Sosyoekonomi

2023, Vol. 31(55), 125-149

RESEARCH ARTICLE

ISSN: 1305-5577
DOI: 10.17233/sosyoekonomi.2023.01.07
Date Submitted: 05.04.2022
Date Revised: 17.06.2022
Date Accepted: 24.11.2022

The Asymmetric Impacts of Oil Prices and Selected Macroeconomic Variables on Stock Markets: The Case of Turkey

Anıl AKÇAĞLAYAN *(https://orcid.org/0000-0002-4827-3636), Ankara University, Türkiye; gokkus@politics.ankara.edu.tr*

Sevgi Eda TUZCU *(https://orcid.org/0000-0002-3658-2546), Ankara University, Türkiye; stuzcu@politics.ankara.edu.tr*

Petrol Fiyatları ile Seçilmiş Makroekonomik Değişkenlerin Hisse Senedi Piyasasına Asimetrik Etkileri: Türkiye Örneği

Abstract

This paper investigates the asymmetric impacts of crude oil prices and other selected macroeconomic variables on the Turkish stock market for the period between 2005:01-2021:06 through the combination of the NARDL model and the quantile regression approach. The findings support the existence of cointegration between the stock market and oil prices. The variations in oil prices have asymmetric impacts in the long run. A positive shock by 1% decreases stock returns by 0.67%, while oil price declines have no significant impact. Quantile regressions show that the effects of oil price shocks are more visible at the low levels of the stock market.

Keywords : Crude Oil Prices, BIST100, NARDL, Asymmetric Effects, Quantile Regression.

JEL Classification Codes : E44, E52, G10, G12, Q43.

Öz

Bu çalışmada, 2005:01-2021:06 döneminde ham petrol fiyatları ile diğer seçilmiş makroekonomik değişkenlerin Türkiye hisse senedi piyasası üzerindeki asimetrik etkileri, NARDL modeli ve kantil regresyon yaklaşımı çerçevesinde ele alınmıştır. Bulgular, hisse senedi piyasası ile petrol fiyatları arasında eşbütünleşme olduğunu göstermektedir. Petrol fiyatlarındaki değişimin uzun dönemde asimetrik etkisi vardır. Petrol fiyatlarındaki %1'lik bir pozitif şok, hisse senedi fiyatlarını %0,67 düşürürken; fiyat düşüşlerinin anlamlı bir etkisi bulunmamaktadır. Kantil regresyon sonuçları, petrol fiyatı etkilerinin özellikle borsanın düşmekte olduğu dönemlerde gözle görülür hale geldiğini göstermektedir.

Anahtar Sözcükler : Ham Petrol Fiyatları, BIST100, NARDL, Asimetrik Etkiler, Kantil Regresyon.

1. Introduction

In his seminal work, Ross (1976) emphasises that stock prices can respond to many factors, not only the market portfolio but also a set of macroeconomic variables. Fama (1991) argues that stock prices contain expectations about future economic activity and represent company earnings and dividends. Since then, many studies have examined the impacts of different macroeconomic variables on stock returns. Among these variables, monetary policy indicators, inflation, interest rates, and exchange rates have been widely used (Fama, 1981; Chen et al., 1986; Bahmani-Oskooee & Sohrabian, 2006; Tiryaki et al., 2019; Çatık et al., 2020; Civcir & Akkoc, 2021). Yet, examining the effect of oil prices on financial markets is a relatively new topic. For this reason, the main aim of this paper is to investigate the asymmetric effect of oil price changes on returns in the Turkish stock market while considering the impacts of several macroeconomic variables on this relationship. More specifically, the asymmetric relationship between oil prices, industrial production, interest rates, exchange rates, and the BIST100 index of Borsa Istanbul is examined for the period 2005:01-2021:06.

The need for energy sources other than oil has become apparent in recent years. The share of renewable energy production has been steadily growing. The World Energy Outlook (2021) predicts that the new energy economy will rely more heavily on clean energy sources in the future. Although the importance of these alternative energy sources alongside natural gas and coal has increased, the leading share of oil in the world's energy consumption has not changed. The World Energy Outlook (2021) forecasts a peak in global oil demand around 2025. This high dependence on oil for energy demand makes countries vulnerable to oil price fluctuations. The relationship between oil prices and selected macroeconomic variables has long been studied since the oil shocks in the 1970s.

For Turkey, the importance of oil is even more pronounced compared to other emerging countries. 32% of Turkey's energy supply comes from oil, the largest energy source for the country's total final consumption (IEA, 2021)[1]. Turkey's dependence on oil imports is also very high. In 2016, the country ranked 58th in the world in terms of oil production but 22nd in terms of oil consumption[2], which makes Turkey a net oil and refined products importer. Nearly 90% of Turkey's oil consumption is covered by foreign suppliers, which significantly increases the input costs[3], particularly when the depreciation of the Turkish Lira against the foreign currencies since 2015. Turkey specialises in diversifying oil supply sources to manage these costs more efficiently[4]. The dependence on oil as a primary energy source has decreased quite a bit in recent years, but fluctuations in the price of oil

---

1 *International Energy Agency (IEA), Turkey 2021, Energy Policy Review, retrieved from: <https://iea.blob.core.windows.net/assets/cc499a7b-b72a-466c-88de-d792a9daff44/Turkey_2021_Energy_Policy_Review.pdf>, 05.01.2022.*

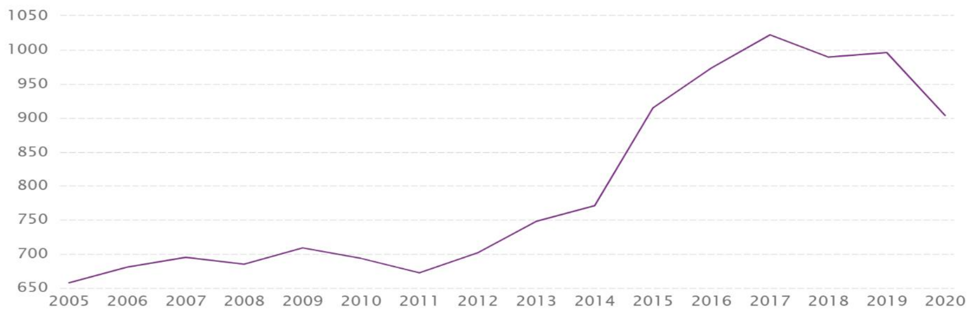
2 *<https://www.worldometers.info/oil/turkey-oil/>, 11.02.2022.*

3 *IEA, <https://www.iea.org/data-and-statistics>, 11.02.2022.*

4 *IEA, Turkey 2021, Energy Policy Review, <https://iea.blob.core.windows.net/assets/cc499a7b-b72a-466c-88de-d792a9daff44/Turkey_2021_Energy_Policy_Review.pdf>, 05.01.2022.*

still protect its vital position in the Turkish economy. Figure 1 demonstrates the evolution of Turkey's oil consumption from 2005 to 2020, where the y-axis shows barrel/ day consumption and the x-axis is the years.

Figure: 1
The Changes in the Oil Consumption of Turkey between 2005 and 2020



Source: <https://www.ceicdata.com/en/indicator/turkey/oil-consumption>, 25.02.2022.

Changes in oil prices can affect stock market indices through many channels. Oil price increases raise production costs, negatively affecting corporate profits, leading to lower cash flows and dividends and, ultimately, lower stock returns (Smyth & Narayan, 2018). Positive oil price shocks also cause households to consume fewer non-oil-related goods and services as energy and energy-related goods become more expensive. The steady rise in oil prices can create inflationary pressures on central banks, forcing them to adjust monetary policy accordingly (Bernanke & Kuttner, 2005, Degiannakis et al., 2018). Interest rate hikes harm stock prices. Finally, investors can perceive the rise in oil prices in different ways. They can react positively to it by associating the price rise with an economic boom or negatively by interpreting this rise as a signal for increased risk premiums (Smyth & Narayan, 2018).

Stock markets have the traditional role of providing liquidity, allocating capital, accelerating economic growth, and producing information for investors. As an emerging market, Borsa Istanbul, the Turkish Stock Exchange, has an important place in the Turkish economy. Currently, 539 companies are traded in BIST Istanbul. According to the latest annual report of Borsa Istanbul (Borsa Istanbul 2020), the market value of the stock exchange in 2020 was 1.783 billion TL, which is 31st among the stock exchanges in the world. With a trading volume of TL 31.3 billion, it is one of the most traded exchanges globally. The total contribution of BIST Istanbul to the total income was 38% in 2020, while the Turkish stock exchange alone contributed 14% to the total revenue in the same year. Although stocks of energy companies have a lower portion in the entire stock market index, oil prices are expected to be influential on the stock exchange due to the input costs and other transmission channels. Çatık, Huyugüzel Kışla, and Akdeniz (2020) also indicate that due to the strong influence of foreign investors in the Turkish stock market, global oil market fluctuations will have a significant effect on asset pricing behaviour in Turkey. Therefore, as an oil-exporting country, it is crucial to understand the relationship between oil price shocks and stock prices in Turkey.

In this study, we examine the impacts of positive and negative oil price shocks on Borsa Istanbul between 2005:01 - 2021:06 with monthly data employing the NARDL model. Besides the oil prices, the potential asymmetric effects of the changes in income and exchange rates are also considered in the model. Previous literature investigates the relationship between oil price changes and stock market returns with various methodologies, including vector autoregressive models, regression models, and the ARDL approach. Smyth and Narayan (2018) indicate clearly that oil price changes have asymmetric impacts on stock returns for different markets. For Turkey, it is also put forth that this relationship is nonlinear and asymmetric (for example, Altıntaş & Yacouba 2018). Yet, very few of these studies apply NARDL as their primary model (for instance, Tiryaki et al., (2019) and Civcir and Akkoc (2021)). Different from the previous studies for Turkey, we select the NARDL approach as our primary methodology to investigate the asymmetric effects. In this sense, our study shows similarities with Tiryaki et al. (2019), in which they consider the asymmetric impacts of oil price changes and selected macroeconomic variables with the same method. However, our choice for monetary policy proxy is different from their study. We employ short-term interest rates as a monetary policy proxy which has been the primary monetary policy tool since the 2000s, not money supply.

Alongside the asymmetry in the oil price-stock market nexus, we further investigate the source of asymmetry in the oil price-stock returns relationship and the role of monetary policy changes in this association. To do so, we benefit from OLS and quantile regressions which include the oil price shocks and their interactions with short-term interest rates as explanatory variables. The quantile regression approach allows us to detect the impact of oil price shocks on the different states of the stock market, namely bearish, regular, and bullish markets. To the extent of our knowledge, our study is the first that combines the NARDL and quantile regression approaches to examine the oil price-stock market nexus for Turkey. This study also contributes to the existing literature by using the most recently available period and showing short-term interest rates' effects on the Turkish stock exchange.

Our findings demonstrate supporting evidence for a long-term asymmetric cointegration relationship among oil prices, exchange rates, income, and stock exchange. We also show the asymmetric effects of oil price variations on the Turkish stock exchange. We find that the Turkish stock exchange is negatively affected by oil price increases but does not react to the oil price decreases. Similarly, our results reveal asymmetric impacts of interest rate and exchange rate changes on the stock market. Our findings also suggest that oil prices as a global factor play a leading role in determining stock returns. These findings will also allow us to offer policies for other energy-dependent emerging economies.

The remainder of this study is organised as follows: First, the literature that investigates the influence of oil price changes is described thoroughly. Second, the NARDL method, the quantile regression approach, and the data employed are explained. The following section demonstrates and interprets the results of unit root tests and estimations from the NARDL model and the quantile regressions. The final section concludes with policy implications.

2. Literature

Crude oil has been accepted as one of the most strategic commodities in the world. The rise and downs in oil prices drive both macroeconomic trends and corporate profitability, geopolitical situations and consumer sentiment. Therefore, it is possible to expect significant effects of oil price changes on stock market indices and economies. Theoretically, the impacts of oil prices can be negative or positive. One can distinguish the effects of positive oil price shocks on production and consumption in different channels for oil-importing countries: First, the share of household expenses on energy and energy-related goods will be increased, resulting in a lower percentage for other goods and services. That is, the total consumption of households will be affected negatively. Second, production costs will rise for countries where oil production demand cannot be satisfied. Oil is one of the primary inputs for producing goods and services, as well as capital and labour. The rise in production costs is almost inevitable, especially when there is no close substitute for oil as an input. The cash flows to the firms will be lower, and eventually, stock prices will decrease (Smyth & Narayan, 2018).

Oil price - stock market association is also affected by monetary policy changes. Increasing oil prices will create an inflationary pressure on central banks, which leads to higher interest rates. Bernanke and Kuttner (2005) note three monetary policy channels for this relationship due to an increase in short-term interest rates. First, increased interest rates will be used as discount rates for future stock dividends, resulting in lower dividends. Second, these interest rates will also be used to discount the future cash flows from firm investments. Higher interest rates will generate lower net present values, similar to stock dividends. Degiannakis et al. (2018) argue that the negative consequences of higher oil prices on stock returns in oil-importing countries will be more severe if the central bank has low credibility in terms of maintaining general price stability in the market. The third effect is through the evaluation process of bonds and bank deposits. As the interest rates rise, returns from bank deposits and bonds will be higher, so these investment options will be seen as more profitable than stock investments. Investing in the stock market will have a higher opportunity cost. As a result, investors will direct their cash flows to the bond market and bank deposits instead of stock markets.

Oil prices also have the potential to influence stock markets indirectly because oil itself as a commodity is one of the investment alternatives in the financial markets. The increase in oil prices will change the portfolio structure of investors and thus affect stock prices. Similarly, Demirer et al. (2020) argue that fluctuations in oil prices can drive investor sentiment. The favourable price shocks can be viewed as increased risk premia in financial markets. Increased uncertainty and risk premia will harm investment decisions (Degiannakis et al., 2018). However, it is also possible to interpret rising oil prices as a sign of an economic boom, as they may represent better corporate performance and rising stock prices (Smyth & Narayan, 2018). These indirect and contradictory effects are particularly pronounced in oil-importing emerging markets such as Turkey.

The literature discusses oil prices as a central factor affecting world economies. Many have investigated the relationship between oil price shocks and several macroeconomic indicators, including industrial production and inflation (Hamilton, 1983; James & Kaul, 1996; Aykırı, 2020) and even other energy sources demand, such as electricity (Akarsu, 2017). Yet, studies examining the effects of oil price changes on financial markets are relatively new.

Empirical evidence focusing on the effects of oil prices on stock prices mainly considers developed countries. The findings from these studies vary based on the methodology employed, the forecast period, and whether countries import or export oil. One of the first studies in this field belongs to Jones and Kaul (1996). They show that the increase in oil prices significantly negatively impacts stock returns in Canada, Japan, the UK, and the USA. Park and Ratti (2008) examine oil price shocks and stock return association for 13 European countries and the USA between 1986 and 2005. Their results indicate that the fluctuations in oil prices decrease stock returns in many European countries. Miller and Ratti (2009) and Kilian and Park (2009) also find supporting evidence for the deteriorating effect of increased oil prices on the stock exchange. There is contradictory evidence as well. Narayan and Narayan (2010) and Arouri and Rault (2012) demonstrate that either oil prices do not influence stock market indices, or this effect is positive. Huang et al. (1996) also find that oil price shocks do not affect stock price returns. Aydoğan, Tunç, and Yelkenci (2017) look at the effects of oil price changes on stock market returns for net oil exporters and importers with a VAR methodology and Granger causality test. They find that oil price changes influence oil-importing countries' stock markets more than oil-exporting ones.

The effects of oil price increases on many macroeconomic variables, including production and inflation levels for Turkey, have also been discussed in the literature (i.e., Berument & Taşçı, 2002; Dedeoğlu & Kaya, 2014; Altay et al., 2013; Doğrul & Soytaş, 2010). The literature discussing this effect on the Turkish stock market usually assumes a symmetric association. These studies mainly employ VAR methodology and causality tests, and the findings vary. Some even show that oil prices and stock markets are positively related. For example, with VAR methodology and weekly data, Eryiğit (2012) investigates the relationship between the BIST100 index, interest rates, and oil prices. The data period covers the dates between 01.07.2001 and 31.10.2008, and the findings indicate a positive association. Halaç et al. (2013) investigate monthly data from BIST 100, crude oil prices, and nominal exchange rate by cointegration method while considering structural breaks. Their evidence also supports a positive association between oil prices and stock returns.

Ünlü and Topçu (2012) examine two different periods, 1990-2001 and 2001-2011, for BIST100 and oil prices relationship by employing cointegration and causality analyses.

They cannot show cointegration or causality for the first period for these two variables. For the second period, however, they find that these variables move together in the long run, and there is one-way causality from oil prices to the stock market index. Contrary to expectations, they show that the increase in oil prices positively affected Turkish stock market returns in the second analysis period. Kapusuzoğlu (2011) shows a long-term one-way Granger causality from BIST 100, BIST 50, and BIST 30 indices to oil prices.

Ekşi et al. (2012) examine the sensitivity of 7 sub-sectors of the manufacturing industry as a stock market proxy to oil prices for the period of 01:1997-12:2009. Their error correction model and Granger causality tests indicate a causality from oil prices to chemistry and base metal industries. Such a causality cannot be shown for other sectors in the short or long term. Similarly, Çatık, Huyugüzel Kışla, and Akdeniz (2020) investigate the sensitivity of Turkish main sectoral stock returns to oil price fluctuations. They consider both the structural breaks in their dataset that cover the period of 03:1997-09:2018 and time-varying parameters in the association. Their results indicate that the dependence on oil prices significantly changes across sectors and time.

In the studies mentioned above that examine Turkey, the relationship between oil prices and the Turkish stock market is assumed to be linear and symmetric. Yet, it is possible to observe a nonlinear and asymmetric relationship between these two. Mork (1989) claims that a change in oil prices creates nonlinear effects. The lack of evidence in the literature for the linear development of oil prices on financial markets may be due to the asymmetric nature of this relationship. Smyth and Narayan (2018) note that there is no reason to believe that this association is uniform for price ups and downs. The possible asymmetric effects have been examined more closely with the recent econometric models in the literature.

Altıntaş and Yacouba (2018) employ the NARDL model to investigate the sensitivity of stock markets to money supply and oil prices for the period of 1988:01-2014:12. In this study, the money supply is considered the primary monetary policy tool. The findings of this study indicate that there is a long-term cointegration association among the variables mentioned above. It is also shown that expansionary monetary policy positively impacts the Turkish stock exchange while tightening has adverse effects. Altıntaş and Yacouba (2018) provide supporting evidence for the asymmetric results of oil price changes on the Turkish stock exchange for the long term. They find that favourable oil price shocks negatively affect stock prices, supporting the increased cost of production argument. The oil price decreases, on the other hand, do not affect stock prices.

Civcir and Akkoc (2021) contribute to the literature on the relationship between oil prices and the stock market by examining sector-level data from Turkey. They consider possible asymmetric effects of oil price shocks on sectoral stock prices in the short- and long-run using the NARDL approach. Their dataset includes daily data on crude oil prices, exchange rates, and subsector stock market indices for the period from 02:2009 to 04:2019. This dataset allows them to examine the relationship between oil prices and the stock market in the period following the global financial crisis. They confirm the nonlinearities, particularly in the short run, but the oil price-stock market association varies by sector. They show that sectors related to financial markets are the most affected by the oil price increase in the long run.

Tiryaki et al. (2019) also look at the impact of the industrial production index, M3 money supply, and real effective exchange rates on stock market returns in Turkey for two different periods, namely 1994:01-2017:05 and 2002:01-2017:05 periods, with the NARDL model. They find that these three variables have long-term asymmetric effects on stock market returns, but these effects are more significant after 2002 than the entire period. The findings also reveal that the positive impact of expansionary monetary policy on stock markets is more critical than the adverse effects of contractionary monetary policy.

Although this paper has a similar aim to Tiryaki et al. (2019) and Civcir and Akkoç (2021), there are significant differences between these studies. First, in this study, short-term interest rates are employed to reflect the central bank’s position, not the M3 money supply, as in Tiryaki et al. (2019) and Altıntaş and Yacouba (2018). Before the 2000s, the main monetary policy instrument was the money supply. However, since the early 2000s, this changed, and interest rates became Turkey's primary monetary policy instrument. They are using the money supply as a monetary policy proxy, as in Tiryakioglu et al. (2019) and Altıntaş and Yacouba (2018), depending on the assumption that the money supply is endogenous. However, we believe that using interest rates will provide a better picture of the stance of central banks toward oil price changes.

The second difference between the studies mentioned above lies in the data used in this paper. Tiryaki et al. (2017) analysed monthly data up to 2017 in two subperiods. Civcir and Akkoç (2021) work with daily data for crude oil prices, exchange rates, and sectoral indices of stock markets. However, this study uses monthly and the most recent data available. For the analysis, the period from 2005 to 2021 is covered. Therefore, we hope that this study presents the current relationship between oil prices and the stock market in Turkey in a non-linear form by employing a NARDL approach. This is one of the contributions of this paper to the growing literature in this field.

This study also differs from the previous literature by examining the source of asymmetry in the oil price-stock market returns relationship while emphasising the role of monetary policy changes. The oil price shocks, namely economic activity demand shock, oil inventory demand shock, oil consumption demand shock, and oil supply shock, are considered the possible reasons for asymmetry, and OLS examines their effects. Quantile regression approaches for different states of the stock market. In this sense, this study is the first that combines the NARDL and quantile regression methods to investigate the oil price-stock market association for Turkey.

3. Data and Methodology

3.1. Data

To examine the possible asymmetric relationship between stock market returns and selected macroeconomic variables, monthly data from the 2005:01-2021:06 period is employed. As discussed in the previous section, the theoretical and empirical literature uses other macroeconomic variables in this association. Following the earlier studies, industrial production index (y) (as in Tiryaki et al., 2019; Erdem et al., 2005; Kandır, 2008; Scholtens & Yurtsever, 2012; Park & Ratti, 2008), interest rates (i) (following Scholtens & Yurtsever, 2012; Park & Ratti, 2008), exchange rates (exc) (Tiryaki et al., 2019), and crude oil prices (oil) are used as the main determinants of stock returns.

BIST 100 index from Borsa Istanbul is used as the proxy for stock prices in Turkey. This is the main index for Borsa Istanbul, including the selected shares traded in the Stars Market[5]. Turkey's monthly industrial production index represents industrial production (2015=100). To reflect the Central Bank’s monetary stance of the Republic of Turkey, interest rates are employed. The exchange rate in US dollars reflects both the international trade relationships and the effects of economic and political changes. An increase in the exchange rates can be interpreted as the depreciation of the Turkish Lira. The Brent-Europe oil price (per barrel in US dollars) is used for oil prices. The industrial production index, exchange rates, and BIST100 data are obtained from the Electronic Data Delivery System of the Central Bank of Turkey. The US Energy Information Administration (EIA) accepts the oil price series. All the variables except interest rates are used in natural logarithms.

To examine the role of oil price shocks in the oil price-stock market relationship, we also employ publicly available oil price shock data computed based on the paper by Baumeister and Hamilton (2019) and provided by Christiane Baumeister's webpage[6].

3.2. The NARDL Approach

Previous literature tests the oil price-stock market return relationship with various methodologies. These include vector autoregressive models (i.e., Sadorsky, 1999; Eryiğit, 2012), different regression models (i.e., Scholtens & Yurtsever, 2012; Nusair & Al-Khasawneh, 2018; Mokni, 2020), GARCH specifications (i.e., Sadorsky, 1999; Arouri & Nguyen, 2010) and ARDL models (Al-haji et al., 2017; Tursoy & Faisal, 2018). These models assume that the relation between oil price and stock market returns is linear. For Turkey, among others, Altıntaş and Yacouba (2018), Tiryaki et al. (2019), and Civcir and Akkoc (2021) find evidence supporting that the association mentioned above is nonlinear and asymmetric. We employ the nonlinear autoregressive distributed lag model as our primary model to account for the asymmetric cointegration relationship between variables.

---

5 *Borsa Istanbul stock indices ground rules determine the definition of BIST 100. <https://www.borsaistanbul.com/files/bist-stock-indices-ground-rules.pdf>, 12.01.2022.*

6 *<https://sites.google.com/site/cjsbaumeister/datasets>, 20.05.2022.*

Nonlinear ARDL (NARDL) is developed by Shin et al. (2013) as an extended version of linear autoregressive distributed lag with short- and long-term asymmetric effects, which Pesaran and Shin have previously proposed (1999) and Pesaran, Shin, and Smith (2001).

The cointegration relationship can be examined with other methods as well. Engle and Granger's (1987) procedure is proper when there are only two variables, whereas Johansen and Juselius's (1990) method is employed when there are many variables. Both of these methods require that all variables be integrated into order one (I(1)). Unlike Engle and Granger and Johansen and Juselius procedures, Pesaran et al. (2001) developed a bound test approach that can be applied even when the variables have different orders of integration. The general dynamic specification of ARDL can be used when the variables are level or first difference stationary. Another advantage of ARDL is that it can decompose the long-term relationship among variables when they are not stationary second difference. The asymmetric bound test is also efficient for small samples using ARDL because all variables' lags can be added to the model. Despite all these advantages over other cointegration procedures, ARDL does not consider asymmetric effects. Shin et al. (2013) add these asymmetric effects into the model and develop the nonlinear ARDL model. Unless the data is integrated into order two (I(2)), NARDL can be successfully employed (Pesaran et al., 2001).

The ARDL model that investigates the symmetric cointegration relation between stock market returns and other macroeconomic variables can be seen in Eq. (1):

$$\Delta Bİ ST100_t = \theta_0 + \theta_b Bİ ST100_{t-1} + \theta_y y_{t-1} + \theta_{oil} oil_{t-1} + \theta_i i_{t-1} + \theta_{exc} exc_{t-1} + \sum_{i=1}^{p-1} \alpha_i \, \Delta Bİ ST100_{t-i} + \sum_{i=1}^{p} \rho_i \, \Delta y_{t-i} + \sum_{i=1}^{r} \beta_i \, \Delta oil_{t-i} + \sum_{i=1}^{s} \varepsilon_i \, \Delta i_{t-i} + \sum_{i=1}^{u} \sigma_i \, \Delta exc_{t-i} + \epsilon_t \quad (1)$$

In Eq. (1), BIST100, *y*, *oil*, *i* and *exc* are stock market return, industrial production index, oil prices, interest rates, and exchange rates, respectively. The first part on the right-hand side of this equation reflects the cointegration association. θs represent the long-term coefficients. The second part of this equation shows the short-term effects. The following null hypothesis tests the symmetric cointegration relationship among variables: $\theta_b = \theta_y = \theta_{oil} = \theta_i = \theta_{exc} = 0$. Pesaran et al., (2001) provide upper critical values when all variables are I(1) and lower critical values when all variables are I(0). If the calculated F statistic is higher than the upper critical value, the null hypothesis of no cointegration is rejected. That is, evidence supports the existence of a long-term cointegration relationship between dependent and explanatory variables. This result indicates the co-movement of these variables in the long run. When the calculated F test is lower than the lower critical values, one can conclude that there is no cointegration. The area in between is the indecisive area.

Yet, the short- and long-term association between variables can be asymmetric and symmetric. The asymmetric and nonlinear effects of explanatory variables on the dependent variable can be examined through the NARDL method. New time series variables created by the positive and negative partial sums of explanatory variables are used to test the short- and long-term asymmetric effects. The new series derived from the oil price variable can be seen below:

$$oil_t = oil_0 + oil_t^+ + oil_t^- \qquad (2)$$

In this equation, oil_0 represents the initial value, oil_t^+ and oil_t^- are the positive and negative partial sums.

$$oil_t^+ = \sum_{i=1}^{t} \Delta oil_i^+ = \sum_{i=1}^{t} maks(\Delta oil_i, 0)$$
$$oil_t^- = \sum_{i=1}^{t} \Delta oil_i^- = \sum_{i=1}^{t} min(\Delta oil_i, 0) \qquad (3)$$

One of the advantages of the NARDL model is that this model can investigate the asymmetric effects of all variables or some of them. In this study, the possible nonlinearity in the effects of all variables on stock markets is considered. Therefore, the nonlinear and asymmetric cointegration relationship can be shown as follows:

$$BİST100_t = \theta_0 + \theta_y^+ y_t^+ + \theta_y^- y_t^- + \theta_{oil}^+ oil_t^+ + \theta_{oil}^- oil_t^- + \theta_{exc}^+ exc_t^+ + \theta_{exc}^- exc_t^- + \theta_i^+ i_t^+ + \theta_i^- i_t^- + e_t \qquad (4)$$

e_t demonstrates the deviations from the long-term equilibrium in the cointegration relationship presented in Eq. (3). ϴ+ and ϴ- denote the impacts of positive and negative variations respectively in the explanatory variable on the dependent variable in the long-run. The asymmetric cointegration model can be obtained by the combination of Eq. (1) and Eq. (4) as follows:

$$\Delta BİST100_t = \theta_0 + \theta_B BİST100_{t-1} + \theta_y^+ y_{t-1}^+ + \theta_y^- y_{t-1}^- + \theta_{oil}^+ oil_{t-1}^+ + \theta_{oil}^- oil_{t-1}^- + \theta_{DK}^+ exc_{t-1}^+ + \theta_{DK}^- exc_{t-1}^- + \theta_i^+ i_{t-1}^+ + \theta_i^- i_{t-1}^- + \sum_{i=1}^{p-1} \alpha_i \Delta BİST100_{t-i} + \sum_{i=0}^{q} \beta_y^+ \Delta y_{t-i}^+ + \sum_{i=0}^{q} \beta_y^- \Delta y_{t-i}^- + \sum_{i=0}^{q} \beta_{exc}^+ \Delta exc_{t-i}^+ + \sum_{i=0}^{q} \beta_{exc}^- \Delta exc_{t-i}^- + \sum_{i=0}^{q} \beta_i^+ \Delta i_{t-i}^+ + \sum_{i=0}^{q} \beta_i^- \Delta i_{t-i}^- + \sum_{i=0}^{q} \beta_{oil}^+ \Delta oil_{t-i}^+ + \sum_{i=0}^{q} \beta_{oil}^- \Delta oil_{t-i}^- \qquad (5)$$

As mentioned, the lagged variables in the first part of Eq. (5) show long-term asymmetric cointegration association. Following Shin, Yu, and Greenwood-Nimmo (2013), first, classical OLS is applied to Eq. (5). To test the long-term asymmetric association among variables, the FPSS test proposed by Pesaran et al. (2001) is conducted. This test has the following null and alternative hypotheses that analyse the existence of cointegration.

$$H_0: \theta_B = \theta_y^+ = \theta_y^- = \theta_{oil}^+ = \theta_{oil}^- = \theta_i^+ = \theta_i^- = \theta_{exc}^+ = \theta_{exc}^- = 0 \qquad (6)$$

$$H_1: \theta_B \neq \theta_y^+ \neq \theta_y^- \neq \theta_{oil}^+ \neq \theta_{oil}^- \neq \theta_i^+ \neq \theta_i^- \neq \theta_{exc}^+ \neq \theta_{exc}^- \neq 0 \qquad (7)$$

The rejection of the null hypothesis supports a long-term asymmetric relationship. The long-term coefficients of positive and negative shocks are normalised by θ_b. For the long-term coefficients of oil price increases and decreases, the following formulae are used respectively[7]: $L_{oil^+} = \frac{-\theta_{oil}^+}{\theta_b}$ and $L_{oil^-} = \frac{-\theta_{oil}^-}{\theta_b}$. The asymmetric relationship between the explanatory variable and the dependent variable is tested by using the Wald test. For example, if the null hypothesis of $L_{oil^+} = L_{oil^-}$ can be rejected, one can infer that the ups and downs in the oil prices have different effects on the stock market index.

The second part of Eq. (5) reflects short-term effects. For this equation, the expectation for the coefficients of y^+_{t-1}, dy^+_{t-i}, and variables are positive. The production growth is likely to increase company profits and cash flows, so production and stock prices are expected to move in the same direction. Interest rate increases are expected to affect stock prices in the short- and long-term negatively. A contractionary monetary policy reduces the demand for company stocks, so the stock prices decline. On the contrary, an expansionary monetary policy will stimulate the demand for company stocks so that the stock prices will rise. As a result, the expectations for the coefficients of i^-_{t-1} and d^-i_{t-i} variables are positive[8].

As an oil-importing country, we expect to observe an inverse effect of oil price increases on stock prices in Turkey. For the impact of exchange rate variations on stock markets, more than one factor plays a role. When the local currency depreciates, the competitive power of export companies increases, so their stocks will be appreciated, however, the imported inputs will be more expensive, and such a change in exchange rates will decrease stock prices.

3.3. The Quantile Regression Approach

Oil price- stock market association can also be sensitive to the origin of the oil price changes[9]. As Kilian (2009) noted, different oil shocks can explain the differences in stock markets in response to oil price fluctuations. Therefore, the asymmetric reaction of the stock market shown in the previous section can result from different oil price shocks. Mokni (2020) also notes that different states of stock markets (namely bearish, regular, or bullish markets) can respond differently to these shocks. In this section, we investigate the effects of different oil price shocks on the Turkish stock market returns for other market conditions.

Kilian (2009) defines oil price shocks as follows: *Supply-side shocks* reflect the availability of crude oil. *Aggregate demand shocks* are due to the changes in global oil demand driven by variations in the global business cycle. *Oil-specific demand shocks* are

---

7 *The long-term coefficients of other variables in the model are computed in the same way:* $L_{y^+} = \frac{-\theta_y^+}{\theta_b}$ *and* $L_{y^-} = \frac{-\theta_y^-}{\theta_b}$ *represent the increase and decreases in the industrial production.* $L_{i^+} = \frac{-\theta_i^+}{\theta_b}$ *and* $L_{y^-} = \frac{-\theta_i^-}{\theta_b}$ *are used for long term coefficients of interest rate increase and decreases.* $L_{exc^+} = \frac{-\theta_{exc}^+}{\theta_b}$ *and* $L_{exc^-} = \frac{-\theta_{exc}^-}{\theta_b}$ *are employed to compute the long-term coefficients of exchange rate increase and decreases respectively.*

8 *Recently, studies show that contractory monetary policy will have more effects on stock markets than expansionary policy (for example, Tiryaki et al., 2019).*

9 *We would like to thank to the anonymous referee to draw our attention to this point.*

caused by the increased demand for oil due to precautionary reasons, such as fears of future oil deficits. Based on the study by Baumeister and Hamilton (2019), we consider three types of demand shocks: economic activity shocks, oil consumption demand shocks, and oil supply shocks. Oil supply shocks reflect supply-side shocks. To observe the separate impacts of these shocks, the following linear model is employed:

$$dBIST100_t = \beta_0 + \beta_1 Oecon_t + \beta_2 Ocons_t + \beta_3 Oinvent_t + \beta_4 Osupply_t + \varepsilon_t \quad (8)$$

Where dBIST100 is the natural logarithm of stock market returns in the first difference, and the righthand side variables represent economic activity shocks ($O_{econ,}$), oil consumption demand shocks ($O_{cons,}$), oil inventory demand shocks ($O_{invent,}$), and oil supply shocks ($O_{supply,}$), respectively.

We also examine the effects of monetary policy changes on the oil shocks-stock market association described in Eq. (8) by adding interaction terms with short-term interest rates (I). Eq (9) shows this situation:

$$dBIST100_t = \gamma_0 + \gamma_1 Oecon_t + \gamma_2 Ocons_t + \gamma_3 Oinvent_t + \gamma_4 Osupply_t + \gamma_5 Oecon_t * I_t + \gamma_6 Ocons_t * I_t + \gamma_7 Oinvent_t * I_t + \gamma_8 Osupply_t * I_t + \vartheta_t \quad (9)$$

Both Eq (8) and (9), when estimated with OLS, summarise the average impact of oil price demand supply shocks on the stock market returns. In other words, these models defined in Eq (8) and (9) answer the following research question: "Do the oil shocks (and their interactions with interest rates) affect stock market returns?". In this paper, we argue that oil price changes can have an asymmetric impact on stock market returns, which may vary based on the state of the stock markets. Therefore, we need to ask whether oil price shocks affect different conditions of stock markets, namely in bearish, regular, or bullish markets. This research question can be answered through the quantile regression approach developed by Koenker and Bassett (1978). This model weights observations asymmetrically depending on the over or under-prediction of the true model. The weight for positive deviations from the regression line will be τ, whereas the negative deviations will be penalised by (1-τ) (Baum, 2013). Linear programming optimisation methods obtain the minimisation of the sum of deviations. Quantile regressions also have the advantage of being robust against non-normality in the error terms and the presence of outliers.

Quantile regression models have been used to examine oil price-stock market association (for instance, Lee & Zeng, 2011; Nusair & Al-Khasawneh, 2018; Mokni, 2020). The quantile regression models are defined below:

$$dBIST100_t(\tau/x) = \beta_0^\tau + \beta_1^\tau Oecon_t + \beta_2^\tau Ocons_t + \beta_3^\tau Oinvent_t + \beta_4^\tau Osupply_t + \beta^\tau E_t \quad (10)$$

This model takes the following form when the interaction terms are also added.

$$dBIST100_t(\tau/x) = \gamma_0^\tau + \gamma_1^\tau Oecon_t + \gamma_2^\tau Ocons_t + \gamma_3^\tau Oinvent_t + \gamma_4^\tau Osupply_t + \gamma_5^\tau Oecon_t * I_t + \gamma_6^\tau Ocons_t * I_t + \gamma_7^\tau Oinvent_t * I_t + \gamma_8^\tau Osupply_t * I_t + \gamma^\tau E_t \quad (11)$$

Following Nusair and Al-Khasawneh (2018), nine quantiles are computed (τ = 0.10, 0.20, 0.30, …., 0.90). The three states of the stock market are defined as follows: Quantiles from 0.10 to 0.30 represent a bearish stock market, quantiles from 0.40 to 0.60 correspond to a regular stock market, and the rest shows a bullish stock market.

4. Empirical Findings

4.1. Asymmetric Relationship between Stock Returns and Macroeconomic Variables: NARDL Approach

The NARDL model can be used if the data is not integrated into order two. Therefore, this study begins with the unit root tests. The sample period covered in this study includes the 2008 financial crisis, which may cause a structural break. Therefore, to test whether the data is stationary**,** besides the traditional ADF test, the Breakpoint test, which also takes the structural breaks into account, is applied. The results are presented in Table 1.

Table: 1
Unit Root Test Results

ADF			Breakpoint			
Variable	**Model and Number of Lags**	**t-stat**	**Model and Number of Lags**	**t-stat**	**Structural Break Date**	**Result**
BIST100	a (1)	-2.43	(0)	-2.81	2009:02	I(1)
dBIST100	b (0)	-16.44***	(0)	-17.03***	2008:10	I(0)
y	a (5)	-2.97	(1)	-2.90	2010:02	I(1)
dy	b (4)	-9.69***	(0)	29.76***	2020:06	I(0)
oil	b (1)	-3.22*	(1)	-3.85	2004:06	I(1)
doil	c (0)	-13.26***	(0)	-16.25***	2020:03	I(0)
exc	a (12)	-1.10	(2)	-2.93	2016:09	I(1)
dexc	a (11)	-6.55***	(0)	-12.71***	2018:08	I(0)
a: Constant and trend; b: Constant; c: No constant or trend model						
*, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.						

ADF and breakpoint test results in Table 1 indicate that all variables are first difference stationary. The results in Table 1 also indicate different structural break dates for the variables employed in this analysis. These different structural break dates show the existence of specific factors affecting the macroeconomic variables. More specifically, this finding implies an asymmetric relationship in the short and long run. In addition, the structural break dates of the stock markets and exchange rates correspond to the global crisis in 2008 and the shock in the exchange rates in 2018, respectively.

Since BIST100 is integrated into order one and no series is integrated into order two, the best model to test the relationship between stock prices and the selected macroeconomic variables is NARDL.

The analysis starts with a model including 24 lags. The model is re-estimated by excluding insignificant explanatory variables. The findings from the cointegration test (FPSS) are reported in Table 2.

Table: 2
Cointegration (F_{PSS}) Test

	F Statistics F_{PSS}	Critical Values*		
		I(0)	I(1)	Conclusion
Bist100 = F(y, oil, exc, i)	17.77	2.86	4.01	Asymmetric Cointegration

** This shows the null hypothesis of no cointegration at the 5% significance level. The critical values for the bound test are obtained from Pesaran et al. (2001).*

The results in Table 2 reject the null hypothesis of no asymmetric cointegration since the computed F statistic is larger than the upper critical values. More specifically, this result supports the long-run asymmetric cointegration between stock prices and industrial production, oil prices, interest rates, and exchange rates. The coefficient of one period-lagged BIST100 variable, which demonstrates the cointegration relationship and is shown in Table 5, is also negative and significant, as expected.

Table 3 reflects the Wald test results in which the asymmetric effects of explanatory variables are tested. Wald test examines whether the coefficients of positive and negative partial sums of any explanatory variable are equal in the long run. If the equality of these partial sums cannot be rejected, one may conclude that a long-term symmetric relationship exists.

Table: 3
Wald Test Results for the Long-Run Asymmetric Relationship among Variables

	F statistic (Probability)	Conclusion
$WALD_{oil}$ (Loil+= Loil-)	20.06*** (0.0000)	Asymmetric
$WALD_{y}$ (Ly+= Lyl-)	13.97*** (0.0004)	Asymmetric
$WALD_{i}$ (Li+= Li-)	11.18*** (0.0014)	Asymmetric
$WALD_{exc}$ (Lexc+= Lexc-)	72.77*** (0.0000)	Asymmetric

The numbers in parentheses show probability values. They all indicate that the symmetric relationship is rejected at the 5% significance level.

The findings from this table reject the hypothesis stating that oil price changes create linear and symmetrical effects on BIST100. In other words, oil price changes affect stock prices asymmetrically. The same result is valid for other macroeconomic variables as well. The positive and negative partial sums for industrial production, interest, and exchange rates are unequal.

Next, the NARDL model is estimated to reflect the asymmetrical relationship between the stock market returns in Turkey and the selected macroeconomic variables. We re-estimate the NARDL model by excluding the variables that are statistically insignificant in explaining the dependent variable, and we obtain the finest model. The results from these estimations are shown in Table 4.

Table: 4
Results from NARDL Estimations for the Relationship between BIST100 and Selected Macroeconomic Variables

Dependent Variable: DBIST			
Variable	**Coefficient**	**Prob.***	
C	2.939***	0.0000	
BIST(-1)	-0.458***	0.0000	
Y_P(-1)	-0.108	0.2242	
Y_N(-1)	0.091	0.4006	
OILL_P(-1)	-0.310***	0.0000	
OILL_N(-1)	-0.028	0.4390	
I_P(-1)	-0.005**	0.0478	
I_N(-1)	0.014***	0.0081	
EXC_P(-1)	0.820***	0.0000	
EXC_N(-1)	-1.004***	0.0000	
DBIST(-2)	0.385***	0.0000	
DBIST(-4)	0.351***	0.0001	
DBIST(-5)	0.969***	0.0000	
DY_P(-5)	0.850***	0.0000	
DY_P(-6)	0.739***	0.0003	
DY_P(-8)	1.133***	0.0000	
DY_P(-10)	1.138***	0.0000	
DY_P(-11)	1.453***	0.0000	
DY_N(-8)	-0.659***	0.0004	
DOILL_P(-5)	-0.245***	0.0006	
DOILL_P(-7)	-0.792***	0.0000	
DOILL_P(-10)	-0.316***	0.0009	
DOILL_P(-12)	0.122***	0.0000	
DOILL_N(-2)	0.288***	0.0000	
DOILL_N(-3)	0.414***	0.0000	
DI_N(-1)	0.122***	0.0000	
DI_N(-2)	-0.118***	0.0000	
DI_N(-3)	0.097***	0.0000	
DI_N(-4)	0.044***	0.0085	
DI_N(-6)	0.083***	0.0000	
DI_N(-13)	0.044***	0.0005	
DEXC_P(-1)	-1.756***	0.0000	
DEXC_P(-4)	0.947***	0.0001	
DEXC_P(-5)	0.863***	0.0003	
DEXC_P(-3)	-0.955***	0.0000	
DEXC_N(-10)	-1.249***	0.0010	
Diagnostic Tests			
Adjusted R-squared	0.802574	Ramsey-Reset	1.51(0.22)
LM	1.27 (0.25)	CUSUM Q	Sta.
BPG	124 (0.17)	CUSUM Q^2	Sta.

The bottom panel of Table 4 also shows the diagnostic tests regarding the validation of model assumptions. Lagrange Multiplier (LM) test and the Breusch-Pagan-Godfrey test indicate that the results are free from autocorrelation and heteroskedasticity. Therefore, it is possible to conclude that the NARDL model is well-specified[10].

[10] *To conserve space, some of the short–term coefficients cannot be reported in this table. However, they are available on request.*

The coefficients that reflect the long-term relationship between BIST100 and selected macroeconomic variables are reported in Table 5. These long-term coefficients are obtained from the estimation of the NARDL model, which is shown in Table 4.

Table: 5
Long-Term Coefficients

Variable	Coefficient	Variable	Coefficient
L_{oil}+	-0.677***	L_i+	-0.012**
L_{oil}-	-0.061	L_i-	0.030***
L_y+	-0.236	L_{exc}+	1.791***
L_y-	0.200	L_{exc}-	-2.193***

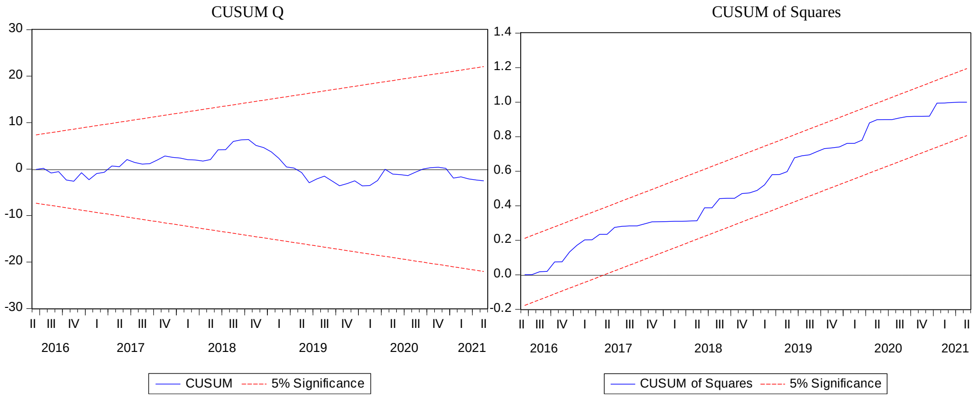
, **, and * indicate significance at the 10%, 5%, and 1% level, respectively.*

Table 5 indicates that all coefficients except industrial production have the expected sign. Although the rise and decline of industrial production yield coefficients with unexpected signs, they are insignificant. That is, the variations in industrial production do not explain the changes in stock prices. Although industrial production does not yield significant positive and negative partial sums in the cointegration, it has a substantial contribution in the short run that is in line with expectations. Excluding industrial production affects estimation negatively. Therefore, we decide to keep industrial production in the model.

However, the changes in oil prices have different impacts on stock prices. Oil price increases have a significant and adverse effect on BIST100. Once they rise by 1%, the BIST100 index experiences a 0.67% decrease. On the other hand, oil price decreases do not affect Turkey's stock market since the long-term coefficient is insignificant. As expected, positive and negative changes in interest and exchange rates have different impacts on stock prices. A tighter monetary policy will have less impact on stock returns than an expansionary policy, which is in line with Bernanke and Kuttner (2005) and Tiryaki et al. (2019). Exchange rate variations have the highest impact on positive and negative shocks. Table 5 shows that when the Turkish Lira depreciates by 1%, stock returns in Borsa Istanbul increase by 1.79%. The effect of adverse shocks on the exchange rates of BIST100 is even more significant. When the exchange rates decrease by 1%, stock returns drawback of 2.193%. The findings in Table 5 reflect the asymmetrical impacts caused by the explanatory variables. The results are primarily in line with previous studies and economic theory.

To test the coefficient stability for the estimated relationship between BIST100 and selected macroeconomic variables, cumulative sum (CUSUMQ) and cumulative sum of squares (CUSUM of squares) are also conducted, as suggested by Brown et al. (1975). The results of CUSUMQ and CUSUM of squares are presented in Figure 2. Both plots show that CUSUM and CUSUM of squares stay within the critical bounds at the 5% significance level. Therefore, the coefficients of the estimated model are stable over the analysis period.

Figure: 2
CUSUMQ and CUSUM of Squares Results



Overall, the findings imply that the effects of oil prices, interest rates, and exchange rates on stock returns in Turkey are asymmetric, which points out the NARDL as the correct estimation method. Tiryaki et al. (2019) show that the asymmetric effects on stock returns are more explicit when the interest rates and exchange rates rise together. This study shows that only increases in oil prices negatively affect stock returns. Decreases in oil prices have no significant impact. The lack of evidence for the oil price decreases must be taken into consideration by policymakers carefully. This finding suggests that the adverse effects of oil price increases on the stock market cannot be reversed easily by oil price falls. We cannot observe an uprising stock market when oil prices decline. Therefore, specific policies are required to manage the negative impacts of oil price hikes.

Demirer et al. (2020) note that oil price changes have important implications for the effectiveness of portfolio diversification. These changes can force many major asset classes, including stock prices, to act in the same direction, reducing the advantages of forming a portfolio. Depending on the size of the positive oil price shocks, portfolio shifts might be considered by investors.

Our findings are mostly in line with the increased production costs argument that claims that when oil cannot be substituted with another input, cash flows to the firm will be negatively impacted, and the stock prices will decrease. To avoid this negative consequence, alternative energy sources, especially renewable energy potential, must be evaluated carefully by policymakers. The dependency on oil as an input must be reduced. Besides, oil price increases have a strong potential to create inflationary pressure. Monetary policymakers must carefully consider this pressure, especially when a tighter monetary policy is not as effective as an expansionary monetary policy.

Our results also indicate that global factors dominate Turkish stock markets. The asymmetric response of stock markets to various macroeconomic variables, particularly oil prices as a commodity traded in stock exchanges, must be considered in portfolio diversification strategies.

4.2. The Role of Oil Price Shocks in the Asymmetric Oil Price - Stock Market Relation: Quantile Regression Approach

In the previous section, we have shown that the changes in oil prices and monetary policy have an asymmetric impact on stock market returns. In this section, we examine the possible sources of asymmetry. To do so, we explore the effects of specific oil price shocks and whether monetary policy change affects the oil shocks - stock returns relationship. The findings for Eq (8), in which only the oil price shocks are considered, are presented in Table 6.

Table: 6
Results from Quantile and OLS Regressions for the Relationship between BIST100 and Oil Price Shocks

	Bearish Market			Normal Market			Bullish Market			OLS
	$\tau_{0.1}$	$\tau_{0.2}$	$\tau_{0.3}$	$\tau_{0.4}$	$\tau_{0.5}$	$\tau_{0.6}$	$\tau_{0.7}$	$\tau_{0.8}$	$\tau_{0.9}$	
O_{econ}	0.013	-0.011	-0.002	-0.002	-0.006	-0.001	-0.002	0.001	-0.006	-0.005
	(0.0193)	(0.0113)	(0.0108)	(0.0112)	(0.0101)	(0.0094)	(0.0084)	(0.0091)	(0.0128)	(0.0073)
O_{cons}	0.003	0.004**	0.006***	0.006***	0.005**	0.001	0.001	0.002*	0.001	0.003**
	(0.0030)	(0.0018)	(0.0017)	(0.0020)	(0.0021)	(0.0023)	(0.0019)	(0.0013)	(0.0029)	(0.0016)
O_{invent}	-0.002	-0.005	0.003	0.008	0.007	-0.001	-0.002	0.003	0.003	0.002
	(0.0127)	(0.0147)	(0.0128)	(0.0110)	(0.0105)	(0.0108)	(0.0098)	(0.0084)	(0.0121)	(0.0071)
O_{supply}	-0.008	-0.008	-0.007	-0.009	-0.009	-0.009	-0.010	-0.003	-0.006	-0.007
	(0.0117)	(0.0058)	(0.0061)	(0.0082)	(0.0080)	(0.0091)	(0.0102)	(0.0116)	(0.0104)	(0.0049)
Constant	-0.087***	-0.056***	-0.026***	-0.007	0.004	0.030***	0.050***	0.070***	0.097***	0.008
	(0.0123)	(0.0083)	(0.0075)	(0.0060)	(0.0053)	(0.0060)	(0.0056)	(0.0049)	(0.0086)	(0.0057)
Observations	197	197	197	197	197	197	197	197	197	197
R-squared										0.063

*Standard errors are provided in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.*

The findings in Table 6 indicate that only oil consumption demand shocks significantly influence the stock market returns, and this effect is observed in bearish and regular markets. For the higher quantiles, the significance of oil consumption shocks almost completely vanishes[11]. This finding is in line with Nusair and Al-Khasawneh's (2018) evidence. They note that the impact of oil price changes is more pronounced for the low levels of stock markets due to worries about the state of the economy. Smyth and Narayan (2018) note in their review that the asymmetric effects of oil prices are less visible in the upper quantiles than in the lower quantiles. Zhu et al. (2016) state that there is a co-movement between oil prices and stock markets for bearish stock markets in China, which disappears in the bullish markets.

[11] *The same analysis is repeated with the oil price shocks that are decomposed into positive and negative price shocks. The results reveal that oil consumption shocks are significant for the bearish and normal market levels when the shocks are positive.*

The summary of the coefficients obtained from different quantiles and their comparison with the standard OLS estimates are provided in Figure 3.

Figure: 3
The Effects of Oil Shocks for Each Quantile

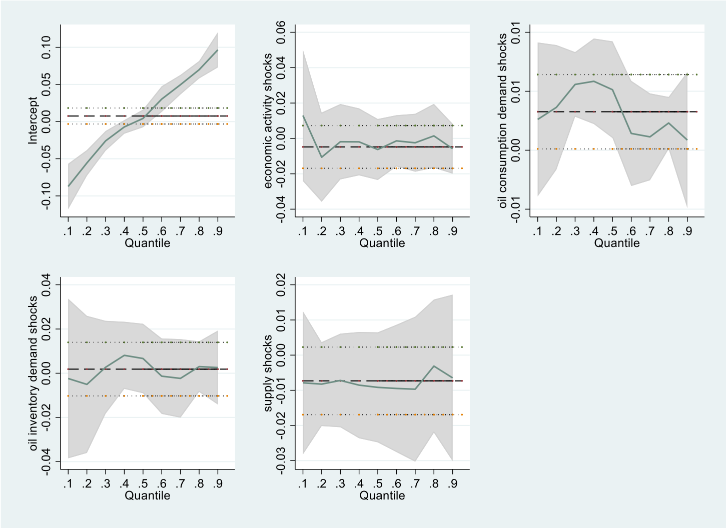


Figure 3 shows that each oil shock's effects and magnitude over quantiles differ significantly from the OLS estimations. In other words, the impact of oil shocks varies depending on the state of stock market returns. The variation is evident for the oil consumption shocks.

Observing the positive impact of oil consumption shocks on the bearish stock markets can be attributed to the investor sentiment approach. Demirer et al. (2020) argue that oil price changes significantly affect investor sentiment. Turkish investors seem to take oil consumption shocks as a sign of a future economic boom. They expect that it will be reflected in better corporate performance, as suggested by Smyth and Narayan (2018). This effect is more substantial when the market is in a bearish state. During the bullish market, they do not expect a more significant economic boom in the future. This finding is essential for policymakers since it shows which oil shock drives investor sentiment and stock market returns.

The same analysis is repeated with the interaction terms by adding a multiplication of each shock with short-term interest rates. The results are demonstrated in Table 7.

Table: 7
Results from Quantile and OLS Regressions with Monetary Policy Interaction Terms

	Bearish Market			Normal Market			Bullish Market			OLS
	$\tau_{0.1}$	$\tau_{0.2}$	$\tau_{0.3}$	$\tau_{0.4}$	$\tau_{0.5}$	$\tau_{0.6}$	$\tau_{0.7}$	$\tau_{0.8}$	$\tau_{0.9}$	
O_{econ}	0.013	-0.008	0.009	0.012	-0.006	-0.017	0.000	0.003	0.011	-0.003
	(0.0357)	(0.0289)	(0.0245)	(0.0246)	(0.0227)	(0.0215)	(0.0232)	(0.0273)	(0.0254)	(0.0167)
O_{cons}	0.004	0.005	0.008	0.009	0.006	0.004	0.007	0.000	-0.007	0.004
	(0.0051)	(0.0050)	(0.0054)	(0.0062)	(0.0068)	(0.0068)	(0.0076)	(0.0068)	(0.0066)	(0.0040)
O_{invent}	0.038*	0.027	0.040*	0.025	0.023	0.024	0.022	0.002	-0.010	0.023*
	(0.0215)	(0.0207)	(0.0226)	(0.0166)	(0.0166)	(0.0236)	(0.0243)	(0.0245)	(0.0244)	(0.0131)
O_{supply}	0.007	-0.000	0.007	0.008	0.011	0.007	0.009	-0.005	-0.008	0.004
	(0.0241)	(0.0131)	(0.0102)	(0.0141)	(0.0140)	(0.0143)	(0.0185)	(0.0232)	(0.0230)	(0.0086)
O_{econ} X Interest Rates	-0.000	-0.000	-0.001	-0.001	0.000	0.002	0.000	-0.000	-0.001	-0.000
	(0.0037)	(0.0028)	(0.0023)	(0.0023)	(0.0021)	(0.0021)	(0.0025)	(0.0028)	(0.0030)	(0.0017)
O_{cons} X Interest Rates	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	0.000	0.001	-0.000
	(0.0004)	(0.0004)	(0.0005)	(0.0005)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0003)
O_{invent} X Interest Rates	-0.004*	-0.003	-0.003*	-0.002	-0.002	-0.002	-0.002	0.000	0.001	-0.002*
	(0.0020)	(0.0018)	(0.0018)	(0.0015)	(0.0015)	(0.0021)	(0.0023)	(0.0025)	(0.0027)	(0.0012)
O_{supply}	-0.001	-0.001	-0.001	-0.001	-0.002	-0.001	-0.001	-0.000	0.001	-0.001
	(0.0023)	(0.0013)	(0.0009)	(0.0013)	(0.0013)	(0.0016)	(0.0018)	(0.0016)	(0.0018)	(0.0009)
Constant	-0.084***	-0.050***	-0.031***	-0.011**	0.006	0.031***	0.049***	0.070***	0.102***	0.008
	(0.0109)	(0.0089)	(0.0064)	(0.0052)	(0.0060)	(0.0072)	(0.0100)	(0.0093)	(0.0111)	(0.0058)
Observations	197	197	197	197	197	197	197	197	197	197
R-squared										0.087

*Standard errors are provided in parentheses. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively.*

Table 7 reveals weak evidence for the impact of oil inventory demand shocks on stock returns. This effect is positive and significant only at the 10% level and valid for bearish stock markets. The interaction term for oil inventory shocks has a negative and significant coefficient. It means that the interest rate changes lower the impact of oil inventory shocks on stock market returns[12]. This effect disappears entirely for the third quartile (Q=0.3).

The reasons behind the lowering effect of interest rate changes on the impact of oil prices can be inferred by looking at the various channels in the transmission mechanism of oil prices to stock returns. We have explained that the positive effects of the oil price shock on the stock market return can be attributed to the higher investor sentiment by examining the results in Table 6. In addition to the investor sentiment channel, one must consider the monetary channel and production costs argument in the oil price-stock returns nexus together. The energy structure of Turkey is highly dependent on imported oil. Oil price shocks elevate production costs significantly. This result has already been put forth using the NARDL approach in the previous section. Increased production costs are reflected in the prices quickly, which creates inflationary pressure on the Central Bank. Here, the monetary channel in the transmission mechanism becomes prominent. As noted by Degiannakis et al. (2018), this pressure causes an increase in short-term interest rates. The rise in interest rates will decrease the value of future cash flows to the firms and eventually negatively affect the stock market. Therefore, the changes in the interest rates will be erased by the positive expectations in the bearish stock markets due to the oil inventory shocks.

[12] *The linear test for the sum of coefficients of oil inventory shocks and the respective interaction terms is significant at 10% for the lowest quantile (τ=0.1) and insignificant for τ=0.30.*

Overall, our findings are in line with the previous literature. We find more pronounced impacts of oil demand shocks in the lower levels of stock markets, as in Zhu et al. (2016), Nusair and Al-Khasawneh (2018), and Smyth and Narayan (2018).

Mokni (2020) shows that oil-importing countries are less sensitive to oil price shocks than oil-exporting countries. Oil demand shocks are influential for oil-exporting countries, and the stock market reacts positively to these shocks. The oil-importing nature of Turkey can explain the lack of highly significant oil price shocks.

5. Conclusion

The literature on the impacts of oil prices on stock exchanges mainly considers developed countries. Their analyses are based on the assumption that this relationship is linear and symmetric. However, there is no reason to believe that such an assumption reflects the true nature of the oil price-stock exchange relationship. In this study, we use the NARDL approach to examine the nonlinear relationship between oil prices, industrial production, interest rates, exchange rates, and stock market index for the Turkish economy using the period between 2005:01 and 2021:06. Different from the existing literature, we use the short-term interest rates as the primary monetary policy tool while analysing the most current data for Turkey. We also look for the source of asymmetry in the oil price-stock market nexus by investigating the effects of different oil price shocks on stock returns. To do so, we employ OLS and quantile regression models, which allow us to detect any impact for varying stock market levels. In this sense, this study is the first that combines the NARDL and quantile regression approaches for the oil price changes - stock market association in Turkey.

Our results suggest a considerable degree of asymmetry in this relationship. More specifically, we show that only positive shocks in oil prices affect the stock prices negatively, while adverse shocks are insignificant. We also demonstrate that changes in interest rates and exchange rates have an asymmetric impact on stock markets. These effects on stock returns are more pronounced when interest and exchange rates rise together.

Our findings are important for both investors and policymakers. We show that oil prices as a global factor play a vital role in the formation of stock prices as risk indicators, besides traditional factors, namely future cash flows and dividends. The asymmetric part of oil prices is especially striking for the effectiveness of portfolio diversification. Oil price changes can force stock prices and other asset classes to move in the same direction, so the advantages of holding a diversified portfolio will be reduced. Depending on the size of the positive oil shock, this reduced effectiveness can be more pronounced. Therefore, investors might consider significant portfolio shifts conditional upon the size of the increase. In addition, investors must understand that only positive oil prices impact stock prices, which cannot be reversed by the oil price decreases.

From the policy formation standpoint, our results support the production cost argument. When oil as input is more expensive, future cash flows to firms will be negatively affected, so stock prices decline. To manage these undesirable consequences, policymakers must concentrate on decreasing oil dependency at the production level by substituting it with alternative energy sources such as renewables. In addition, monetary policymakers must carefully consider the potential of oil price hikes to increase inflation.

References

Akarsu, G. (2017), “Analyzing the Impact of Oil Price Volatility on Electricity Demand: The Case of Turkey”, *Eurasian Economic Review*, 7(3), 371-388.

Al-hajj, E. et al. (2017), “The Influence of Oil Price Shocks on Stock Market Returns: Fresh Evidence from Malaysia”, *International Journal of Energy Economics and Policy*, 7(5), 235-244.

Altay, B. et al. (2013), “Oil Price, Output and Employment in Turkey: Evidence from Vector Error Correction Model”, *International Journal of Energy Economics and Policy*, 3(SI), 7-13.

Altinay, G. (2007), “Short-Run and Long-Run Elasticities of Import Demand for Crude Oil In Turkey”, *Energy Policy*, 35(11), 5829-5835.

Altıntaş, H. & Y. Kassouri (2018), “Asymmetric Responses of Stock Prices to Money Supply and Oil Prices Shocks: New Evidence from A Nonlinear ARDL Approach”, *International Journal of Economics and Financial Issues*, 8(4), 45-53.

Arouri, M.E.H. & C. Rault (2012), “Oil Prices and Stock Markets in GCC Countries: Empirical Evidence from Panel Analysis”, *International Journal of Finance & Economics*, 17(3), 242-253.

Arouri, M.E.H. & D.K. Nguyen (2010), “Oil Prices, Stock Markets and Portfolio Investment: Evidence from Sector Analysis in Europe Over the Last Decade”, *Energy Policy*, 38(8), 4528-4539.

Aydoğan, B. et al. (2017), “The Impact of Oil Price Volatility on Net-Oil Exporter and Importer Countries’ Stock Markets”, *Eurasian Economic Review*, 7(2), 231-253.

Aykırı, M. (2020), “Petrol Fiyatlarındaki Hareketliliğin Temel Makroekonomik Göstergeler Üzerindeki Etkisi”, *Sosyoekonomi*, 28(45), 121-138.

Bahmani-Oskooee, M. & A. Sohrabian (1992), “Stock Prices and the Effective Exchange Rate of the Dollar”, *Applied Economics*, 24(4), 459-464.

Baum C. (2013), *Quantile Regression*, <http://fmwww.bc.edu/EC-C/S2013/823/EC823.S2013.nn04.slides.pdf>, 05.06.2022.

Bernanke, B.S. & K.N. Kuttner (2005), “What Explains the Stock Market's Reaction to Federal Reserve Policy?”, *The Journal of Finance*, 60(3), 1221-1257.

Berument, H. & H. Taşçı (2002), “Inflationary Effect of Crude Oil Prices in Turkey”, *Physica A: Statistical Mechanics and Its Applications*, 316(1-4), 568-580.

Borsa Istanbul (2020), *2020 Entegre Faaliyet Raporu*, <https://Borsaistanbul.Com/Files/BIST2020EntegreFaaliyetRaporuveFinansalTablolar.Pdf>, 11.02.2002.

Brown, R.L. et al. (1975), “Techniques for Testing the Constancy of Regression Relationships Over Time”, *Journal of the Royal Statistical Society*, 37(2), 149-163.

Çatık, A.N. et al. (2020), “Time-Varying Impact of Oil Prices on Sectoral Stock Returns: Evidence from Turkey”, *Resources Policy*, 69(C), 101845.

Chen, N.F. et al. (1986), "Economic Forces and the Stock Market", *Journal of Business*, 59(3), 383-403.

Civcir, I. & U. Akkoc (2021), "Non-Linear ARDL Approach to the Oil-Stock Nexus: Detailed Sectoral Analysis of the Turkish Stock Market", *Resources Policy*, 74(4), 102424.

Dedeoğlu, D. & H. Kaya (2014), "Pass-Through of Oil Prices to Domestic Prices: Evidence from An Oil-Hungry but Oil-Poor Emerging Market", *Economic Modelling*, 43, 67-74.

Degiannakis, S. et al. (2018), "Oil Prices and Stock Markets: A Review of the Theory and Empirical Evidence", *The Energy Journal*, 39(5), 85-130.

Demirer, R. et al. (2020), "Oil Price Shocks, Global Financial Markets and their Connectedness", *Energy Economics*, 88, 104771.

Doğrul, H.G. & U. Soytas (2010), "Relationship Between Oil Prices, Interest Rate, and Unemployment: Evidence from An Emerging Market", *Energy Economics*, 32(6), 1523-1528.

Eksi, I.H. et al. (2012), "Sensitivity of Stock Market Indices to Oil Prices: Evidence from Manufacturing Sub-Sectors in Turkey", *Panoeconomicus*, 59(4), 463-474.

Engle, R.F. & C.W. Granger (1987), "Co-Integration and Error Correction: Representation, Estimation, and Testing", *Econometrica*, 55, 251-276.

Eryiğit, M. (2012), "The Dynamical Relationship Between Oil Price Shocks and Selected Macroeconomic Variables in Turkey", *Economic Research-Ekonomska Istraživanja*, 25(2), 263-276.

Fama, E.F. (1981), "Stock Returns, Real Activity, Inflation, and Money", *The American Economic Review*, 71(4), 545-565.

Halaç, U. et al. (2013), "The Turkish Stock Market Integration with Oil Prices: Cointegration Analysis with Unknown Regime Shifts", *Panoeconomicus*, 60(4), 499-513.

Huang, R.D. et al. (1996), "Energy Shocks and Financial Markets", *Journal of Futures Markets*, 16(1), 1-27.

International Energy Agency (2021), *World Energy Outlook 2021*, <https://Iea.Blob.Core.Windows.Net/Assets/4ed140c1-C3f3-4fd9-Acae-789a4e14a23c/Worldenergyoutlook2021.Pdf>, 11.02.2022.

Johansen, S. & K. Juselius (1990), "Maximum Likelihood Estimation and Inference on Cointegration - With Applications to the Demand for Money", *Oxford Bulletin of Economics and Statistics*, 52(2), 169-210.

Jones, C.M. & G. Kaul (1996), "Oil and the Stock Markets", *Journal of Finance*, 51(2), 463-491.

Kapusuzoglu, A. (2011), "Herding in the Istanbul Stock Exchange (ISE): A Case of Behavioral Finance", *African Journal of Business Management*, 5(27), 11210-11218.

Kilian, L. & C. Park (2009), "The Impact of Oil Price Shocks on the US Stock Market", *International Economic Review*, 50(4), 1267-1287.

Kilian, L. (2009), "Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market", *American Economic Review*, 99(3), 1053-69.

Koenker, R. & G. Bassett Jr (1978), "Regression Quantiles", *Econometrica*, 46(1), 33-50.

Miller, J.I. & R.A. Ratti (2009), "Crude Oil and Stock Markets: Stability, Instability, and Bubbles", *Energy Economics*, 31(4), 559-568.

Mokni, K. (2020), "A Dynamic Quantile Regression Model for the Relationship Between Oil Price and Stock Markets in Oil-Importing and Oil-Exporting Countries", *Energy*, 213, 118639.

Mork, K.A. (1994), "Business Cycles and the Oil Market", *The Energy Journal*, 15, 15-38.

Narayan, P.K. & S. Narayan (2010), "Modelling the Impact of Oil Prices on Vietnam's Stock Prices", *Applied Energy*, 87(1), 356-361.

Nusair, S.A. & J.A. Al-Khasawneh (2018), "Oil Price Shocks and Stock Market Returns of the GCC Countries: Empirical Evidence from Quantile Regression Analysis", *Economic Change and Restructuring*, 51(4), 339-372.

Park, J. & R.A. Ratti (2008), "Oil Price Shocks and Stock Markets in the US and 13 European Countries", *Energy Economics*, 30(5), 2587-2608.

Pesaran, M.H. & Y. Shin (1999), "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis", in: S. Strom (ed.), *Econometrics and Economic Theory in the 20th Century: the Ragnar Frisch Centennial Symposium* (371-413), Cambridge University Press.

Pesaran, M.H. et al. (2001), "Bounds Testing Approaches to the Analysis of Level Relationships", *Journal of Applied Econometrics*, 16(3), 289-326.

Sadorsky, P. (1999), "Oil Price Shocks and Stock Market Activity", *Energy Economics*, 21(5), 449-469.

Scholtens, B. & C. Yurtsever (2012), "Oil Price Shocks and European Industries", *Energy Economics*, 34(4), 1187-1195.

Shin, Y. et al. (2014), "Modelling Asymmetric Cointegration and Dynamic Multipliers in A Nonlinear ARDL Framework", in: *Festschrift in Honor of Peter Schmidt* (281-314), New York, NY: Springer.

Smyth, R. & P.K. Narayan (2018), "What Do We Know About Oil Prices and Stock Returns?", *International Review of Financial Analysis*, 57, 148-156.

Tiryaki, A. et al. (2019), "Asymmetric Effects of Industrial Production, Money Supply and Exchange Rate Changes on Stock Returns in Turkey", *Applied Economics*, 51(20), 2143-2154.

Tursoy, T. & F. Faisal (2018), "The Impact of Gold and Crude Oil Prices on Stock Market in Turkey: Empirical Evidences from ARDL Bounds Test and Combined Cointegration", *Resources Policy*, 55, 49-54.

Zhu, H. et al. (2016), "The Heterogeneity Dependence Between Crude Oil Price Changes and Industry Stock Market Returns in China: Evidence from A Quantile Regression Approach", *Energy Economics*, 55, 30-41.