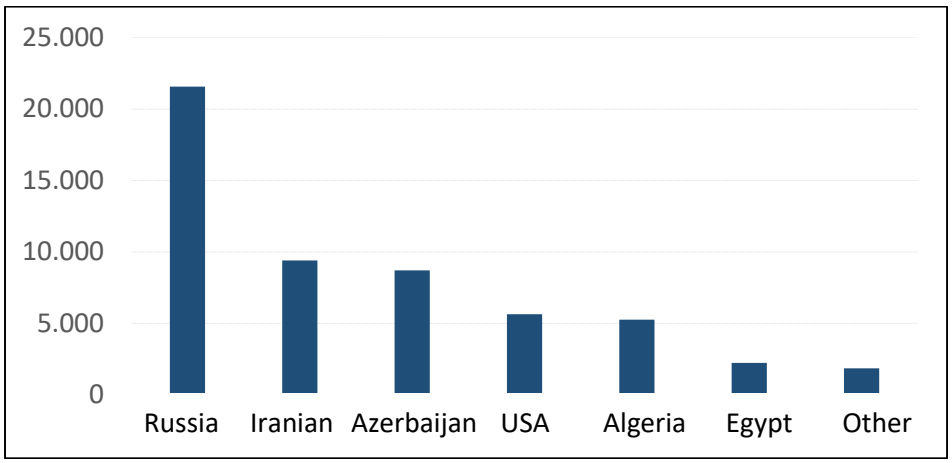
1. Introduction

Energy sources have always occupied an important place in terms of basic needs in Maslow's hierarchy of needs (Maslow, 1943). Since the industrial revolution, economic growth has brought with it an increase in production, thus the demand for energy has increased even more (Destek& Sinha, 2020). While coal was the first energy source used for production, energy sources such as oil, natural gas and electricity began to be used in the following period. The impact of energy on the economy became evident with the oil crisis in the early 1970s.

Since the energy sector output is the basic input of all sectors, there is a close relationship between energy prices and macroeconomic factors (Güler, 2022). Countries that do not have sufficient energy resources are dependent on imports. While countries that export energy resources have a foreign trade surplus, countries that import energy resources have a foreign trade deficit (Shahbaz et al., 2019; Shahbaz et al., 2023). Since the foreign trade deficit directly increases the current account deficit, this chain affects macroeconomic factors negatively one after another (Ullah, Tekbaş&Doğan, 2023; Destek,2016).

Energy resources are rare and unevenly distributed in the world, and due to these characteristics, it is an important actor in terms of political and economic balances in the world. The relationship between energy consumption and economic growth has been examined under four different hypotheses: growth, conservation, neutrality and feedback (Apergis & Payne, 2009). The large fluctuations in energy prices in recent years negatively affect the economies of countries dependent on energy imports. The 2008 global economic crisis, the 2018 currency trade wars, the 2020 Covid-19 pandemic and the Russia-Ukraine war negatively affected the world economy and was reflected in energy prices. Using fossil-based energy to meet energy demand has dramatically disrupted the environmental and ecological balance and caused climate change. Although natural gas is fossil-based, its carbon emissions are lower than coal. Therefore, natural gas is used in electricity generation, residences, industry and the service sector (Okumuş, Güzel & Destek, 2021; Pata, Erdoğan & Ozkan, 2023). However, Turkey is 99.31% dependent on imports for natural gas consumption. Approximately 55 billion Sm^3 of natural gas was imported in 2022 (EPDK, 2023). T.C. Presidency Of The Republic Of Türkiye. Directorate Of Communications (2023).

Figure 1: Countries From Which Turkey Imports Natural Gas

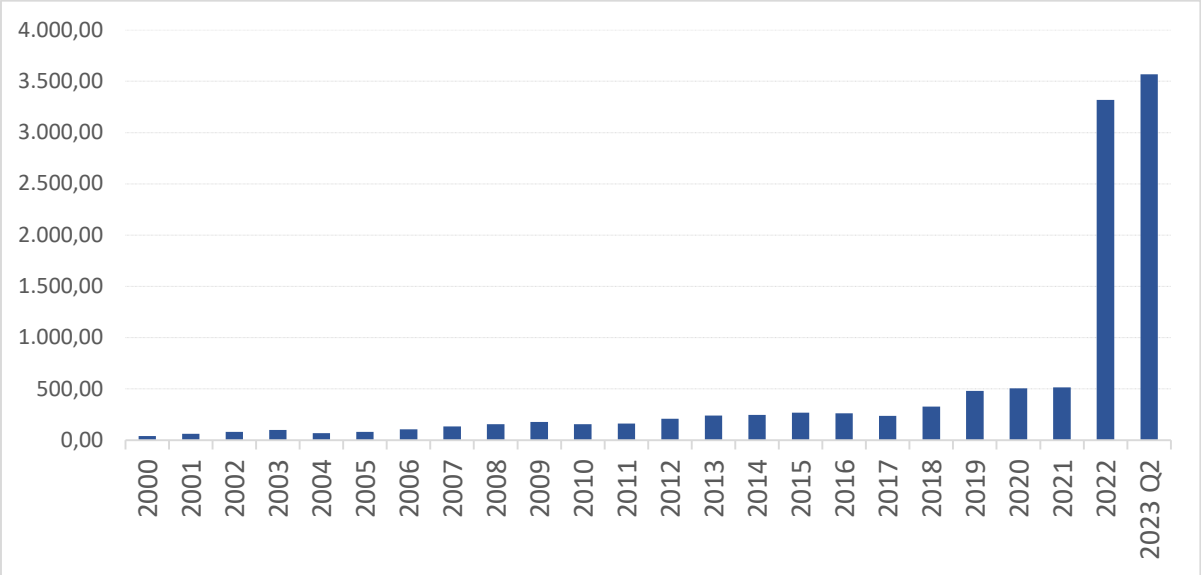


Source: EPDK, 2023.

As it is seen in Figure 1, approximately half of natural gas imports are from Russia. Political, geographical and economic events in the countries from which Turkey imports natural gas, especially the Russia-Ukraine war, affect natural gas prices, and the increase in natural gas prices affects inflation, economic growth and current account deficit (EPDK, 2023).

Figure 2 shows the change in the natural gas price index in Turkey between 2000-2023 (Q2).

Figure 2: Natural Gas Price Index



Source: TCMB, 2023a

As it is seen in graph 2, natural gas prices have highly increased after 2021. The main reason for this is that, since we are a natural gas importer country, the prices determined in international markets are reflected in natural gas prices.

In Turkey, which has to constantly import natural gas to continue production and meet the needs in housing, foreign trade deficit is growing further and also directly increases the current account deficit.

The increase in energy prices creates macroeconomic damage. Inflation is considered one of the most critical problems for all country economies. The price increase in natural gas increases production costs, thus resulting in cost inflation. On the other hand (Bernanke, 2007; Güler & Kaplan, 2022), high energy costs reduce businesses' ability to invest in new capital. The decrease in investments slows down economic growth. On the other hand, since natural gas imports cause foreign exchange outflow from the country, the foreign exchange supply decreases and the exchange rate increases. In this way, the balance of payments is disrupted and the gross domestic product is negatively affected (Bulut, 2020; Yeri & Kibritçioğlu, 1998).

Achieving high and stable economic growth is among the primary goals of all countries. To achieve this, it is necessary to establish the macroeconomic basis (Doğan, Tekbaş & Gursoy, 2022).

One of the most urgent problems that need to be solved to establish macroeconomic balance is to reduce natural gas-related cost inflation. The main solution for this is to reduce

dependence on imports. The key factor at this point is the natural gas reserve resources that Turkey has found in the Black Sea. Thus, the foreign trade deficit will be closed by not importing. In this way, it is predicted that economic growth will increase (Kevser et al., 2023).

In the study, unlike the literature, natural gas price inflation is taken into account as an indicator of energy inflation. The main source of motivation is to guide policy makers in the field of energy to reduce the fluctuation in natural gas prices. The work continues as follows. In the second chapter, the literature is presented comprehensively. The third section includes the data and methodology used. In the fourth section, the analysis results are explained. In the last section, within the framework of the results obtained, the natural gas in the Black Sea and the role of Turkey in the natural gas pipeline of the neighboring countries are discussed from an ecopolitical perspective (TANAP, Russia-Turkey Natural Gas Pipeline, Blue Stream, Turkey-Greece Natural Gas Interconnection) (T.C. Enerji ve Tabi Kaynaklar Bakanlığı, (2023).

2. Literature

Studies examining the relationships between energy inflation and macroeconomic factors are based on studies examining energy prices and macroeconomic factors. Therefore, the literature is presented under two headings: In most of the studies in the literature, oil prices were used to represent energy prices, and oil price inflation data were used to represent energy inflation.

2.1. Studies Examining the Relationships Between Energy Prices and Macroeconomic Factors

There are some studies on these issues specifically in Turkey: While examining the relationship between oil prices and macroeconomic factors with data from the period 1991-2004, the VECM error correction model was used (Karabulut & Danışoğlu, 2006). As a result, it was determined that there was a positive relationship between oil prices and the current account deficit and a negative relationship between the growth rate. When the MGARCH method was applied to the data for the years 1990-2008, it was determined that the first factor determining the current account deficit was the ratio of exports to imports, and the second factor was oil prices (Erdoğan & Bozkurt, 2009). When ADF unit root test, VECM and cointegration analysis were applied to the data for the period 1984-2008 (Demirbaş, Türkay & Türkoğlu, 2009), it was determined that the changes in oil prices increased the current account deficit.

When VAR analysis was applied to the data covering the period 1999-2008, it was seen that oil price shocks had a significant effect on the current account in the short term (Özlale & Pekkurnaz, 2010). Similarly, Yaylalı & Lebe (2012), who applied VAR analysis, used data between 1986 and 2010, clarified that imported crude oil prices had an impact on monetary policy, and determined that crude oil prices were an important reason for the change in inflation. When Granger causality analysis was applied for the 1992-2012 period, it was concluded that there was a unidirectional causality from oil prices to foreign trade deficit in the medium term, but this effect disappeared in the long term (Bayat, Şahbaz & Akçacı, 2013). Köse & Ünal (2021) evaluated the period between March 1988 and August 2019 with monthly

data to examine the effects of oil price and oil price volatility on inflation in Turkey. As a result, it was determined that the effect of oil price and oil price volatility on inflation was limited in the first months, but increased in the following months.

There are studies examining oil prices and macroeconomic factors in other countries as well: In the USA, England, France, Germany and Japan, data for the period 1980-2001 were examined using the Philips curve (LeBlanc & Chinn, 2004). It was concluded that the increase in oil prices caused a moderate effect on inflation. Cunado & Gracia (2005), on the other hand, applied unit root tests and granger causality tests in South Korea, Japan, Malaysia, Thailand, the Philippines and Singapore, taking into account the period between 1975 and 2002. Although the least impact was seen in Malaysia, it was concluded that sudden fluctuations in oil prices had a significant impact on the economies of other countries where the study was conducted. During the period 1975-2008, the situation in America was examinded with VAR analysis (Clark & Terry, 2010). Beginning in 1975, after 1985 when the sensitivity of core inflation to changes in energy prices in the United States decreased rapidly, it was determined that the decline in energy inflation pass-through continues in the face of monetary policy that has become less sensitive to energy inflation. Qianqian (2011) examined data from 1999-2008 in China using a cointegration and error correction model. As a result, it was determined that the increase in oil prices caused total net exports and real output to decrease and inflation to increase. Chuku et al. (2011) analyzed the relationship between variables in Nigeria during the period 1970-2008 using Dickey-Fuller and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. As a result, it was determined that the change in oil prices had an impact on the current account balance in the short term. Akıncı, Aktürk & Yılmaz (2012), applied panel data analysis in the Organization of the Petroleum Exporting Countries (OPEC) and oil importing countries in the period 1980-2011. They found that the increase in oil prices in OPEC countries increased economic growth, while the opposite situation occurred in oil importing countries. Zakaria, Khiam & Mahmood (2021), who examined the effect of world oil prices on inflation using 1980-2018 data in South Asian countries, applied non-linear analysis as well as cointegration and VAR analysis and determined the existence of cointegration between oil prices and inflation, and it became clear that the shock in global oil prices affects inflation in South Asian countries and that this effect is permanent.

2.2. Studies Examining the Relationships Between Energy Inflation and Macroeconomic Factors

The data covering the 2003-2021 period were used in the research of Alıcı & Kızıltan (2023), which examined the relationship between energy inflation and macroeconomic factors in Turkey, which is the focus of our study. The data on the annual percentage change in electricity, gas and other fuels were used to represent energy inflation data, and the data on the annual percentage change in the consumer price index was used to represent inflation data. Bai-Perron Multiple Breakpoint, Narayan-Popp two-break unit root test, cointegration test and Gregory-Hansen and Hatemi-J test were applied. As a result, it was concluded that energy inflation and inflation rates move in the same direction.

There are also studies focusing on Pakistan: Haider, Ahmed & Jawed, (2014) used OLS, GLS and GMM models to examine data for the period 1973-2012 in Pakistan. As a result, it was

determined that monetary and fiscal policy decisions affect energy supply, and that this effect, together with any international oil price shock and exchange rate depreciation, puts upward pressure on energy inflation. Kousar et al. (2022), who examined the data for the period 1972-2021 using the VAR model, determined that there was a significant and positive relationship between the twin budget deficit and exchange rate and energy inflation, while Liaqat et al. (2022), tried to create a different perspective on the connection between oil price inflation and economic growth. For this purpose, Augmented Dickey-Fuller test and autoregressive distributed lag model were used. It was concluded that oil price inflation does not affect economic growth in both the short and long term, but causes inflation to increase. Iqbal et al. (2021) applied unit root test, ADF test, Bound test, ARDL cointegration tests to the data to examine the situation in the period 1991-2019. They confirmed that energy demand increased as a result of economic activities, thus energy inflation emerged, and they determined that energy inflation played a critical role in the formation of inflation.

Breitenfellner, Cuaresma & Mayer (2015), examined data from 18 OECD countries in the period 1975-2015 using logit model. While the results show that shocks in oil prices are reflected in financial markets, it was concluded that energy price inflation should be used as a leading indicator in the analysis of macro financial risks. Bawa, Abdullahi & Ibrahim (2016), who examined the situation in Nigeria between 1981 and 2015, used energy inflation data as an independent variable to determine the inflation dynamics. He determined that consumer prices are affected by past inflation, money supply, average rainfall and international crude oil price inflation. Choi et al. (2018), who examined the impact of fluctuations in global oil prices on domestic inflation in 72 developed and developing countries in the period 1970-2015 with an unbalanced panel found that a 10% increase in energy inflation globally increased domestic inflation by 0.4 points, and the effect disappeared after 2 years. Choi et al. (2018), found that a 10% increase in energy inflation globally increased domestic inflation by 0.4 points, and the effect disappeared after 2 years.

Among the studies focusing on European countries, Soliman et al. (2023), took the United Kingdom into consideration and applied non-linear autoregressive distributed lag (NARDL) and structural vector autoregressive model (SVAR) to the data for the period 2015-2022. They determined that the increase in energy inflation and CPI negatively affected agricultural production, while the increase in energy inflation and decreases in CPI affected agricultural production positively. Corsello & Tagliabracci (2023), who examined the period from June 2021 to February 2023 with VAR analysis using monthly data, investigated the situation in the countries in the Euro zone. As a result, they determined that the contribution of energy inflation to core and food inflation was low in the normal period, while its contribution to core and food inflation was high in recent periods when inflation in energy prices was experienced. It was also found that in the first nine months of 2022, energy inflation constitutes more than sixty percent of headline inflation. Andreani & Giri (2023,) examined the period 1970-2020 in 6 developed OECD countries, Germany, France, Italy, Japan, the United Kingdom and America, and for this purpose, they evaluated the historical behavior of energy price volatility from an alternative perspective using wavelet power spectrum. As a result, it was found that energy inflation volatility concentrated in the frequency range between approximately 1.5 and 5.5 years.

In this study, unlike the literature, the effect of natural gas price inflation, as an indicator of energy inflation, Turkey are evaluated on macroeconomic factors is examined through econometric analysis. With the results obtained, the availability of natural gas in the Black Sea and the natural gas pipeline routes passing through within the ecopolitical framework. Thus, it is aimed to gain a different perspective and contribute to the literature.

3. Data and Methodology

In this study, it is aimed to determine the asymmetric relationships between natural gas price inflation and macroeconomic factors in Turkey for the period 1998Q1-2023Q2 The % change in natural gas prices is used as the dependent variable. The independent variables are current account deficit, inflation and economic growth. The variables used in the study are presented in Table 1.

Table 1: Data Set

Variable	Abbreviation	Source
Natural Gas Price Inflation (Annual % change in natural gas prices)	Dg	TCMB (2023b)
Inflation (Annual % change in domestic producer price index)	Enf	TCMB (2023b)
Current Account Deficit	Od	TCMB (2023c)
Economic Growth (Real GDP per Capita)	GSYH	IMF (2023)

The data in Table 1 were analyzed with autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) approach.

$$Dg_t = \beta_0 + \beta_1 Enf_t + \beta_2 Gsyih_t + \beta_3 Od_t + u_t$$

Unit root analysis of the variables was examined with Augmented Dickey-Fuller (ADF) and Zivot-Andrews tests. For the short and long term prediction method, in Autoregressive Distributed Lag (ARDL) and Non-Linear Bounds Test (NARDL) approach, the (N)/ARDL method was used since the variables are allowed to be integrated as (I(0) or I(1)) at different levels.

In the ARDL approach developed by Pesaran & Shin (1998), Pesaran, Shin & Smith (2001), Shin et al. (2014), after the integrated levels of the variables in the model are determined as I(0) and I(1), the lag lengths of the data of the variables in the model are determined using the appropriate lag criterion, and the ARDL model is estimated. After determining the existence of a cointegration relationship with the F-test, the long and short term relationships between the variables are estimated and examined.

While the optimum lag length is p for the dependent variable and q1, q2 and q3 for the independent variables, respectively, the general version of the ARDL(p, q1, q2, q3) model to be estimated in our study is given below:

$$Dg_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Dg_{t-i} + \sum_{i=1}^{q_1} \beta_i Enf_{t-i} + \sum_{i=1}^{q_2} \delta_i Gsyih_{t-i} + \sum_{i=1}^{q_3} \theta_i Od_{t-i} + \varepsilon_t$$

3.1. Emprical Result

Descriptive statistics of the variables included in the natural gas inflation model are included in Table 2.

Table 2: Descriptive Statistics of Variables Included in the Model

	Average	Median	Maximum	Minimum	S.D.	Skewness	Kurtosis	Observe Number
Dg	383.77	157.54	5315.87	5.88	834.22	4.29	21.79	102
Inf	302.55	175.30	2221.56	12.08	422.64	3.17	13.08	102
GDP	0.06	0.09	0.36	-1.00	0.16	-2.74	19.40	102
Od	0.69	-0.03	85.98	-10.59	8.87	8.83	85.42	102

When the results in Table 2 are examined, considering the quarterly period of 1998Q1-2023Q2 for Turkey, the average of natural gas inflation is 383.77, the average of the producer price index is 302.55, the average of public GDP is 0.06, and the average of the balance of payments is 0.69. There are 102 observations in the 1998Q1-2023Q2 time period.

ADF (Augmented Dickey-Fuller) was developed by Dickey and Fuller (1979), Dickey and Fuller (1981) method was used to examine the stationarity of the variables. Table 3 shows the ADF unit root test results.

Table 3: ADF Unit Root Test Result of Variables

Test	**Deterministic Component**	**Dg**	**Inf**	**GDP**	**Od**
Augmented Dickey-Fuller (ADF)	**Constant**	I(1)	I(1)	I(0)	I(0)
	Constant+Trend	I(1)	I(1)	I(0)	I(0)

When the ADF unit root test results in Table 3 are examined, natural gas inflation and inflation variables are stationary at the I(1) level, while gross domestic product and balance of payments variables are stationary at the I(0) level.

Considering that there may be a structural break before investigating a long-term relationship between the series, the stationarity of the series was investigated with the Zivot & Andrews (ZA) (1992) test, which takes structural break into account. Zivot & Andrews unit root test results are given in Table 4.

Table 4: Zivot-Andrews Unit Root Test Results

Variables	Model	Break Period	Lag Lenght (k)	Test Statistics
Dg	A	2019Q3	4	0.61
	B	2019Q3	4	-3.18***
	C	2019Q2	4	-3.37*
Inf	A	2019Q2	4	3.72
	B	2019Q3	4	0.48**
	C	2019Q2	4	0.74
gdp	A	2016Q3	4	-3.21
	B	2005Q1	4	-3.13
	C	2004Q4	4	-3.13
Od	A	2004Q3	4	-10.60*
	B	2004Q4	4	-10.48
	C	2005Q1	4	-11.41***

Model A indicates that there is a change in the intercept coefficient (constant) of the trend function under the trend stationary alternative hypothesis, Model B indicates that there is a change in the trend, and Model C indicates that the change in the trend occurs simultaneously in the constant and trend. Critical values are taken from Zivot-Andrews (1992) in Table 2 and Table 4. ***, ** and * refers to 1%, 5% and 10% significance levels, respectively.

In Table 4, according to the results of ZA (1992) with structural breaks, there is a general break in the 2019Q3 period for natural gas inflation, in the 2019Q3 period for the producer price index, and in the 2005Q1 period for the balance of payments in Turkey. However, although there is a structural break in the GDP series, it was concluded that the series contains a unit root and therefore the series is not stationary at level.

After determining the different integrated degrees at the I(0) and I(1) levels between the variables, the ARDL estimation results are shown in Table 5.

Table 5: ARDL Boundary Test Findings

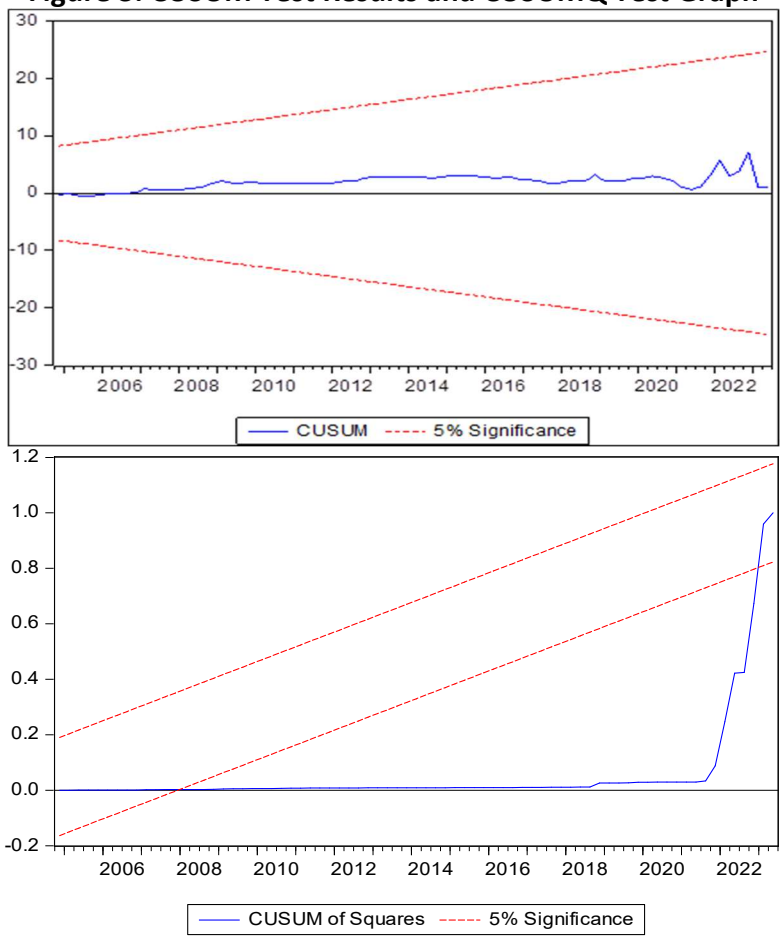
Functional Model	ARDL Model	k	F Statistics
$Dg = f\left(Enf, Gsyih, Od\right)$	**ARDL(5, 7, 4, 0)**	**3**	**8.71*** **
Critical Values			
	%10	%5	%1
Lower Limit	2.82	3.36	4.56
Upper Limit	3.88	4.51	5.96

Note: *** represents statistical significance at the 1% level. The k in the table gives the lag length. The determined lag length was calculated taking into account the Akaike Information Criterion (AIC). F=0.33 (prob.=0.72) for Breusch-Godfrey Serial Correlation LM Test, F=3.55 (prob.=0.00) for Breusch-Pagan-Godfrey Heteroscedasticity Test. Ramsey Reset test F statistic=53.48 (prob.=0.00). According to the CUSUM test result, long-term coefficients are stable. Since the trend and constant coefficients are not significant, the "none" model was preferred.

According to the ARDL boundary test results in Table 5, there is a long-term cointegration relationship between the variables. Since the calculated F statistic is greater than the upper critical values, the null hypothesis stating that there is no long-term relationship between the variables is rejected and the alternative hypothesis is accepted (The upper critical values at

F=8.71, 10%, 5%, and 1% are 3.88, 4.51 and 5.96). As a result, there is a long-term relationship between natural gas inflation and other variables. CUSUM test results and CUSUMQ test graph are given in Figure 3.

Figure 3: CUSUM Test Results and CUSUMQ Test Graph



Long-term coefficient results for the ARDL(5, 7, 4, 0) model are given in Table 6.

Table 6: Long-Term Coefficient Estimates

Variable	Coefficient	Std. Error	t-statistic	Poss.
Inf	0.23	0.45	0.51	0.61
Gdp	-1543.52	1036.97	-1.49	0.14
Od	-1.42	1.13	-1.26	0.21
Note: **HAC robust estimation** results were used for coefficient estimations				

When the long-term results in Table 6 are examined, an increase in the broad producer price index increases natural gas inflation by 0.23 units, while an increase in gross domestic product reduces natural gas inflation by 1543.52 and an increase in the current account deficit reduces natural gas inflation by 1.42 units.

ARDL Error Correction Model was estimated for the short-term relationships between the variables in the natural gas inflation model and the result regarding the error correction coefficient is given in Table 7.

Table 7: ARDL Error Correction Model Result

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	81.59***	16.68	4.89	0.00
D(DG(-1))	0.36***	0.08	4.41	0.00
D(DG(-2))	-0.29**	0.13	-2.26	0.03
D(DG(-3))	2.61***	0.18	14.48	0.00
D(DG(-4))	-1.03***	0.32	-3.27	0.00
D(ENF)	3.90***	0.35	11.30	0.00
D(ENF(-1))	-0.83	0.63	-1.32	0.19
D(ENF(-2))	2.21***	0.62	3.56	0.00
D(ENF(-3))	-0.49	0.82	-0.60	0.55
D(ENF(-4))	-2.07**	0.80	-2.61	0.01
D(ENF(-5))	0.59	0.88	0.67	0.50
D(ENF(-6))	2.75***	0.82	3.34	0.00
D(GSYH)	35.44	100.42	0.35	0.73
D(GSYH(-1))	612.18***	157.11	3.90	0.00
D(GSYH(-2))	387.83***	125.26	3.10	0.00
D(GSYH(-3))	238.22**	110.85	2.15	0.03
CointEq(-1)*	**-0.54*** **	**0.09**	**-6.02**	**0.00**
Adjusted R^2=0.74				
Boundary Test Critical Values for t Statistics of Error Correction Coefficient				
t statistic=--6.02	%10	%5	%2.5	%1
Lower Limit	-2.57	-2.86	-3.13	-3.43
Upper Limit	-3.46	-3.78	-4.05	-4.37
Note: ***, ** indicate statistical significance at 1% and 5% levels, respectively.				

When the results in Table 7 are examined, an increase in the producer consumption index in the short term increases natural gas inflation by 3.90 units, and an increase in gross domestic product increases natural gas inflation by 35.44 units. The error correction coefficient for the natural gas inflation model is negative and statistically significant. It can be said that a deviation of the balance in the short term can correct itself after approximately 1.8 quarters and reach the long-term balance. Table 8 shows the ARDL and NARDL model cointegration results.

Table 8: Linear and Non-Linear ARDL Model Cointegration Test Results

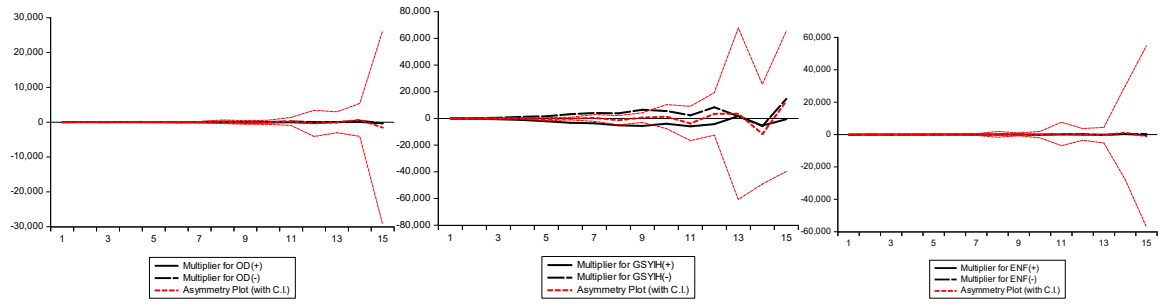
	F Statistic	Asymptotic Critical Values				Result
		%1		%5		
		I(0)	(1)	I(0)	(1)	
ARDL Model	F_{ARDL} = 8.71	3.36	4.51	4.56	5.96	There is cointegration.
NARDL Model	F_{NARDL} = 9.78	4.09	5.51	3.01	4.21	There is cointegration.

When the results in Table 8 are examined, the null hypothesis is rejected and the alternative hypothesis is accepted in both the ARDL model and the NARDL model. NARDL model estimation results are given in Table 9.

Table 9: NARDL Model Estimation Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DG(-1)	0.40***	0.07	6.12	0.00
DG(-2)	-0.08	0.09	-0.86	0.39
DG(-3)	2.44***	0.34	7.11	0.00
DG(-4)	-2.52***	0.29	-8.69	0.00
INF^+	**4.17*** **	**0.34**	**12.43**	**0.00**
INF^+ (-1)	-2.13***	0.58	-3.66	0.00
INF^+ (-2)	-0.89	0.75	-1.19	0.24
INF^+ (-3)	-0.03	1.54	-0.02	0.98
INF^+ (-4)	-2.16*	1.22	-1.77	0.08
INF^-	6.01	7.04	0.85	0.40
INF^- (-1)	-4.13	5.90	-0.70	0.49
INF^- (-2)	21.71*	10.94	1.98	0.05
INF^- (-3)	-38.75***	6.22	-6.23	0.00
GDP^+	**-192.67***	**104.30**	**-1.85**	**0.07**
GDP^+ (-1)	-349.56**	159.68	-2.19	0.03
GDP^+ (-2)	-336.32***	99.38	-3.38	0.00
GDP^+ (-3)	-421.45***	125.08	-3.37	0.00
GDP^+ (-4)	-157.60	116.60	-1.35	0.18
GDP^-	-59.48	163.67	-0.36	0.72
GDP^- (-1)	-423.53***	145.26	-2.92	0.00
GDP^- (-2)	-456.59**	211.32	-2.16	0.03
GDP^- (-3)	-103.76	206.96	-0.50	0.62
GDP^- (-4)	-448.64*	225.58	-1.99	0.05
OD^+	0.12	0.30	0.40	0.69
OD^+ (-1)	-12.50***	4.18	-2.99	0.00
OD^+ (-2)	-3.86	3.52	-1.10	0.28
OD^+ (-3)	-9.38**	4.04	-2.32	0.02
OD^+ (-4)	-8.11**	3.28	-2.47	0.02
OD^-	**-13.31*** **	**4.18**	**-3.18**	**0.00**
OD^- (-1)	-3.43	3.73	-0.92	0.36
OD^- (-2)	-8.88**	4.12	-2.15	0.04
OD^- (-3)	-8.21**	3.27	-2.52	0.01
C	-188.03**	69.81	-2.69	0.01
***, ** and * indicate significance at the 1%, 5% and 10% levels, respectively.				

Figure 4: Asymmetric Relationships for the Natural Gas Inflation Model



When the long-term dynamic effects estimated in the NARDL model are examined in Table 9, it is seen that the long-term positive coefficient of the producer price index and gross domestic product and the long-term negative coefficient of the balance of payments are statistically significant. While an increase in the producer price index in the long term increases natural gas inflation by 4.17 units, an increase in gross domestic product reduces natural gas inflation by 192.67 units, and an increase in the balance of payments reduces natural gas inflation by 13.31 units.

When the graphs in Figure 4 are examined, there is an asymmetric relationship between natural gas inflation and producer price index, natural gas inflation and gross domestic product, and natural gas inflation and balance of payments.

4. Conclusion

The Turkish economy has been struggling with inflation for many years. Therefore, it is important to identify and analyze the factors affecting inflation. The energy sector is important for development as it is the basic input of all sectors and it is important in development plans. Additionally, energy prices affect all macroeconomic variables. However, the use of fossil energy resources increases CO_2 emissions, which causes climate change and affects the Earth dramatically. Among fossil energy sources, the type of energy that is more environmentally friendly is natural gas. Just like other energy sources, natural gas is not evenly distributed around the world. Therefore, while some countries in the world are natural gas exporters, some countries are natural gas importers. While there is a foreign trade surplus in natural gas exporting countries, there is a foreign trade deficit in natural gas importing countries. This situation shows why natural gas affects the world so much economically. Natural gas importing countries are affected by all the economic, geographical and political changes of the countries they import from. As a matter of fact, the 2008 global economic crisis, the 2018 currency-trade wars, the 2020 Covid-19 pandemic and the Russia-Ukraine war affected energy prices.

In this study, unlike the literature, the asymmetric relationship between natural gas price inflation and macroeconomic factors was examined, representing energy inflation. Among the macroeconomic factors, current account deficit, inflation and economic growth were used as independent variables.

The price of natural gas used in electricity generation, manufacturing industry, housing and service sectors in Turkey has increased significantly in recent years due to the impact of the Russia-Ukraine war.

This study was used and ARDL, NARLD analyses were applied. When the results of the ARDL model are examined for the long term, it is revealed that an increase in the producer price index increases natural gas inflation, while an increase in economic growth and balance of payments reduces natural gas inflation.

When the results of the ARDL model are examined for the short term, it is determined that an increase in the producer price index and economic growth increases natural gas inflation. In

the short term, when there is a deviation from the equilibrium, it is thought that the long-term equilibrium will be reached afterf approximately 1.8 quarters.

When the NARDL model results are evaluated for the long term, it has been proven that an increase in the producer price index increases natural gas inflation, and an increase in the gross domestic product and balance of payments reduces natural gas inflation. As a result, it was found that there is an asymmetric relationship between natural gas inflation and producer price index, natural gas inflation and gross domestic product, and natural gas inflation and balance of payments.

The obtained results are similar with the results of the studies performed by (Alıcı & Kızıltan, 2023; Akıncı, Aktürk & Yılmaz, 2012; Andreani & Giri, 2023; Bayat et al., 2013; Bawa et al., 2016; Breitenfellner et al.,2015; Choi et al., 2018; Cunado & Gracia, 2005; Clark & Terry, 2010; Chuku et al., 2011; Corsello & Tagliabracci, 2023; Erdoğan & Bozkurt, 2009; Giri, 2022; Haider et al., 2014; Karabulut & Danışoğlu, 2006; Kousar et al., 2022; Köse & Ünal, 2021; LeBlanc & Chinn, 2004; Liaqat et al., 2022; Özlale & Pekkurnaz, 2010; Yaylalı & Lebe, 2012; Qianqian, 2011; Zakaria et al., 2021) who examined the relationships between oil prices and macroeconomic factors. The main problem for both oil and natural gas is the dependence on imports. Therefore, dependence on imports needs to be reduced.

Considering the analysis results obtained in this study, it becomes clear that the natural gas in the Black Sea is a key factor in reducing Turkey's dependence on natural gas imports and ensuring energy supply security.

Turkey has the potential to become a natural gas center with its recent availability of natural gas in the Black Sea and its strategic location in natural gas pipelines. The transfer of natural gas found by neighboring countries to Turkey via pipeline is also important from an ecopolitical point of view. The developments in this field are as follows:

- With the Russia-Ukraine war, European Union member countries began to avoid using Russian natural gas. Although it is not easy to realize this situation in the short term, the steps taken have changed the energy geopolitics. It is planned that Turkey's role in the transmission of Russian natural gas will increase and a large supply center will be established in our country.
- Turkey's LNG[2] capacity is increasing day by day. While the operating LNG terminals are Marmara Ereğlisi, Egegaz, Aliağa FRSU[3]; the LNG terminals under construction are Saros FSRU and Dörtyol FSRU.
- On November 27, 2019, Turkey signed an agreement with Libya to delimit maritime jurisdiction. Simultaneously, the pipeline route designed to transfer the natural gas discovered in the Eastern Mediterranean to Europe by sea has come under the control of Turkey.
- In January 2022, the USA withdrew its support from the EastMed Pipeline Project, which was carried out to transport natural gas in the Eastern Mediterranean to Europe. This

[2] Liquefied natural gas.
[3] The Floating Storage and Regasification Unit.

decision is a development that will strengthen Turkey's position in the Eastern Mediterranean (SETA, 2022).

- In the period between August and December 2022, 710 billion m^3 of natural gas reserves were found in the Black Sea. It is estimated that when production reaches full capacity, reserves will meet 30% of the need in Turkey. With the third phase planned to be completed in 2028, daily production is expected to be 60 million m^3. Thus, dependence on imports of natural gas will end, and international fluctuations in natural gas prices will not affect our country (Eti et al., 2023; T.C. Presidency of the Republic of Türkiye) In light of all these developments, it is predicted that the Black Sea will move towards becoming the Caspian Sea or the Eastern Mediterranean.

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Etik Beyanı: Bu çalışmanın tüm hazırlanma süreçlerinde etik kurallara uyulduğunu yazar beyan eder. Aksi bir durumun tespiti halinde Fiscaoeconomia Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazarına aittir.

Ethical Approval: The author declares that ethical rules are followed in all preparation processes of this study. In the case of a contrary situation, Fiscaoeconomia has no responsibility, and all responsibility belongs to the study's author.