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Energy Prices and Investor's Sentiments in the Tehran Stock Exchange: An ARDL Bounds Testing Approach

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ABSTRACT

The main purpose of this study is to examine the relationship between energy prices (oil and natural gas) and individual investor sentiments on the Tehran stock exchange. Oil and natural gas are two strategic commodities among the world's most important energy sources. Energy price fluctuations, directly and indirectly, affect the economy and financial markets, especially those oil-exporting and importing countries. We monthly examined the relationships between energy prices and investor sentiment using the Autoregressive Distributed Lag (ARDL) technique from 2010 to 2020. The results showed that crude oil prices positively affect investor sentiment both in the long and short run, which is consistent with the oil-exporting structure of the Iranian economy. Moreover, the results demonstrated neither a short-run nor a long-run association between gas prices and investor sentiment. The study's findings suggest that oil prices could be used to predict investor sentiments and optimize an investor's portfolio.

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1. Introduction

Energy, especially oil and gas, has a significant role in economic development and considerably influences various economic and financial sectors worldwide. Crude oil and gas are among the world's primary energy sources, and fluctuations in their prices, particularly oil, have a substantial influence on the global economy and the financial markets of oil and gas exporters and importers (Acaravci et al., 2012; Howarth et al., 2017). According to the International Energy Agency (IEA), crude oil and natural gas represent approximately 65 percent of global energy usage, rising to 75 percent in oil and gas-rich economies such as Iran (IEA, 2020). Oil has financial characteristics in addition to commodity ones, and it is traded as a significant financial asset on future exchanges (Degiannakis et al., 2018). Changes in oil prices can affect the market and many companies, directly and indirectly, depending on whether a country is an importer or exporter of oil and gas (Basher et al., 2018). Energy prices can influence the financial market through various channels, such as stock valuation, monetary, output, fiscal, and uncertainty channels (Degiannakis et al., 2018).

The sentiment is a pillar of contemporary behavioral finance and one of the significant factors influencing investor decisions in financial markets (Baker & Wurgler, 2006; He, 2020). Studies have proven that investor sentiment and psychological factors influence market volatility and the price of financial assets (Brochado, 2020). Numerous academics and organizations have employed investor sentiment as a crucial stock market monitoring indicator due to its predictive ability (Jiang et al., 2021). Many types of research have been conducted on the impact of investor emotions and sentiments on capital markets, a growing area that has expanded into various financial and economic fields. However, only a few research have examined the relationship the other way around, i.e., if investor sentiment can be described by a set of economic factors (Apergis et al., 2018). Due to the strategic and crucial importance of crude oil and energy prices in nations' economies, recent studies have examined the relationship between oil prices and investor sentiment in the financial market. These studies have called into question whether energy prices influence investor sentiment in financial markets (Apergis et al., 2018; Ding et al., 2017; He, 2020; Jiang, et al., 2021; Rehman & Arshad, 2017; Zhang & li, 2019). Investors are susceptible to sentiment, and their decision-making attitude can be influenced by global risk factors such as oil price fluctuations (Shahzad et al. (2019).

Iran has the world's largest discovered oil and gas reserves and is a major oil-producing and exporting country. The Iranian economy is a single-commodity economy that mainly relies on crude oil and petrochemical product exports, so fluctuations in the prices of oil and petroleum products influence all markets, especially the capital market. Access to cheap energy as a factor of production has been one of the primary reasons for Iranian industries' comparative advantages. Chemical, petroleum products, rubber, and plastic industries, which account for more than 30% of Iran's stock market value, are entirely dependent on energy prices, and other vital industries such as the manufacture of basic metals, mining of metal ores, and cement, which account for 25-30% of Iran's stock market value, are directly affected by changes in energy prices. As a result, oil price changes can significantly impact these companies' export prices and cash flows, affecting investor sentiment. Understanding the relationship between investors' sentiment and energy price changes in the stock market can help make appropriate investment decisions and reduce the risks for investors, stabilizing the market by policymakers and understanding the company's competitive position.

Because of the significance and novelty of the subject, this study investigates how changes in oil and gas prices affect investor sentiment in the Iranian equity market. In several ways, this article contributes to the current literature. First, most of the research on this area has concentrated on the U.S. and Chinese markets; to the best of our knowledge, this is the first study that investigates the relationship between energy prices and stock market sentiment in oil-exporting countries at the market level. Second, the ARDL approach has been used in the survey, which can capture the dynamics of changes in energy prices and their impact on investor sentiment in the short and long term. Third, because the authorities do not provide the investor sentiment index in the Iranian capital market, this research provides a composite index based on a combination of variables taken from the literature and adopting the PCA method.

This paper is structured into the following sections. The theoretical framework and a review of the literature follow this introduction. The third section explains the methodology and research data, while section four discusses the model's empirical results. The last section discusses the research's conclusions and policy implications.

2. Theoretical Framework and Literature Review

Oil and gas are considered strategic commodities in today's modern world, and their price changes substantially influence the global economy, economic development, financial markets, social stability, and people's lives (Ding et al., 2017). Depending on the level of industrialization and whether the country is a net exporter or importer of oil and energy, the volatility of crude oil prices affects the equity market as an economic barometer (Awartani & Maghyereh. 2013; Hashmi et al., 2021). Many kinds of research have been performed to see how energy price movement and oil shocks affect the equity market. These studies show that oil significantly impacts stock price changes and stock market volatility in oil-exporting and oil-importing countries (e.g., Hashmi et al., 2021; Park & Ratti, 2008; Wang & Liu. 2016).

With the development of behavioral finance in the last two decades to describe how financial markets behave, researchers have turned their attention to exploring the relationship between energy and petroleum prices and investor sentiment. Investor sentiment is one of the modern behavioral finance principles (Brochado, 2020). Investor sentiment is, in fact, one of the key variables influencing investors' decisions in the financial markets (He, 2020). According to Baker and Wurgler (2006), investors choose stocks whose features reflect their sentiments, which might be either an overall sense of optimism or pessimism about stocks. The classical finance hypothesis that rational investors always pressure capital market prices to equal the present value of predicted future cash flows is contradicted by historical stock market trends (Baker & Wurgler, 2007). Theoretical explanations for the effect of investor sentiment on stock price deviations from fundamental value are addressed by Shleifer and Vishny (1997). DeLong et al. (1990) describe sentiment as an unjustified belief about future cash flows and investment risks. Investor sentiment has been studied concerning consumption (Throop, 1992), stock prices (Baker & Wurgler, 2007), energy prices (Du et al., 2016), industry returns (Rehman & Shahzad, 2016), and a variety of other economic variables (Shen, Yu & Zhao, 2017). In recent years, the relationship between investor sentiment and energy prices has attracted the attention of researchers (e.g., Ding et al., 2017).

There have been two types of studies conducted on the relationship between energy prices (especially oil) and sentiments. The first examined (Wang et al., 2021; Qadan, & Nama, 2018) how emotions and sentiments affected fluctuations in oil prices on international oil markets, while the second (e.g., He, 2020) examined how changes in oil prices affect investors' sentiments in the stock market, which is also the subject of the current study.

The first set of research looks at the impact of investor sentiment on oil prices in futures and derivatives markets (e.g., Du & Zhao, 2017; Maghyereh et al., 2020; Wang et al., 2021). These studies primarily examine how investor sentiment affects oil prices based on the theory that investor sentiment influences oil prices via economic factors and speculative activity (He, 2020). These studies focus on the price of oil in international markets and believe that some changes in the price of oil in world markets cannot be explained by fundamental economic factors and are caused by psychological and emotional factors of investors (Yao et al., 2017). According to research, investor sentiment can not only explain oil price changes but can also be used to project future oil returns over longer time horizons (Chen et al., 2021; Deeney et al., 2015; Du et al., 2016; He & Casey, 2015; Maghyereh et al., 2020; Wang et al., 2021).

The second set of studies indicates a significant correlation between changes in global energy prices and stock market sentiment. (Ding et al., 2017). Energy prices influence investor attitudes and sentiment via macroeconomic fundamentals and the equity market (He, 2020).

Changes in oil prices may have a substantial influence on investor attitudes by impacting actual economic activity and macroeconomic factors such as economic growth, inflation, consumption, and so on, as investor sentiment is sensitive to changes in the macroeconomic environment (Ding et al., 2017; He, 2020; He et al., 2019; Ye et al., 2020; Jiang et al., 2021). According to Bouri et al. (2017), oil price variations significantly impact stock market returns, and as a result, oil price shocks affect investor psychology and sentiment. Furthermore, investor confidence and mood are influenced by the macroeconomic environment. Because of the commodity and financial aspects of energy, energy price shocks can postpone or alter crucial decisions regarding production, expenditure, saving, investment opportunities, and other issues (Xiao et al., 2018). Under these circumstances, oil and energy market volatility is intrinsically transmitted to the economic and financial sectors, affecting investment decisions and sentiments (He et al., 2019).

The impact of energy price volatility on the economy and the stock market differs depending on whether the nation is an importer or exporter; as a result, the impact of these shocks on investor sentiment will vary based on the country’s reliance on energy and oil resources beyond its borders (Basher et al., 2018; Rehman & Arshad, 2017). A rise in oil prices, for example, increases the input production costs in oil-importing economies, impacting the economy’s supply side. On the demand side, rising oil and energy costs raise the overall price level, lowering real disposable income and, as a result, lowering aggregate demand (Hamilton, 2009). Oil price changes can significantly influence these countries’ economic circumstances and output because they increase the whole price level (Hashmi et al., 2021, Jiang & Liu, 2021). Increased oil prices, for example, increase macroeconomic uncertainty and economic pressures, resulting in higher inflationary expectations and interest rates in oil-importing countries, undermining investor confidence (Jiang & Liu, 2021).

Oil price shock mainly affects real economic indicators in oil-exporting regions through the Gross Domestic Product channel. As the revenues of these countries increase due to an increase in oil prices, the demand for goods and financial assets also increases because the price of oil affects the stock prices of companies through expected future cash flows, and thus higher energy and oil prices increase positive investor emotions and sentiment (Hashmi et al., 2021; Masoudi Alavi et al., 2021; Wang et al., 2013). Stock prices are influenced by information about future potential and existing economic situations. A company’s share price is always equal to the expected present value of discounted future cash flows. Oil price shocks can have a direct impact on stock prices by affecting expected future cash flows, or they can have an indirect impact by changing interest rates, which are used to discount future cash flows, both of which impact investors’ emotions and sentiment (Basher et al., 2018; Bjørnland, 2009). The rise in oil-related companies’ cash flows that increase their share prices and returns will enhance consumption and investment through the wealth and income avenues, along with economic growth and real GDP. According to Apergis et al. (2018), the impact of monetary policy on influencing the relationship between energy prices and stock market sentiment cannot be overlooked. The effects of oil price shocks on stock prices are influenced by the interest rate used to discount the anticipated future cash flows, and the nominal interest rate is determined by anticipated inflation, which is influenced by the government’s monetary policy, which may be expansionary if oil prices rise.

As previously stated, the relationship between oil prices and investor sentiment is one of the new issues explored in recent years. Most of these studies focus on the stock markets of nations such as China and the United States, as discussed below.

Using the quantile regression approach, Apergis et al. (2018) investigated whether energy prices (i.e., crude oil and natural gas prices) impact U.S. investor sentiment. The study results suggest a statistically significant relationship between oil and natural gas prices and investor sentiment. According to Ding et al. (2017), a percent increase in crude oil prices leads to a 3.94 percent decline in stock market investor sentiment over time. He and Zhou (2018) found that crude oil demand shocks considerably impacted U.S. stock market investor sentiments. Güntner and Linsbauer (2018) propose that aggregate demand shocks have significant positive effects on the U.S. consumer sentiment index during the first few months but have negative long-term effects. They find that shocks to oil demand, in particular, have a long-lasting negative impact. Ayazi et al. (2019) investigated the impact of the crude oil business cycle on investor sentiments using the GMM method in Iran stock exchange companies. The study found that the crude oil boom increases investor sentiment. Shahzad et al. (2019) investigated the asymmetric effects of disaggregated oil price shocks on uncertainty and investor sentiment. According to this study, positive and negative oil supply and demand shocks have different effects on investor sentiment, and the long-term effects of positive and negative oil demand and supply shocks are more substantial than the short-term ones. According to He et al. (2019) research in the Chinese stock market, the influence of the equity market on investor sentiment grows as the impact of oil price shocks on stock markets increases. He (2020) observed a one-way causality between oil price movements and equity market investor emotion in China. The findings of this research also indicated that changes in petroleum prices had a negative influence on Chinese investor sentiments in the majority of the cases. This impact was enormous at the beginning of the 2007 financial crisis but diminished as the global economy reached relative stability in 2012. Masoudi Alavi et al. (2021) investigated the impact of oil prices on investor sentiment with the PMG technique in the Tehran Stock Exchange in three industry groups: entire, oil-related, and non-oil-related industries. The findings show that oil prices affect investor sentiment in the short and long run. The results also show that in the long run, the oil price is positive and significant in all three groups, and the oil price coefficient is higher in oil-related industries than in non-oil-related industries. Jiang et al. (2021) found that OPEC oil supply shocks positively and significantly influence Chinese investors' sentiments, whereas OPEC oil demand shocks have a negative and significant effect. According to research conducted in other countries, studying the relationship between energy prices and investor sentiment is an interesting and novel field of research. The results of this study show that if investors and stock market policymakers have a deeper understanding of oil price swings on investor sentiments, they will be able to make more accurate estimates to reduce the negative consequences of oil shocks.

3. Econometrics Model and Research Method

The following econometric model was used to examine the relationship between energy prices (crude oil and natural gas prices) and investment sentiment:

$$\mathrm{SENT}_t = \alpha_1 + +\delta_2\mathrm{OIL}_t + \delta_3\mathrm{GASP}_t + \delta_4\mathrm{CPI}_t + \delta_5\mathrm{GDPS}_j + \delta_6\mathrm{INTRB}_t + \delta_7\mathrm{OLCP}_t + \varepsilon_t \tag{1}$$

Our model's explanatory variables are the OPEC oil price (OIL) and gas price (GASP). Furthermore, basic macroeconomic variables influencing financial markets include the Consumer Price Index (CPI) as a measure of inflation, the interbank rate (INTRB), industrial gross domestic product (GDPS), and the interaction term of CPI and oil prices (OLCP), which has been employed as a control variable. Since our variables data were monthly and data of the industrial gross domestic product are published quarterly, we used the linear match last conversion approach in Eviews to convert the quarterly industrial gross domestic product to monthly data. Aside from the gas and oil variables, the rest of the variables in the model are control variables intended to avoid model misspecification bias, adapted from the Apergis et al. (2018) and Verma and Verma (2021) articles. Crude oil prices were collected from the OPEC website, gas prices were obtained from the INVESTING.COM website, and data for other macroeconomic factors were retrieved from the Iranian Central Bank time series data.

The model's dependent variable is an index of investor sentiment. The sentiment index was calculated using five indexes, as in Baker and Wurgler (2007 and 2006) and Firth et al. (2015) papers, as well as the investor attention index as in Brochado (2020) and Mbanga et al., 2019. In general, the overall sentiment index was calculated monthly by using the principal component analysis (PCA) method with six implicit sentiment variables of trading volume (VOLT), the number of new accounts for investors (NCOD), the value of transactions (VLUT), mutual fund flows (NIC), number of trades (NTR), and investor attention index (ATN). The study's first principal component (PC1) is regarded as a monthly sentiment index. PCA is a dimensionality reduction technique that involves projecting each data point onto only the first few major components to create lower-dimensional data while maintaining as much variety as possible. The first principal component is a direction that maximizes the expected data's variance.

Data of trading volume, number of trades, and value of transactions were collected from Rahavardnovin software, the number of new accounts was derived from the Central Securities Depository of Iran, the mutual fund flows were obtained from the Fipiran website, and the investor's attention index was derived from Google Trends. Google Trends is a Google service that examines the popularity of Search On google in different regions and languages. Many papers have used investor attention obtained from Google Trends as an indicator of sentiments (such as Brochado, 2020; Da et al., 2015; Mbanga et al., 2019). When users enter search phrases into Google Trends, the app returns the term's search volume history, between 0 and 100. The data are available from 2004, and we restricted our data sample to Iran from 2011–2020. We used the average search volume of two of the phrases, the stock market (بازار بورس) and stock (سهام) in Persian on Google to gain the investors' attention in the Iran equity market.

This study was conducted monthly from 2011 through 2020. The study method was the Autoregressive Distributed Lag (ARDL) Model, which Pesaran and Shin proposed in 1995. This method is widely used in economic and financial research since it has many advantages over other econometric techniques. The ARDL method's most significant advantage is that it may be used whether the variables are integrated with level I(0) or in the first difference I(1). Furthermore, unlike other methods, this method does not suffer from the problem of bias in estimating small samples, and it is an efficient method for estimating the model with small samples. This approach may also estimate long-run coefficients and short-run dynamics and verify cointegration and the long-run relation between variables. After short-term shocks are applied to the model, the ECM model may also be used to calculate the speed of adjustment to the long-run equilibria. Moreover, because of the lack of correlation between the residuals in the ARDL models, endogeneity problems do not arise in these models (Pesaran et al., 2001). The valuable feature of the ARDL method is that no particular conditions must be satisfied before estimating. In the ARDL method, we must prove cointegration between the variables to estimate the model's long-run coefficients, and F-statistics are used for this purpose. The resulting F-statistics are compared to two critical value bounds. The null hypothesis of no cointegration is rejected if the estimated F-statistic is greater than the upper critical value. The null hypothesis is accepted if the estimated F-statistic is below the lower critical bound (Pesaran et al., 2001). For Eq. (1), the ARDL model is the following relationship between energy prices and sentiment responses:

$$\begin{aligned}\Delta SENT &= \beta_0 + \sum_{i=1}^{n}\gamma_{1,i}\Delta SENT_{t-i} + \sum_{i=0}^{n}\gamma_{2,i}\Delta OIL_{t-i} + \sum_{i=0}^{n}\gamma_{3,j}\Delta GASP_{t-i} + \sum_{i=0}^{n}\gamma_{4,j}\Delta CPI_{t-i} \\ &+ \sum_{i=0}^{n}\gamma_{5,i}\Delta GDPS_{t-i} + \sum_{i=0}^{n}\gamma_{6,i}\Delta INTB_{t-i} + \sum_{i=0}^{n}\gamma_{7,i}\Delta OLCP_{t-i} + \theta_1 SENT_{t-i} + \theta_2\Delta OIL_{t-i} \\ &+ \theta_3\Delta GASP_{t-i} + \theta_4\Delta CPI_{t-i} + \theta_5\Delta GDPS_{t-i} + \theta_6\Delta INTB_{t-i} + \theta_7\Delta OLCP_{t-i} + \varepsilon_t\end{aligned} \tag{2}$$

The null hypothesis of no cointegration between variables is:

$H_0\colon \theta_1 = \theta_2 = \cdots = \theta_7 =$ and the alternative hypothesis is $H_1\colon \theta_1 \neq \theta_2 \ldots \neq \theta_7 \neq 0$. To identify the best lag, we can employ the Akaike (AIC), Schwartz (SBC), or Hanna Quinn Criteria (H.Q.). This paper uses Schwartz Information Criteria (SIC) to determine the best lag length in Eq. (2). If the variables are co-integrated, we can use the ARDL approach as in Eq. (3) to estimate the long-run equilibrium relationship.

$$\begin{aligned}SENT &= \beta_0 + \sum_{i=1}^{p}\gamma_{1,i}SENT_{t-j} + \sum_{i=0}^{q}\gamma_{2,i}OIL_{t-i} + \sum_{i=0}^{s}\gamma_{3,i}GASP_{t-i} + \sum_{i=0}^{t}\gamma_{4,j}CPI_{t-i} \\ &+ \sum_{i=0}^{h}\gamma_{5,i}GDPS_{t-i} + \sum_{i=0}^{d}\gamma_{6,i}INTB_{t-i} + \sum_{i=0}^{v}\gamma_{7,i}OLCP_{t-i} + \varepsilon_t\end{aligned} \tag{3}$$

The Schwartz (SIC) criteria are used to identify the appropriate lag values in equation (3). Finally, coefficients of the short-run model and error-correction term (ECM) are assessed by the following model:

$$\begin{aligned}SENT &= \gamma_0 + \sum_{i=1}^{P}\gamma_{1,i}\Delta SENT_{t-i} + \sum_{i=0}^{q}\gamma_{2,i}\Delta OIL_{t-i} + \sum_{i=0}^{s}\gamma_{3,i}\Delta GASP_{t-i} + \\ &\sum_{i=0}^{t}\gamma_{4,i}\Delta CPI_{t-j}\sum_{i=0}^{h}\gamma_{5,i}\Delta GDPS_{t-j} + \sum_{i=0}^{d}\gamma_{6,i}\Delta INTB_{t-i} + \sum_{i=0}^{v}\gamma_{7,j}\Delta OLCP_{t-i} + \varphi ECM_{t-1} + \vartheta_t\end{aligned} \tag{4}$$

Equation (4) describes the error correction term (ECM_{t-1}) that shows that the variation in the dependent variable is a result of the deviation from the long-run relationship (expressed by the error correction component) and the changes in the other explanatory variables. This model correlates the short-run and long-run behavior of the two variables. The optimal lag values are chosen as in equation (2) using the Schwartz information criterion (SIC). γs are coefficients of short-term dynamic, and φ is an error-correction term (ECM_{t-1}) coefficient that is the speed of adjustment.

4. Empirical Results

4.1 Constructing Sentiment Index

In the initial part of the research, we used PCA analysis to create the overall sentiment index, as shown in Table 1. The eigenvalues reveal that the first principle component (PC1) is the best principal component in calculating the sentiment index since PC1 has a variance (Eigenvalues) of 4.468, which explains almost 75% of the standardized variance in the six variables. In the second part of Table 1, loadings or weights are reported for each principal component, indicating how much each of the initial explanatory variables contributes to that principal component. As we have seen, most of these variables are highly dependent on the first components.

Table 1. Principal Component Analysis

INDEX: SENT	1	2	3	4	5	6
Eigenvalues	4.468	0.702	0.478	0.304	0.030	0.019
Proportion	0.745	0.117	0.080	0.051	0.005	0.003
Cumulative Proportion	0.745	0.862	0.941	0.992	0.997	1.000
Variable	PC1	PC2	PC3	PC4	PC5	PC6
VLUT	0.466	-0.096	-0.069	-0.008	-0.765	0.429
VOLT	0.412	-0.516	-0.184	0.288	0.546	0.386
NTR	0.452	-0.317	-0.013	0.130	-0.141	-0.812
NCOD	0.333	0.735	-0.368	0.445	0.115	-0.044
NIC	0.408	0.179	-0.206	-0.836	0.244	-0.016
ATN	0.363	0.228	0.885	0.052	0.156	0.079

Source: research findings

4.2 Summary of Descriptive Statistics

Panel A in Table 2 provides the descriptive statistics for the variables, whereas Panel B shows a correlation matrix.

Table 2. Summary Statistics of Variables for the Period of 2011–2020.

Variables	OIL	GASP	CPI	GDPS	INTRB	OLCP	SENT
Panel A: Descriptive statistics							
Avg	74.72	3.13	100.68	402494.0	20.77	6744.97	6.40
Median	65.902	2.933	95.03	401961.3	19.77	6148.98	-0.641
Maximum	122.49	5.163	214.16	445233.2	28.81	13147.27	15.30
Minimum	19.902	1.733	38.67	353696.1	9.007	2659.07	-1.20
Std. Dev	28.022	0.755	44.53	18527.95	3.90	2459.52	2.12
Panel A: Correlation matrix							
OIL	1.00						
GASP	0.62	1.00					
CPI	-0.63	-0.51	1.00				
GDPS	0.25	0.13	-0.08	1.00			
INTRB	0.11	0.34	-0.27	0.02	1.00		
OLCP	0.17	0.04	0.59	0.12	-0.015	1.00	

Source: research findings

As the summary statistics show, the average price of a barrel of crude oil during this period was around 74.7 $, with a maximum of 122 $ and a minimum of 19.9 $. The average investor sentiment index was 6.40, with a maximum of 15.30 and a minimum of -1.20. As the results show, the correlation between the variables is low, excluding the price of oil and gas, which shows the co-movement of these two variables; therefore, the possibility of multicollinearity between the explanatory variables is low. It is worth noting that the correlation between variables does not show a cause-and-effect relationship and only shows co-movement between two variables. The correlation between oil and the CPI is negative, indicating the inverse co-movement between oil prices and inflation in the Iranian economy's review period. The correlation between CPI and GDPS is tiny and close to zero, which can be attributed to the use of real GDP data in the model.

4.3 Stationary Test

A pre-estimation evaluation employing a stationary test is required to avoid spurious regression and determine the order of variable integration in the time series ARDL model. In this paper, we used the Augmented Dickey-Fuller (ADF) unit root test to test the stationarity of variables. Table 3 shows that, apart from GASP, all variables are non-stationary at the level form. In the first-differenced form, the null hypothesis of the unit root is rejected, and all series have become stationary. According to the stationarity result, all variables are integrated into I(1) series, and none of the variables are I(2) series; thus, we could use ARDL bounds testing procedures to consider the long-run cointegration between energy prices and investor sentiment.

Table 3. Augmented Dickey-Fuller (ADF) Unit Root Test

Variables	At level		First difference		Integration order
	T-statistic	Prob	T-statistic	Prob	
SENT	0.589	0.842	-13.061	0.00	I(1)
OIL	-1.377	0.156	-7.264	0.00	I(1)
GASP	-1.878	0.342	-9.799	0.00	I(1)
CPI	0.851	0.999	-4.815	0.0008	I(1)
GDPS	-3.972	0.002	----	----	I(0)
INTRB	-2.356	0.401	-12.775	0.00	I(1)
OLCP	0.2956	0.770	-8.358	0.00	I(1)

Source: research findings

4.4 Dynamic Estimation of the Model

Table 4 estimates the dynamic relationship between sentiment, crude oil, natural gas prices, and other variables, with a model determination coefficient of 92 percent, indicating that explanatory variables explain 92 percent of the dependent variable. The findings indicate that oil prices and inflation have a positive and statistically significant influence on the sentiment index at the level. On the other hand, the lags of these two variables negatively influence sentiment, which may be explained by the adjustment of the effect of these two variables on subsequent periods. On the other hand, the price of natural gas does not affect investors' sentiments.

Table 4. Results of Estimating the Dynamic Relationship With ARDL Model (1, 1, 0, 0, 4, 1, 0)

Variable	Coefficient	Std. error	T-statistic	Prob
C	-4.612	1.88	-2.46	0.016
SENT	0.350	0.08	4.24	0.0001
OIL	0.169	0.025	6.69	0.000
OIL(-1)	-0.118	0.027	-4.43	0.000
GASP	-0.073	0.109	-0.67	0.503
CPI	0.291	0.055	5.32	0.000
CPI(-1)	-0.254	0.094	-2.71	0.008
CPI(-2)	-0.077	0.096	-0.79	0.427
CPI(-3)	-0.152	0.096	-1.58	0.118
CPI(-4)	0.242	0.057	4.27	0.000
GDPS	-4.40E-06	3.30E-06	-1.33	0.186
INTRB	0.028	0.023	1.22	0.219
OLCP	-0.002	0.0002	-10.31	0.000
OLCP(-1)	0.002	0.0002	7.155	0.000
R^2=0.92	F=81.49 (000)	D.W=1.80		
Diagnostic tests				
Test	χ^2	Prob		
Serial correlation	0.538	0.7643		
Heteroscedasticity	0.879	0.348		
Normality	3.435	0.179		

Source: research findings

One of the issues in estimation by ARDL methods is determining the optimal length of the lags in the model. The optimal ARDL model selected employing the Schwartz-Bayesian Criteria (SBC) was ARDL (1, 1, 0, 0, 4, 1, 0). Since the SBC saves the number of lags, this criterion has been used to determine the optimal model's number of lags. Furthermore, diagnostic tests are shown at the bottom of Table 4. The Durbin–Watson and Breusch–Godfrey tests indicate a lack of serial correlation in the residuals (χ^2 p-value>0.05). ARCH test results show that residuals are homoscedastic (χ^2 p-value>0.05). The Jarque–Berra statistic was used to test the normality of estimated residuals, and the results confirmed the normality of residuals (χ^2 p-value>0.05).

4.5 Bounds Tests for Cointegration

The cointegration among variables was investigated using the Pesaran ARDL-bound testing approach (Pesaran et al., 2001). Table 5 provides the calculated F-statistics at various significance levels and crucial values. As previously stated, if the estimated F-statistic is above the critical value, the null hypothesis of no cointegration is rejected. At a 5% and 1% level of significance, the F-statistics is far above the critical value (16.38> numbers in I(0) and I(1)). As a result, the null hypothesis of no cointegration is rejected, indicating that the series in our investigation are co-integrating in the long run.

Table 5. F-Bounds Tests for the Existence of a Long-Run Cointegration

F statistics	Critical bounds	I(0)	I(1)
16.38	10%	2.12	3.23
	5%	2.45	3.61
	1%	3.15	4.43

Source: research findings

4.6 Long-Run Estimation

After confirming the presence of a long-run cointegration relationship, the long-run coefficients were calculated using equation (3). Long-run estimates are provided in Table 7. The oil price coefficient is statistically significant and positive.

The oil price coefficient of 0.079 implies that a one-dollar oil price increase results in a 0.079 increase in investor sentiment in the long term. Gas prices do not have a significant effect on sentiment in the Iranian stock market in the long term. The results confirm those of Masoudi Alavi et al. (2021) in the Iranian oil industry and Jiang et al. (2021) OPEC oil supply shock. On the other hand, our results contradict those of Apergis et al. (2018) in the United States, and He et al. (2019), Ye et al. (2020), and Jiang et al. (2021) non-OPEC oil shocks in China. Apergis et al. (2018) found that oil and gas prices negatively influenced U.S. market sentiment in different quantiles in the U.S.

Table 6. ARDL long-Run Coefficient

Variable	Coefficient	Std. error	T-statistic	Prob
oil	0.079	0.015	5.259	0.0000
gasp	-0.113	0.170	-0.664	0.508
cpi	0.085	0.014	6.071	0.000
gdps	-6.76E-06	4.97E-06	-1.359	0.177
intrb	0.043	0.034	1.291	0.199
OLCP	-0.0006	0.0002	-3.140	0.002

Source: research findings

The fact that the countries under consideration are either oil exporters or importers explains the difference in results between this study and the others. Because Iran, unlike China, is an oil exporter, increased oil prices could positively affect the profitability of firms, particularly those exporting petroleum derivatives, which has been magnified in recent years by rising currency rates in the Iranian economy. Besides, inflation and the sentiment index have a positive relationship. Furthermore, the data show that changes in the interbank rate and industrial GDP are not significantly related to the sentiment index. Meanwhile, while negative and significant, the interaction term factors of oil prices and inflation are very small and negligible.

4.7 ECM Test and Short-Term Dynamic Relationship

Table 7 displays the short-run analysis statistics as well as the coefficient of ECM. The short-term results are almost identical to long-run signs and are consistent with a priori expectations. Oil prices and inflation have a positive and significant effect on investor sentiments in the short run, just as they do in the long run, and an increase in oil prices leads to an increase in investor sentiments in the short run, but the estimated short-run coefficients are larger than the long-run coefficients. Calculating the

ECM coefficient is an essential part of the short-run dynamics. The ECM_{t-1} has a correct sign (-0.649) and is significant, confirming the variables established cointegration relationships.

Table 7. Short Run Dynamic of ARDL and ECM Regression

Variable	Coefficient	Std. error	T-statistic	Prob
C	-4.612	0.431	-10.66	0.000
D(OIL)	0.169	0.023	7.359	0.000
D(CPI)	0.291	0.049	6.007	0.000
D(CPI(-1))	-0.014	0.054	-0.257	0.798
D(CPI(-2))	-0.091	0.055	-1.639	0.105
D(CPI(-3))	-0.242	0.051	-4.754	0.000
D(OLCP)	-0.002	0.0002	-11.495	0.000
ECM(-1)	-0.649	0.058	-11.159	0.000
R^2=0.68	F=29.93 (000)	D.W=1.80		

Source: research findings

The coefficient of ECM_{t-1} indicates the speed of the adjustment from the short-run to the long-run equilibrium in response to external shocks. If the coefficient is between 0 and -1, the equilibrium converges to the long-run equilibrium path. In this case, the ECM_{t-1} coefficient is -0.649. This means that around 65 percent of the disequilibria caused by the previous month's shocks will be returned to long-run equilibrium in the current month.

4.8 Model Stability Test

Finally, the CUSUM and CUSUMQ tests were used to test the model's stability. The results, as shown in Figure 1, indicate that the CUSUM (Figure 1-A) and CUSUMSQ (Figure 1-B) plots are within the 95% confidence band; therefore, the null hypothesis based on the stability of the coefficients at 0.05 cannot be rejected over the sample period of 2011–2020.

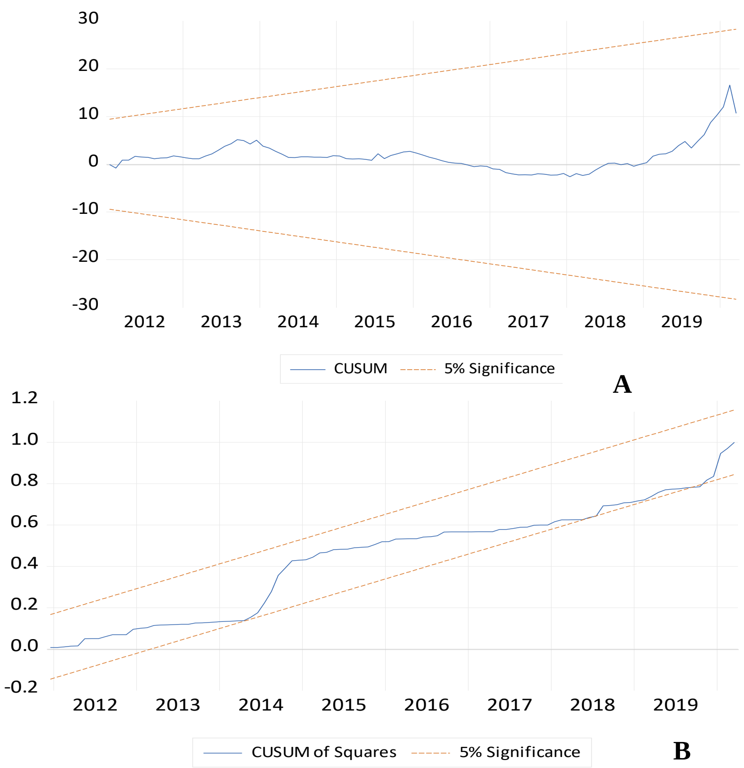

Figure 1. Stability Tests by CUSUM (A) and CUSUMQ (B)

5. Conclusion and Recommendations

In this article, we investigated how changes in energy prices (oil and gas) impacted investor sentiment on the Iranian stock market using the ARDL method. The investor sentiment was extracted using six indicators and the PCA method. The study's findings revealed that changes in oil prices have a positive and significant impact on investor sentiment, both in the short and long terms. The price of natural gas, however, were not found to have any significant impact on investors' sentiments either in the short or long term. The results of the oil price impact are consistent with the widely held belief that oil prices significantly impact investor sentiment. Although oil and natural gas are close energy substitutes in some cases, it seems that oil news dominates markets on a global and national level, and markets are more sensitive to oil news.

The findings of this study, although consistent with the general view that the price of oil has a positive effect on investor sentiment, are inconsistent with the findings of some other similar studies such as Apergis et al. (2018), He et al. (2019), and Ye et al. (2020). Mixed results can be interpreted on whether a nation is an energy exporter or importer. In countries like China, where industries depend heavily on oil imports, rising oil prices can be a negative shock and harm investor sentiment. On the contrary, in the Iranian stock market, the most important industries such as chemicals, petroleum products, rubber and plastic industries, the manufacture of basic metals, mining of metal ores, cement, and some other industries, which make up more than half of the national stock market value, are directly dependent on energy prices. Because many of these firms are exporters and benefit from low energy prices, positive energy price shocks can increase their revenue and influence investor sentiment. Meanwhile, some studies (He, 2020) showed that this relationship is nonlinear, asymmetric, and time-varying; therefore, different methods can have different results. Moreover, the difference in results may be attributed to the type of oil price shocks (supply side or demand side), as Jiang et al. (2021) research results showed.

This study's empirical findings have several implications for investors, policymakers, and managers. At first, this study contributes to the existing theories investigating the relationship between investor sentiment and energy prices in oil-exporting countries. Second, because sentiments significantly impact stock price changes and market volatility, these insights may be helpful for investors' hedging activities, allowing investors to use information about the oil market to rebalance and optimize their portfolios and make better investment decisions. Additionally, by better understanding the factors that affect their business's share performance, company managers in the energy sector and other sectors may be better prepared to make decisions and improve the competitive positions of their businesses in the market. Regulators and policymakers can mitigate extreme risk and stabilize the operation of the stock market by observing the dynamic impact of investor sentiment in the market.

Finally, important areas for future research include the relationship between energy prices and investor sentiment in bull and bear markets, the asymmetric effects of negative and positive oil price shocks on investor sentiment, and the impact of energy price changes on investor emotions and sentiments at the firm level.

References

Acaravci, A., Ozturk, I., & Kandir, S. Y. (2012). Natural gas prices and stock prices: Evidence from EU-15 countries. *Economic Modelling*, *29*(5), 1646-1654.

Apergis, N., Cooray, A., & Rehman, M. U. (2018). Do energy prices affect U.S. investor sentiment? *Journal of Behavioral Finance*, *19*(2), 125-140.

Awartani, B., & Maghyereh, A. I. (2013). Dynamic spillovers between oil and stock markets in the Gulf Cooperation Council Countries. *Energy Economics, 36*, 28-42.

Ayazi, S., Garkaz, M., Saeedi, P., & Matoofi, A. (2019). Investor sentiment based on the crude oil business cycle. *Financial Knowledge of Securities Analysis*, *12*(42), 129-145.

Baker, M., & Wurgler, J. (2006). Investor sentiment and the cross‐section of stock returns. *The Journal of Finance*, *61*(4), 1645-1680.

Baker, M., & Wurgler, J. (2007). Investor sentiment in the stock market. *Journal of Economic Perspectives*, *21*(2), 129-152.

Basher, S. A., Haug, A. A., & Sadorsky, P. (2018). The impact of oil-market shocks on stock returns in major oil-exporting countries. *Journal of International Money and Finance*, *86*, 264-280.

Bjørnland, H. C. (2009). Oil price shocks and stock market booms in an oil exporting country. *Scottish Journal of Political Economy*, *56*(2), 232-254.

Bouri, E., Jain, A., Biswal, P. C., & Roubaud, D. (2017). Cointegration and nonlinear causality amongst gold, oil, and the Indian stock market: Evidence from implied volatility indices. *Resources Policy*, *52*, 201-206.

Brochado, A. (2020). Google search-based sentiment indexes. *IIMB Management Review*, *32*(3), 325-335.

Chen, Z., Liang, C., & Umar, M. (2021). Is investor sentiment stronger than VIX and uncertainty indices in predicting energy volatility? *Resources Policy*, *74*, 102391.

Da, Z., Engelberg, J., & Gao, P. (2015). The sum of all FEARS investor sentiment and asset prices. *The Review of Financial Studies*, *28*(1), 1-32.

De Long, J. B., Shleifer, A., Summers, L. H., & Waldmann, R. J. (1990). Noise trader risk in financial markets. *Journal of Political Economy*, *98*(4), 703-738.

Deeney, P., Cummins, M., Dowling, M., & Bermingham, A. (2015). Sentiment in oil markets. *International Review of Financial Analysis*, *39*, 179-185.

Degiannakis, S., Filis, G., & Arora, V. (2018). Oil prices and stock markets: A review of the theory and empirical evidence. *The Energy Journal*, *39*(5)

Ding, Z., Liu, Z., Zhang, Y., & Long, R. (2017). The contagion effect of international crude oil price fluctuations on Chinese stock market investor sentiment. *Applied Energy*, *187*, 27-36.

Du, D., & Zhao, X. (2017). Financial investor sentiment and the boom/bust in oil prices during 2003–2008. *Review of Quantitative Finance and Accounting*, *48*(2), 331-361.

Du, D., Gunderson, R. J., & Zhao, X. (2016). Investor sentiment and oil prices. *Journal of Asset Management*, *17*(2), 73-88.

Firth, M., Wang, K., & Wong, S. M. (2015). Corporate transparency and the impact of investor sentiment on stock prices. *Management Science*, *61*(7), 1630-1647.

Güntner, J. H., & Linsbauer, K. (2018). The effects of oil supply and demand shocks on U.S. consumer sentiment. *Journal of Money, Credit and Banking*, *50*(7), 1617-1644.

Hashmi, F., Aftab, H., Martins, J. M., Nuno Mata, M., Qureshi, H. A., Abreu, A., & Mata, P. N. (2021). The role of self-esteem, optimism, deliberative thinking, and self-control in shaping the financial behavior and financial well-being of young adults. *Plos one*, *16*(9), e0256649.

Hamilton, J. D. (2009). Causes and Consequences of the Oil Shock of 2007-08 (No. w15002). National Bureau of Economic Research.

He, L. T., & Casey, K. M. (2015). Forecasting ability of the investor sentiment endurance index: The case of oil service stock returns and crude oil prices. *Energy Economics*, *47*, 121-128.

He, Z. (2020). Dynamic impacts of crude oil price on Chinese investor sentiment: Nonlinear causality and time-varying effect. *International Review of Economics & Finance*, *66*, 131-153.

He, Z., & Zhou, F. (2018). Time-varying and asymmetric effects of the oil-specific demand shock on investor sentiment. *PloS one*, *13*(8), e0200734.

He, Z., He, L., & Wen, F. (2019). Risk compensation and market returns: The role of investor sentiment in the stock market. *Emerging Markets Finance and Trade*, *55*(3), 704-718.

Howarth, N., Galeotti, M., Lanza, A., & Dubey, K. (2017). Economic development and energy consumption in the GCC: An international sectoral analysis. *Energy Transitions*, *1*(2), 1-19.

International Energy Agency. (2020). *World energy outlook*. Available at: https://iea.blob.core.windows.net/assets/a72d8abf-de08-4385-8711-b8a062d6124a/WEO2020.pdf

Jiang, W., & Liu, Y. (2021). The asymmetric effect of crude oil prices on stock prices in major international financial markets. *The North American Journal of Economics and Finance*, *56*, 101357.

Jiang, Y., Ma, C. Q., Weber, O., & Ren, Y. S. (2021). How do structural oil price shocks affect China's investor sentiment? The critical role of OPEC oil supply shocks. *Asia‐Pacific Journal of Financial Studies*, *50*(5), 500-526.

Maghyereh, A., Awartani, B., & Abdoh, H. (2020). The effects of investor emotions sentiments on crude oil returns: A time and frequency dynamics analysis. *International Economics*, *162*, 110-124.

Masoudi Alavi, S. H., Nadiri, M., & Saranj, A. R. (2021). The dynamic impact of oil price on investor sentiment in Tehran Stock Exchange: An industry-level analysis. *Iranian Journal of Finance*, *5*(3), 38-57.

Mbanga, C., Darrat, A. F., & Park, J. C. (2019). Investor sentiment and aggregate stock returns: The role of investor attention. *Review of Quantitative Finance and Accounting*, *53*(2), 397-428.

Park, J., & Ratti, R. A. (2008). Oil price shocks and stock markets in the U.S. and 13 European countries. *Energy Economics*, *30*(5), 2587-2608.

Pesaran, M. H., & Shin, Y. (1995). An autoregressive distributed lag modelling approach to cointegration analysis (Vol. 9514). Cambridge, UK: Department of Applied Economics, University of Cambridge.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326.

Qadan, M., & Nama, H. (2018). Investor sentiment and the price of oil. *Energy Economics*, *69*, 42-58.

Rehman, M. U., & Arshad, (2017) A. Energy prices and emerging market investor sentiments. *ACRN Oxford Journal of Finance and Risk Perspectives 6.3 – Special Issue FRAP/SSFII Conference (2017), 121-134.*

Rehman, M. U., & Shahzad, S. J. H. (2016). Investors' sentiments and industry returns: Wavelet analysis through Squared Coherency Approach. *ACRN Oxford Journal of Finance and Risk Perspectives*, *5*, 151-162.

Shahzad, S. J. H., Bouri, E., Raza, N., & Roubaud, D. (2019). Asymmetric impacts of disaggregated oil price shocks on uncertainties and investor sentiment. *Review of Quantitative Finance and Accounting*, *52*(3), 901-921.

Shen, J., Yu, J., & Zhao, S. (2017). Investor sentiment and economic forces. *Journal of Monetary Economics*, *86*, 1-21.

Shleifer, A., & Vishny, R. W. (1997). The limits of arbitrage. *The Journal of Finance*, *52*(1), 35-55.

Throop, A. W. (1992). Consumer sentiment: Its causes and effects. *Federal Reserve Bank of San Francisco Economic Review*, *1*, 35-59.

Verma, R., & Verma, P. (2021). Investor sentiments and pricing errors. Review of Behavioral Finance, 13(4), 450-462.

Wang, L., Ma, F., Niu, T., & Liang, C. (2021). The importance of extreme shock: Examining the effect of investor sentiment on the crude oil futures market. *Energy Economics*, *99*, 105319.

Wang, Y., & Liu, L. (2016). Crude oil and world stock markets: Volatility spillovers, dynamic correlations, and hedging. *Empirical Economics*, *50*(4), 1481-1509.

Wang, Y., Wu, C., & Yang, L. (2013). Oil price shocks and stock market activities: Evidence from oil-importing and oil-exporting countries. *Journal of Comparative Economics*, *41*(4), 1220-1239.

Xiao, J., Zhou, M., Wen, F., & Wen, F. (2018). Asymmetric impacts of oil price uncertainty on Chinese stock returns under different market conditions: Evidence from oil volatility index. *Energy Economics*, 74, 777-786.

Yao, T., Zhang, Y. J., & Ma, C. Q. (2017). How does investor attention affect international crude oil prices? *Applied Energy*, *205*, 336-344.

Ye, Z., Hu, C., He, L., Ouyang, G., & Wen, F. (2020). The dynamic time-frequency relationship between international oil prices and investor sentiment in China: A wavelet coherence analysis. The Energy Journal, 41(5).

Zhang, Y. J., & Li, S. H. (2019). The impact of investor sentiment on crude oil market risks: Evidence from the wavelet approach. *Quantitative Finance*, *19*(8), 1357-1371.