



ORIGINAL ARTICLE

The Relationship between OPEC Basket Oil Prices and the Index of Selected Industries in the Tehran Stock Exchange during the COVID-19 Pandemic

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(Received: 8 April 2024

Accepted: 13 April 2025)

KEYWORDS

Industrial index;
Risk;
Tehran Stock
Exchange;
OPEC

ABSTRACT: The COVID-19 pandemic has affected financial market indices by creating a crisis, so that with a possible change in the price of the OPEC oil basket, it can ultimately affect related indices in oil exporting and importing countries. Therefore, the impact of OPEC oil price changes on the indices of selected related groups on the Tehran Stock Exchange, which are affected by oil prices, was investigated from 2017 to 2022. In each consecutive five-month period, starting from the first month under review, a linear relationship between four dependent variables, including the index of groups of petroleum products, chemical products, transportation, and coal, along with the independent variable, the average monthly price of the OPEC oil basket, was obtained. It was found that by examining the average impact of the OPEC oil basket price on each industry index, it is possible to gain an attitude regarding the effectiveness of oil-related industry groups. The results of the research indicate that the indicators of the transportation industry and chemical products changed in sign compared to the price of the OPEC oil basket during the outbreak of COVID-19, and this issue can be attributed to the impact of the outbreak of COVID-19 on the Tehran Stock Exchange market. Also, in other investigated industries, stable changes were not observed continuously before and after the outbreak of COVID-19.

INTRODUCTION

The coronavirus pandemic has indeed had a significant impact on the global energy sector, particularly on OPEC oil production and the overall environment. The rapid spread of the virus resulted in a substantial decrease in the demand for crude oil, leading to a sharp decline in its price. Consequently, OPEC member countries faced considerable challenges in effectively managing the market. [1]. Conversely, one positive outcome of the pandemic has been a substantial reduction in environmental pollution worldwide. The closure of

industries, decreased trade in non-essential items, and suspension of transportation networks in countries such as China, Italy, Spain, America, and Brazil have contributed to a significant decrease in environmental pollution [2]. Reductions in pollution are particularly notable in regions where industries and transportation networks have been halted. The spread of COVID-19 has also had an impact on electricity consumption, as well as the steel and cement sectors, resulting in a decrease in coal consumption and subsequent improvement in air

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DOI: 10.60829/jchr.2025.1106597

quality. Air pollution has long been recognized as a risk factor for various chronic diseases, making individuals more vulnerable to severe respiratory and cardiovascular conditions. Studies have shown that prolonged exposure to air pollution, particularly NO₂, can increase susceptibility to the consequences of COVID-19 [3]. During the pandemic, there has been a noticeable decrease in atmospheric particulate matter with a diameter of 2.5 µm in many areas, leading to improved air quality [4].

The stock market, as a main component of the economy, undergoes significant changes influenced by external events, including the impact of the COVID-19 pandemic. During this unique era, the focus on public health and the development of new pharmaceutical products has attracted attention in the capital market, directly affecting the performance of pharmaceutical companies' stocks [5]. The demand for chemical products has increased with the outbreak of COVID-19, leading to improved productivity in certain companies. Pharmaceutical companies and those involved in public health have generally experienced a rise in their stock prices during this period.

However, the closing of borders and disruptions in transportation networks have posed challenges for chemical manufacturers in terms of raw material supply and product delivery. While some chemicals experienced unprecedented increases in demand due to the healthcare sector's pressure to provide medical equipment, disinfectants, and drugs, other chemical industries did not witness the same trend [6].

Given the widespread impact of COVID-19 on various countries' economies, particularly oil-exporting nations, it is possible that it has also influenced the indices of oil-related industries in the Tehran Stock Exchange. Gaining awareness about the extent and nature of the impact of oil prices on industry indices such as petroleum products, chemical products, transportation, and coal – all directly or indirectly linked to the oil industry – can assist investors in making informed decisions and instill confidence in shareholders. This knowledge can help them navigate the market effectively and strive to maintain or increase their capital.

During disease outbreaks that disrupt the daily lives of a significant portion of the global population, it is crucial

to consider appropriate and timely measures to prevent the detrimental effects of these epidemics. When examining the fluctuations in the stock market caused by various factors, it is important to note that a large number of variables change simultaneously. Therefore, analyzing the changes in a single influential factor on the index of a specific industry may not indicate its overall effectiveness in the capital market. To provide a complete understanding for shareholders, whose portfolios include stocks from multiple industries, it is reasonable to evaluate the effects of oil price changes on the Tehran Stock Exchange market. By exploring the simultaneous changes in several indices influenced by global oil price fluctuations, shareholders can gain a clearer perspective on the effectiveness of their stock portfolio at any given time.

Furthermore, studying the changes induced by oil price fluctuations on the stock market, which can manifest in numerous index changes, can reduce shareholders' investment risks and incentivize asset transfer to the capital market. This would result in increased liquidity in the market and a reduction in societal inflation. Moreover, as stock prices rise, owners of listed companies would see an increase in the value of their company and a greater potential for capital expansion, ultimately leading to higher income.

Various studies have been conducted on the impact of OPEC basket oil price changes on different indices in the Tehran Stock Exchange market. The following section will provide a brief overview of some of these studies.

In a study by Gholami Baladezaei and Ahmadi, OPEC oil price changes were used to examine the variation in the number of members from different industry groups in the list of the 50 most active seasonal companies in the Tehran Stock Exchange market over a 5-year period from 2010 to 2016. The research findings indicated that an increase in oil prices had the highest positive effect on industries such as mass production, real estate, chemical products, investments, and multi-disciplined industrial companies. On the other hand, the materials and pharmaceutical products industries, as well as metal product manufacturing, experienced the maximum decrease in the number of companies in the list of the 50 most active seasonal companies in a given year [7]. In another study by Gholami Baladezaei and Sarfi, cubic

spline interpolation was employed to analyze the relationship between OPEC basket oil price changes and the total index of the Tehran Stock Exchange on a monthly basis from 2018 to 2022. The findings revealed that the total index of the Tehran Stock Exchange was influenced by OPEC oil price changes during the outbreak of COVID-19 for a period of approximately six months [8]. Moghadam and Vahad Moghadam investigated the role of oil price fluctuations as one of the main factors contributing to economic crises in both oil-exporting and oil-importing countries. They found a significant relationship between these fluctuations and the abnormal return of shares in companies listed on the Tehran Stock Exchange [9].

Saghafi and Ghanbarian explored the relationship between oil price shocks and various indices of the Tehran Stock Exchange between 2008 and 2014. Their research demonstrated a long-term equilibrium relationship between OPEC oil prices and six capital market indices, including the total stock market index, industry index, price index of fifty companies, index of top fifty companies, yield and price index, and index of thirty large companies [10]. In a study by Fakari Sardehae et al., the effects of crude oil price changes on the Tehran Stock Exchange index were investigated over the period of 2011 to 2016. The results indicated that oil shocks had negative effects on the stock market in both the short and long term [11]. In a study conducted by Delangizan et al., the effects of fuel price changes on greenhouse gas production in Iran's road transport sector from 1991 to 2014 were investigated. The research findings revealed that an increase in gasoline prices in the passenger sub-sector led to a significant decrease in pollutant emissions. However, in the sub-sectors of buses, minibuses, trucks, and tractors, an increase in oil and gas prices was associated with an increase in pollutant emissions. Additionally, an increase in the share of investment in the transportation sector relative to total investment was found to significantly increase pollutant emissions [12]. In another research study by Taheri et al., the effect of energy carrier price increases on the cost of air pollutant control was examined. The study focused on the costs incurred by various sectors due to the emission of air pollutants in Iran [13]. Goli et al recently in a study used the time series econometric approach of co-accumulation

equations and vector error correction model in a research to investigate the effects of IPCC policies on OPEC oil supply and demand [14].

Among other recent studies in this regard, we can refer to the study conducted by Hatamerad et al. and Manzarzadeh Tamam et al. Hatamerad et al. investigated the relationship between macroeconomic variables and stock prices of four prominent OPEC oil exporting members from 1996 to 2018. The results of their research showed that there is a weak negative correlation between the OPEC oil price and the stock price index [15]. The purpose of Manzarzadeh Tamam et al. study is to investigate the impact of some macro economic variables on the performance indicators of selected companies of Tehran Stock Exchange in the period of 2010 to 2021. The hypothesis test of this research showed that sanctions have moderated the relationship between exchange rate fluctuations and the performance indicators of companies [16].

MATERIALS AND METHODS

The data related to OPEC oil basket price and four selected industry indices in the Tehran Stock Exchange from 2017 to 2022 were analyzed. The monthly price data for the OPEC oil basket were obtained from the OPEC website. By converting the Gregorian months to solar months and cross-referencing the prices in each respective month, the average price of the OPEC oil basket for solar months was obtained. For the four selected industrial indices (petroleum products, chemical products, transportation, and coal), data were obtained from the Tehran Stock Exchange website, and monthly index prices were estimated.

The number of months under review was sixty months. The following linear model was applied in this research:

$$\alpha_i CH_{i,t} + \alpha_{i+1} OP_{i,t} + \alpha_{i+2} TR_{i,t} + \alpha_{i+3} CO_{i,t} = \alpha_{i+4} OPEC_{i,t} + b \quad (1)$$

where $CH_{i,t}$ is the index value of chemical products, $OP_{i,t}$ is the index value of petroleum products, $TR_{i,t}$ is the value of transportation index and $CO_{i,t}$ is the value of the coal index and $OPEC_{i,t}$ is the value of the monthly price of the OPEC oil basket in month t and in the five-month period i .

The research model employed a linear model, with the index values of petroleum products, chemical products, transportation, and coal as dependent variables, and the monthly price of the OPEC oil basket as the independent variable.

RESULTS

For the four dependent variables of oil product, chemical product, transportation, coal industry indices and an independent variable of the monthly price of the OPEC oil basket during the research months, some central indices and dispersion indices have been calculated in the table below.

Table1. Descriptive statistics indicators for research variables.

variables	Range	Min	Max	Mean	Std deviation	Variance
The monthly price of the OPEC oil basket	84	22	107	65	15	240
Chemicals products	113226	133	113359	40511	39152	1532898098
Oil products	36431297	105929	36537226	2541730	4962629	2.463
Transportation	95113	3422	98536	17179	19007.00501	361266239
Coal	52900	1196	54097	18195	17972	3230045677

Figures 1 to 4 illustrate the dispersion of each industry index in relation to the OPEC oil basket price. The graphs suggest that the relationship between the dependent

variables and the oil price is not linear, quadratic, cubic, or conventional regression.

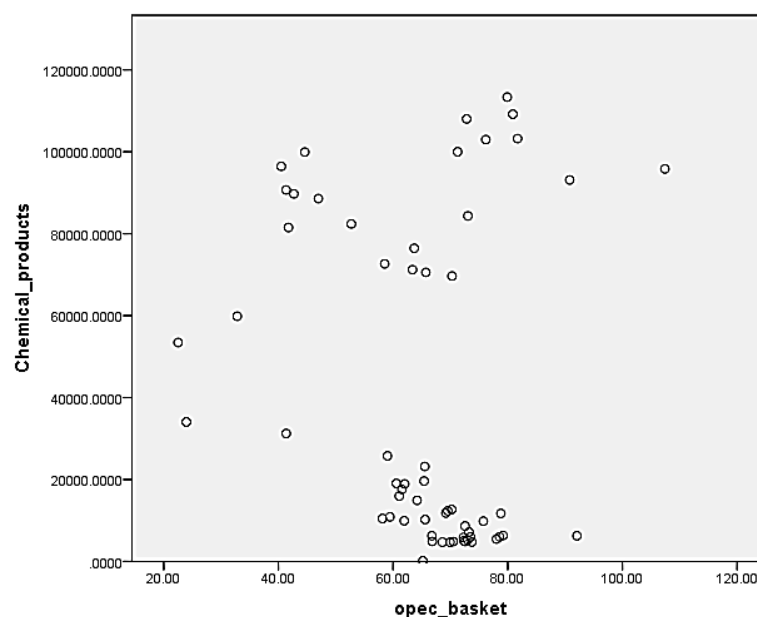


Figure 1. The diagram of the dispersion of the index of chemical products compared to the price of the OPEC oil basket during the research period

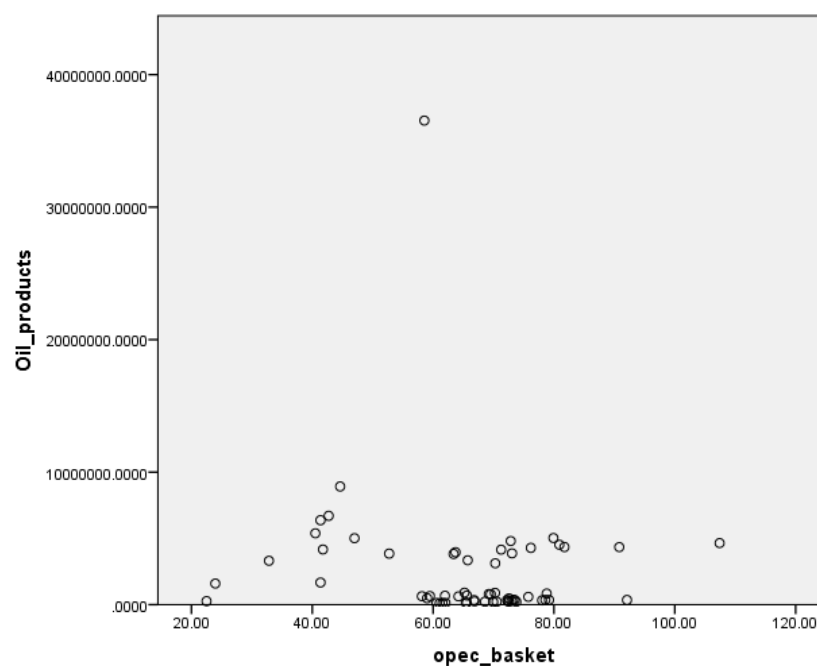


Figure 2. The diagram of the dispersion of the oil products index compared to the price of the OPEC oil basket during the research period

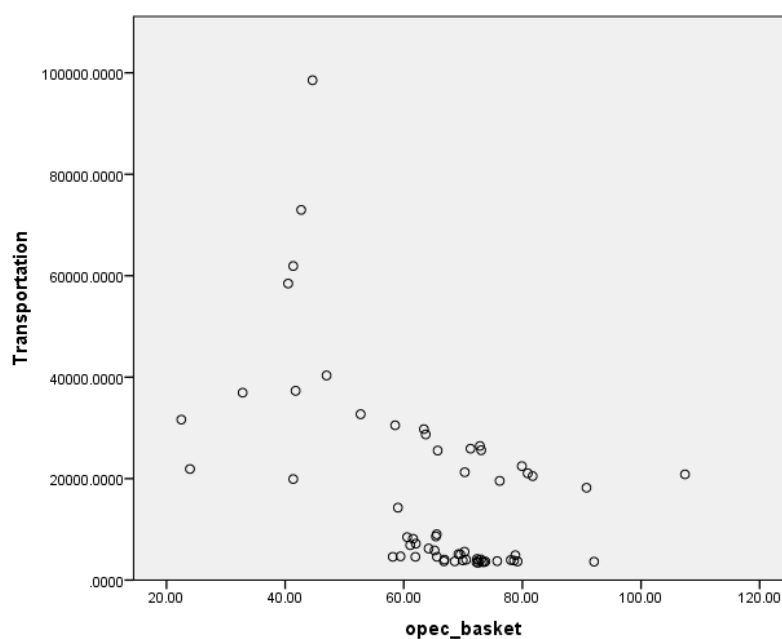


Figure 3. The graph of the dispersion of the transportation index in relation to the price of the OPEC oil basket during the research period

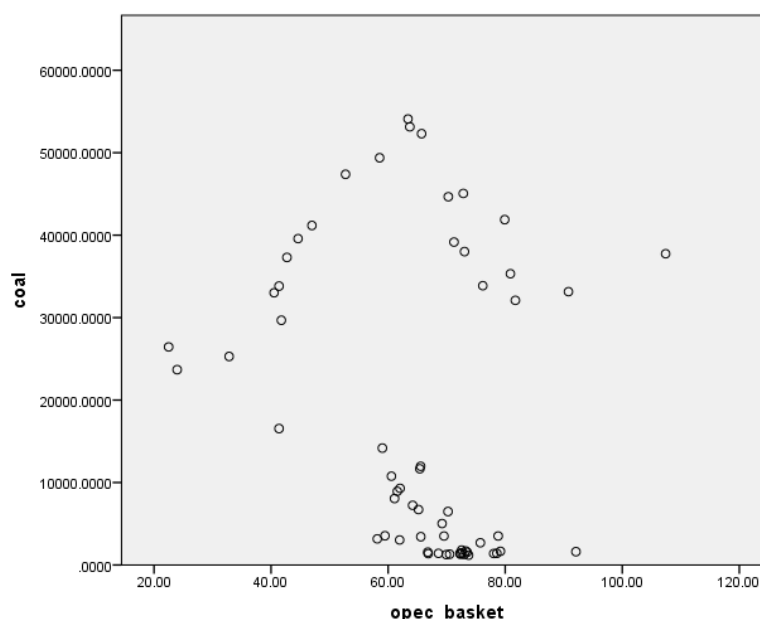


Figure 4. The graph of the dispersion of the coal index compared to the price of the OPEC oil basket during the research period

To investigate the linear relationship between the indicators of selected industries and the price of the OPEC basket oil during the research period, the model used in the analysis considered a constant parameter (b) of one, maintaining the generality of the subject. As a result, the remaining five parameters were specified as coefficients for each of the variables.

Considering these conditions, five consecutive months sub-intervals were measured as suitable sub-intervals for the above model, so that the examination of such a relationship in the first five-month sub-interval, from the first month of the research to the fifth month, in the second five-month sub-interval, from the fifth month to the ninth month, and in the same way until the end of the research months. Of course, by adding one month to the months of the research, the final sub-interval was also considered to be five months.

In each of the five-month sub-intervals, a system of equations with five equations and five unknowns can be obtained using the observations related to the indices of selected industries and the price of the OPEC oil basket for the respective months.

If the coefficients matrix is invertible then the parameters will be obtained uniquely.

That is, we will have the following model in the sub-interval of five months i for $1 \leq i \leq 15$.

$$\begin{aligned} \alpha_i CH_{i,t} + \alpha_{i+1} OP_{i,t} + \alpha_{i+2} TR_{i,t} + \alpha_{i+3} CO_{i,t} \\ = \alpha_{i+4} OPEC_{i,t} + 1 \end{aligned} \quad (2)$$

$t = 1, 2, 3, 4, 5.$

Due to the fact that the 15th five-month period included only four months, the first month of 1401 was also added to the period. In all investigated five-month intervals, all coefficient matrices are invertible, and the unique answer for variable coefficients in each five-month sub-interval has been calculated using Maple software ([17] and [18]).

Then, by putting these coefficients in model (2) and by dividing the sides of the equation by the coefficient of each dependent variable, an expression can be obtained that shows the amount and type of relationship (direct or inverse) between that dependent variable and the price of the OPEC oil basket. So in each five-month interval, these relations can be found according to Tables 2 to 6.

Table 2. The amount and type of relationship between the indices and the price of the OPEC oil basket in the first to third sub-intervals

index		The first five months	The second five months	The third five months
Chemicals products	Change amount	-15.5605416240607	-9.68835312334779	6.49610233191293
	Relation type	Inverse relation	Inverse relation	direct relation
Oil products	Change amount	2396.60394367726	1638.96152918482	-556.236250970210
	Relation type	direct relation	direct relation	Inverse relation
Transportation	Change amount	46.1616778938271	35.1931469015116	4.20168492189544
	Relation type	direct relation	direct relation	direct relation
Coal	Change amount	-86.0252144820134	43.1862552733104	-14.9094107807761
	Relation type	Inverse relation	direct relation	Inverse relation

Table 3. The amount and type of relationship between the indices and the price of the OPEC oil basket in the fourth to sixth intervals

Index		The fourth five months	The fifth five months	The sixth five months
Chemical products	Change amount	-329.828826816595	-2756.40006183969	60.2555008704911
	Relation type	Inverse relation	Inverse relation	Direct relation
Oil products	Change amount	6480.19993706589	-7732.42161527283	15063.2068378296
	Relation type	Direct relation	Inverse relation	Direct relation
Transportation	Change amount	20.7634251465768	51.7572436512826	166.214632603255
	Relation type	Direct relation	Direct relation	Direct relation
Coal	Change amount	-95.9721854302769	119.795430327337	-39.4747443342836
	Relation type	Inverse relation	Direct relation	Inverse relation

Table 4. The amount and type of relationship between the indices and the price of the OPEC oil basket in the 7th to 9th intervals

Index		The seventh five months	The eighth five months	The ninth five months
Chemical products	Change amount	-26351.8934326104	-34.2026815934226	-3610.06362723885
	Relation type	Inverse relation	Inverse relation	Inverse relation
Oil products	Change amount	78180.0090200513	311.746183660600	72832.3793413699
	Relation type	Direct relation	Direct relation	Direct relation
Transportation	Change amount	36.6554414113848	-71.3535031431198	-1415.51569682820
	Relation type	Direct relation	Inverse relation	Inverse relation
Coal	Change amount	-98.0997602068206	75.0108035594623	346.203292785911
	Relation type	Inverse relation	Direct relation	Direct relation

Table 5. The amount and type of relationship between the indices and the price of the OPEC oil basket in the 10th to 12th intervals.

Index		The tenth five months	The eleventh five months	The twelfth five months
Chemical products	Change amount	-4227.64011714778	54206.6034546348	-837.467680000537
	Relation type	Inverse relation	Direct relation	Inverse relation
oil products	Change amount	-366456.380100129	-203229.124322658	2588728.17205709
	Relation type	Inverse relation	Inverse relation	Direct relation
Transportation	Change amount	18159.3505761308	2764.62288736967	-567.939265566748
	Relation type	Direct relation	Direct relation	Inverse relation
Coal	Change amount	1487.32325213398	-5062.04446812368	-229.703466005575
	Relation type	Direct relation	Inverse relation	Inverse relation

Table 6. The amount and type of relationship between the indices and the price of the OPEC oil basket in the 13th to 15th intervals

Index		The thirteenth five months	The fourteenth five months	The fifteenth five months
Chemical products	Change amount	-229562.144477718	188.589302440350	369.267438275070
	Relation type	Inverse relation	Direct relation	Direct relation
Oil products	Change amount	229792.877567374	-6051.70760922675	192704.451892615
	Relation type	Direct relation	Inverse relation	Direct relation
Transportation	Change amount	-2796.95947764694	-100.527358231884	-119.574933841023
	Relation type	Inverse relation	Inverse relation	Inverse relation
Coal	Change amount	1501.40461771244	85.4237382668970	-1351.76373822734
	Relation type	Direct relation	Direct relation	Inverse relation

Using the data of each row in tables 2 to 6, for each sub-interval of five months, the rate of change of each dependent variable when the independent variable changes by one unit - if the other variables are assumed to be constant - has been determined. Also, the type of relationship between each dependent variable and independent variable is specified directly or inversely which shows how each of the industrial indices will increase or decrease in the five-month interval with the increase or decrease in the price of the OPEC oil basket. According to the time of the announcement of the epidemic of COVID-19 in the world through the World

Health Organization, which occurred in March 2018, this date falls within the ninth five-month period. The change in the index of oil products industries due to the fluctuations in OPEC oil prices during this time and before and after remained negative and unchanged. The change in the index of chemical products, on the other hand, exhibited positive changes during the ninth five-month period and several sub-intervals preceding it. However, it turned negative in several sub-intervals following the outbreak of COVID-19. This change seems to be a result of the spread of Covid-19. Similarly, the transportation industry index showed a negative values

change during the ninth and eighth sub-intervals but backed positive values in the subsequent two sub-intervals.

The change in the coal index compared to the price of OPEC oil was positive during the ninth sub-interval and remained consistent before and after. It seems that the Covid-19 pandemic had no effect on the relationship between these two variables. During this time, the oil products and coal indices maintained their respective inverse and direct relationships with the price of oil. Therefore, the relationship between the oil products and

coal indices and the price of oil remained unchanged in the five months following the outbreak of COVID-19, while the other two indices were affected by this outbreak (the transportation index shifted from a reverse to a direct relationship, and the chemical products index shifted from a direct to a reverse relationship).

In Table 7, for each industry index, the average of changes in the index due to a change in one unit of OPEC oil price, if the rest of the indices remain constant, and the average of decrease and average of increase are mentioned separately.

Table 7. Average of change, increase and decrease in the index for each industry as a result of OPEC oil price changes

variables	Average of change in the index	Average of decrease in the index	Average of increase in the index
Chemical products	-14193.5785334107	-26773.4889799712	10966.2423597105
Oil products	-171556.907046835	-528792.340325891	66600.0484725365
Transportation	1080.87003205149	-845.311705876319	2364.99119067002
Coal	-221.309706502095	-872.249123448846	522.621055722763

The data in Table 7 shows how much each index is affected by the change in OPEC oil prices on average during the research period, and the average decrease and average increase of each index are also reported in the entire research period. This table provides an effective guide for investors and analysts to analyze the market situation in order to make the best and most reliable investment decision with minimal information and reduce investment risk as much as possible.

DISCUSSION

Conclusion and suggestions

The COVID-19 pandemic has had a significant impact on the global economy, including OPEC basket oil prices and stock markets. The rapid spread of the virus resulted in a decrease in energy demand, leading to a sharp decline in the prices of energy carriers. During this period, companies with a focus on health-oriented activities received increased attention from investors and the stock market.

This article investigates the type and extent of changes in

four indicators of oil-related industries in the Tehran Stock Exchange due to fluctuations in OPEC basket oil prices. The study examines these changes in five-month intervals, establishing a linear relationship between the values of selected industry indices and OPEC basket oil prices. Within each interval, the type and rate of change for each index were analyzed.

The changes observed in the transportation industry and chemical products index compared to the price of the OPEC oil basket during the COVID-19 outbreak serve as evidence of the pandemic's impact on the Tehran Stock Exchange market. This highlights the need for further research in this field. It is worth noting that in other industries examined in this research, no sustained changes were observed consistently before and after the COVID-19 outbreak.

ACKNOWLEDGEMENTS

The authors would like to acknowledge the assistance of Dr. Keramatollah Heydari Rostami during various stages of preparation of this article.

Conflict of interests

No conflict.

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