

The Effect of Covid-19 Outbreak on Registered Oil Companies at Tehran Stock Exchange

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ABSTRACT

The goal of this paper is to study the effect of Covid-19 outbreak on oil markets volatility. Covid-19 as a pandemic has a significant negative effect on global economy. Alongside the global economy, stock markets responded to the outbreak immediately. The first case appeared in February 20 in Iran. The outbreak has different implication for Iranian economy. Using daily data on return of oil companies registered at Tehran Stock Exchange (TSE), change in new cases integrated into the E-GARCH model as a proxy for the virus outbreak from February 20, 2020 until December 12, 2020, it applies an E-GARCH model to derive volatilities in index. To test the effect of Covid-19 outbreak on the volatilities in oil companies' index, change in daily new cases integrated into the E-GARCH model as a proxy for the virus outbreak. The results show that, despite of fresh money pumped into the market and increase in market transactions and volume of trade, during the first phase of outbreak, Covid-19 has negatively affected returns of oil companies' prices.

1. Introduction

Covid-19 first appeared in Wuhan City, Hubei Province, China in December 2019. The World Health Organization declared it as a global pandemic, on March 11, 2020. Following the global crisis of coronavirus disease in different parts of the world, the coronavirus was officially confirmed in Iran on February 20, 2020

(WHO, 2020). In March 24, 2020, the situation in Iran changed from white to yellow (Ministry of Health, 2020). Covid-19 outbreak has significant effect on global economy. Financial markets are the first one which immediately response to global crisis like Covid-19 outbreak. Corbet et al. (2020), Zhang et al. (2020) and Gunay 2020 showed that alongside the negative impact of pandemic on global economy, financial markets in

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Asia, Europe, and North America, responded to the covid-19 outbreak negatively.

Most Covid 19 researches focused on specific countries, and the result showed that this pandemic has been affected economies in different ways. Some economies affected negatively, while others responded positively. Different sectors of stock markets also responded to corona virus differently. Health and food related industries' stockf returns increased while transportation, entertainment, real estate, truism related activities' stock returns decreased in response to corona virus outbreak. Commodity markets response to covid-19 outbreak are not alike. Metal and agricultural commodities responded moderately to the COVID-19 pandemic. Energy prices, especially oil prices affected severely during pandemic (World Bank, Oct., 2020). Metal prices, declined relatively modestly and have returned to levels that preceded the shock, according to the semi-annual Commodity Markets Outlook report. Agriculture prices were relatively unaffected by the pandemic. Oil prices fell dramatically in the early stages of COVID-19 and have only partially regained pre-pandemic price levels, despite some recovery, are expected to stabilize below pre-pandemic levels next year. Energy price decline in response to Covid-19 outbreak affects oil related industries. Beside of negative effects of outbreak on people working in these industries, decrease inenergy demand will result in decline in profitability in energy industries, like refineries.

This paper applies GARCH family models to investigate the effect of Covid-19 on international oil markets. The rest of the paper is as follow. Part 2 reviews the literature. Data and methodology discussed in part 3. Part 4 allocated to empirical results. Part 5 concludes the ramarcs.

2. Literature Review

Oil has the highest in the world trade and has significant effect on economic variables, then its price fluctuations have a remarkable effect on real economy and consequently financial markets (Charib et al., 2020). Downstream industries complete the supply chain between oil and industries. Petroleum is refined by refineries and petrochemical products produces in petrochemical plants. Investigations show that the price of index oil like WTI declined into a negative level on April 2020. This is mainly a direct consequence of decrease in demand for crude oil caused by the slowdown in the level of economic activities created by Coronavirus outbreak. Change in the economic situation,

immediately represented in change in financial markets indices in response to oil price decrease

Commodity markets fluctuations, like crude oil, are not only affected by the market's fundamentals, economic and political variables (Wang et al., 2011), but also by non-economic phenomenon like epidemic disease (Icheck and Marinc, 2018). This by itself has a significant effect on inefficiency of these markets. Ghazani and Ebrahili (2019) showed that world oil market was inefficient which implies non-fundamental variables have significant effect on the behavior of oil prices, and corona virus outbreak changed the behavior of the markets. More precisely, oil markets become more inefficient during the pandemic outbreak compared to the pre-Covid-19 period, showing the pandemic has implications for oil markets. However, efficiency of oil markets depends on volume of trades, trends in demand and supply as well as to epidemic and pandemic disease, showing that the investors response to change in the world condition. Inefficient behavior of oil markets in pre and during the outbreak period brings out the possibility to forecast future pricing behaviors in these markets based on past information (Mensi et al., 2020). This critical change in the behavior of oil markets may be transmitted into oil related companies prices at stock markets. Downstream industries like refineries returns at stock markets are highly correlated to the oil markets. Thus, any change in the behavior of oil markets affects immediately the behavior of downstream industries.

International institutions published and revised predictions of pandemic effects on global economy showing that it has different effects on each economy depending on control policies, government interventions and households response to the outbreak. Governments' interventional policies like lockdowns and social distancing will result in reduction in the level of economic activities. Labor force adjustment and decrease in household income decreases demand for goods and services, which will decrease the production in consequent.

Health Protocols on international trade have signification effects on trade balance and economic growth in trade dependent economies. Net imported economies will suffer from inputs, intermediary commodities as well as finished products, which affect production and social welfare respectively. The pandemic affects supply chain, as well as demand side of economy. The question is that, which industries are more affected by the pandemic. Any attempts to stimulate affected sectors need to have a perfect knowledge about



the mechanism of diffusion of negative effect of outbreak within the economy and between the industries.

The Corona virus has seriously affected the global economy and caused a major decline in value chain; production, sales and employment rates (Lahmidi and Bakiros 2020). This crisis has affected capital market differently around the world. Alfaro et al. (2020) investigated US stock market data, and showed that stock market value has declined in response to the SARS and Covid-19 pandemic. Corbet et al. (2020) examined the effect of Corona virus on stock returns and found that companies named with the corona experienced severe negative returns and tremendous increases in volatility when Covid-19 became contagious. Mazur et al, (2020), using S & P500 data and stock price and trading volume data, studied US stock market performance during the Covid-19 period, concluded that natural gas, food, health and software stocks had high returns, while real estate and entertainment experienced significant decline in stock prices. Ramley and Wagner, 2020 examined the effects of Covid-19 on American companies. They also showed that US GDP has fallen by about 4.8 percent in the first month of 2020, and the unemployment rate has risen above 20 percent. Takahashi and Kazuo (2020) showed that the Japanese stock market dropped by the same degree as the US stock market. Using a reduced form regression analysis by computing the BHARs in three phases of the first quarter of 2020, they concluded that this pandemic disease interacts negatively with stock market returns. Al-Awadi et al. (2020) analyzed the effects of Covid -9 disease on Chinese corporations. Zhang, Hu and Ji (2020), tested different models and showed that: (i) VIX positively responded to out of China new cases, (ii) positively affected by the death ratio, and the effect in regions outside of china is stronger, (iii) and the coronavirus outbreak has a positive effect on the financial markets' volatility. They concluded that if the corona virus persist for a long time, the international markets enters into a new episode of stress show how the relationship between the stocks exchanges of countries before and after the Covid-19 crisis. Baker et al. (2020) compared the US stock market response to various infectious diseases and concluded that the stock market fluctuated the most in the face of this disease.

Shehzad et al. (2020) studied the nonlinear behavior of the financial markets of the United States, Germany, Italy, Japan, and China during the Coronavirus and global financial crises has been examined; Corona indicates a significant impact on the S&P 500 stock. However, this has not affected NASDAQ index. Okuria and Lane (2020) used Correlation Analysis Detrended Moving Cross-Correlation Analysis (DMCA) and Analyzed Techniques Detrended Cross-Correlation Analysis (DCCA) for the stock markets in the quiet period and the Covid-19 period. Wagner (2020) showed that stock markets provide specific information in rapid and complex situations and also reacted rapidly to the pandemic corona virus, which varies over time depending on the stage of the outbreak. At the same time as the news of the growth of the number of people with coronary heart disease is spreading, the returns of the stock markets are decreasing. Nadem Ashraf (2020) concluded that with the increase and growth of deaths in this disease, we are witnessing a negative reaction on stock returns.

3. Data and Methodology

3.1. Data

This paper test the effect of corona virus outbreak on volatility in price of oil companies registered at Tehran Stock Exchange (TSE). Daily data on Covid-19 outbreak obtained from WHO website and checked by publicly published data by Ministry of Health. The data cover period from February 20, 2020 to December 12, 2020, since the first two cases of Covid-19 appeared in February 20, 2020. Figure 1 illustrates trend of daily new cases and death people for the whole period of 20-02-2020 until 12-12-2020. In the first month of outbreak, the number of new cases was below 1000 person. With increase in the number of infections government conducted presentational policies, including the limitation on between the counties traveling. People stated at home at the time of New Year holidays and this helped government to control outbreak. During the next three months new cases increased moderately. In third part of May the number of newly infections started to increase on average with respect to previous period. As it is shown new cases increased from October drastically and November experienced new cases which was on average above 10000 infections.

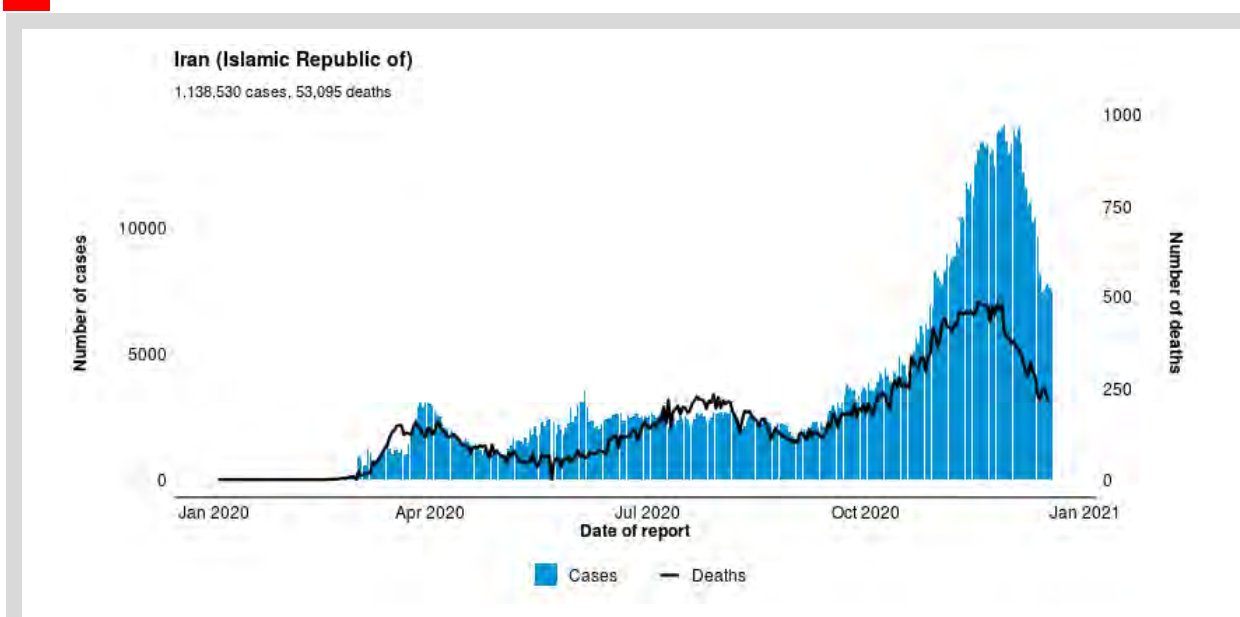


Figure 1. Illustrates trend of daily new cases and death people.

Source: <https://worldhealthorg.shinyapps.io/covid/>

Government intervention and policies could result in reduction in number of infections and death people. According to data, government policies especially traveling bans in April resulted in significant decrease in number of new cases. Increase in numbers of trips in June and July increased the number of new cases. As it can be seen, the number of dead people decreased during that period which could be attributed to the efforts of ministry of health, increase in general knowledge on Covid-19, new tests and methods of treatments. Although collective efforts of community controlled numbers of cases during August, but October was a starting point for new regime of infections and death. Sharp increase in infected people attributed to availability of tests by the ministry of health but reports show that opening activities caused cases to increase. Therefore government started new interventional policies in November which continued to December.

New policies affected number of new cases in early December such that we witnessed backward in the figures.

To have a more precise perspective on the government policies to cope with Covid-19 we reported Oxford COVID-19 Government Response Tracker (OxCGRT) in table (1). The Oxford COVID-19 Government Response Tracker (OxCGRT) is a program established by the Blavatnik School of Government at the University of Oxford, UK. Data on seventeen different indicators of government response are recorded. These include containment, economic, and health system policies. Non-quantitative indicators are converted to ordinal scales based on a series of criteria. These are combined into a number of response indices on a quantitative scale. Each indicator in the table is shown as a percentage of the maximum possible value¹.

Table 1. Oxford COVID-19 Government Response Tracker (OxCGRT).

	POLICY	CURRENT INDEX	MAXIMUM INDEX
1	Oxford Stringency Index	71	71
2	School closing	100	100
3	Workplace closing	100	100

¹Hale, Thomas, Sam Webster, Anna Petherick, Toby Phillips, and Beatriz Kira (2020) - "Oxford COVID-19 Government

Response Tracker", Blavatnik School of Government. Published online at covidtracker.bsg.ox.ac.uk. Retrieved from: <https://covidtracker.bsg.ox.ac.uk/> [Online Resource]



	POLICY	CURRENT INDEX	MAXIMUM INDEX
4	Cancel public events	100	100
5	Restrictions on gatherings	100	100
6	Close public transport	50	100
7	Stay at home requirements	33	67
8	Restrictions on internal movement	100	100
9	International travel controls	75	75
10	Income support	50	50
11	Debt/contract relief	50	100
12	Public information campaigns	50	50
13	Testing policy	33	67
14	Contact tracing	50	100

Source: <https://worldhealthorg.shinyapps.io/covid/>

According to the data reported in table(1), government touched maximum scores in closing public events, school closing, restriction on internal movement, as well as gatherings. But it seems that the government succeeded to control public gatherings rather than private and family gatherings since the specialist reported that most people affected in family gatherings. Lack of resources to support income, caused the small and medium businesses do not put limitation on their employee, which resulted in increase in number of new cases. Poor people, which cannot afford for sharp

increase in prices of remedies, are exposed to disease and high proportion of them die. Figure (2) indicates the (OxCGRT) alongside of new cases. The figure indicates that the government intervention started at the beginning of outbreak. It resulted in decrease in number of new cases in April. According to the overall score of the index, during the next months there was no serious policy intervention, which resulted in soaring the number of disease in mid and end of summer. Opening activities and using public transportation were main factors, which in large cities the effect was larger. Debates on closing the schools are

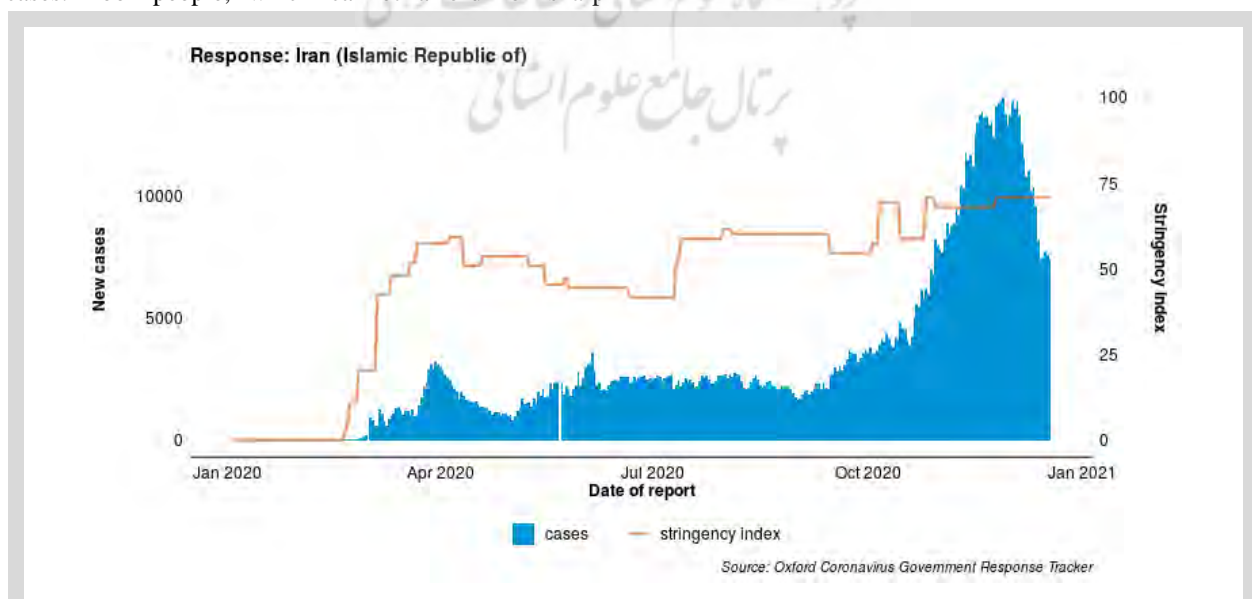


Figure 2. (OxCGRT) alongside of new cases.

Source: oxford coronavirus government response tracker

To test the pandemic effect on registered oil companies at TSE we use daily data on index of oil companies, which constructed from daily transaction of seven oil refineries, and an energy fund traded at the

market. Since the Covid-19 data are 7 days a week and the market closed during Tuesday and Fridays, we rolled over new cases of these two days on five active days in the stock market, Thursday, Wednesday, Saturday, Sunday and Monday of the next week.

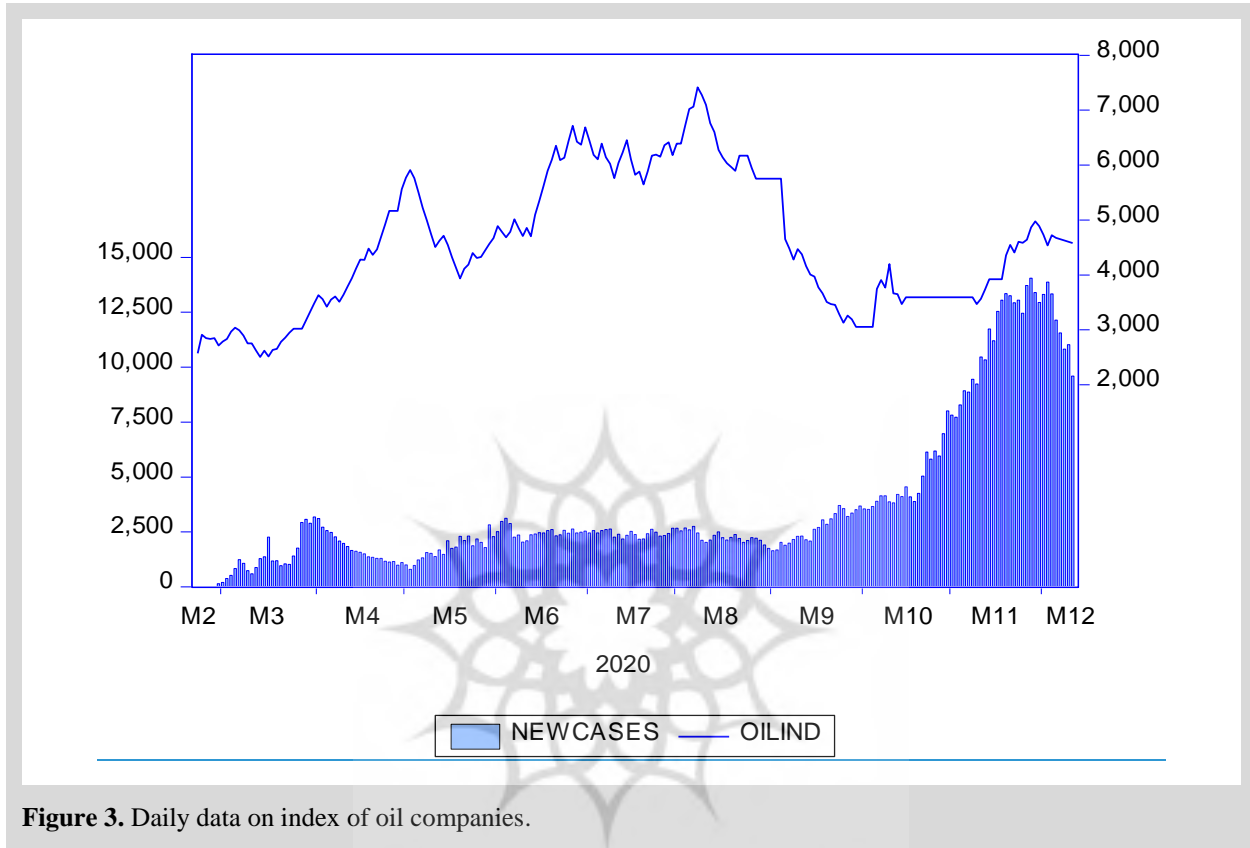


Figure 3. Daily data on index of oil companies.

3.2. Methodology

The aim of the paper is to estimate the relationship between new cases of Covid-19 on return of registered oil companies at TSE. To do this it use a GARCH family model in order to integrate volatilities into the model. Structural and linear time series models are not capable of explaining some important features of financial markets like leptokurtosis, volatility clustering or volatility pooling and leverage effects. Classic econometric model postulate that, the variance of the disturbance term is identically independently distributed. However, most financial time series experience high volatilities in response to shocks into the market. In such circumstances, homoskedasticity assumption is relaxed. Engle (1982, 1995), Bollerslev (1986), Bollerslev-Ghysels (1996) proposed a group of models that answer to these concerns and allow for modeling the mean as well as the variance of the error term. Campbell, Lo and

MacKinlay (1997) propose a non-linear data generating process $y_t = f(u_t, u_{t-1}, u_{t-2}, \dots)$ where u is an identically independently distribute error term is and f is a non-linear function. To model and forecast volatilities of financial markets, Engle (1982) proposed ARCH model. To cope with limitations of estimation of ARCH model, and to guarantee for positive conditional variance, Bollerslev (1986), suggested GARCH model. Nelson (1990, 1991) developed IGARCH models to solve the problem of unit roots in modelling non-stationary time series. GARCH in Mean model developed by Engle, Lilien, and Robins (1987) to integrated volatilities into the mean equation. Alongside to different assumptions about the distribution of error term, like t-distribution (Bollerslev, 1987), generalized error distribution (Nelson, 1991), GJ-Runkle (1993) and Nelson (1991) integrated non-linear behavior in to the volatility models.



Symmetric ARCH/GARCH models assign the same weight to positive and negative shocks, therefore it is assumed that they have the same effect on volatility. In contrast, leverage effect postulates that financial markets react more to “bad” news than “good” news (Black, 1976). Following Nelson (1991) we apply an exponential GARCH (EGARCH) model to investigate the effect of Covid-19 on daily return oil companies’ index as follow:

$$r_t = \alpha_0 + \beta_1 r_{t-1} + \beta_2 cov19_t + \varepsilon_t$$

$$Ln(h_t) = \alpha_0 + \alpha_1 \left| \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \beta_1 Ln(h_{t-1}) \quad (1)$$

Where, r_t stands for return on oil companies index, $cov19_t$ is change in daily new cases as a proxy for cCovid-19 outbreak.

In the case of non-stationary variables, and co-movements in models variable, estimated parameters and inference are not reliable, because t-ratios no longer have a t-student distribution. If the model variable are non-stationary, the shocks effects remain forever and estimated model is spurious regressions. To test for stationarity, there are a series of test with different assumptions about the presence of break point in the data. Test developed by Dickey and Fuller(1979) and Fuller(1976), examines the null hypothesis of the series has a unit roots($\phi=1$ in $y_t = \phi y_{t-1} + u_t$,) against the one-sided alternative $\phi < 1$. Critical values are derived from Monte Carlo simulation in Fuller (1976). To cope with the problem of autocorrelation in disturbance term of estimated equation, Dickey and Fuller suggest an “augmented” form of test, which includes higher lags of difference of dependent variable in the explanatory variables. Alternative Augmented Dickey-Fuller (ADF) test is expressed as follow:

Table 2. Unit root test.

Variable	ADF test			PP Test		
	τ	Critical Value		τ	Critical Value	
Olindr	-12.6	1%	-4.002	-12.77	1%	-4.002
		5%	-3.431		5%	-3.431
		10%	-3.139		10%	-3.139
Covid-19	-6.88	1%	-4.002	-11.96	1%	-4.002
		5%	-3.431		5%	-3.431
		10%	-3.139		10%	-3.139

$$\Delta y_t = \varphi y_t + \sum_{i=1}^p \alpha_i \Delta y_{t-1} + u_t \quad (2)$$

Information criterion like Akaik Information Criteria (AIC), Swartz Bayesian Criteria (SBC) and Hannan-Queen Information (HQIC) Criteria are used to choose optimal number of lags for difference variable, of difference in the test. To cope with the problem of autocorrelation in disturbance term, Phillips and Perron(PP) have performed a more comprehensive tests and integrated an correction term into Dickey-Fuller process. The test result is similar to ADF tests. In the presence of structural breaks in time series which slope coefficient tends to unity, standard unit root test like Dickey-Fuller, Philips-Peron test do not perform well, and the tests fail to reject existence of unit root in data. In small samples which lager break are more probable, the power of test decreases. Since most of macroeconomic variables contain a deterministic trend with a structural break, then taking the breaks into account will result in rejection of existence of unit roots in most macroeconomic variables and therefore, most of macroeconomic time series will be stationary(Perron 1989).

4. Empirical Results

Before estimating the model, we test for unit root test in data to avoid spurious regression. We apply Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests to ensure if the data are stationary. The results reported in table (2). The results show that model’s variables are stationary and have no unit root.

We do breakpoint unit root test to ensure for power of ADF test. The result shows that test criteria is -13.37. Since test statistic is greater than all critical values, the null hypothesis based on that the data has, a break point is rejected and there is no unit root in the data and return

on oil companies index is variance and trend-stationary. Figure. (4) Shows Dickey-Fuller statistics of breakpoint unit root test.

Figure.4 Dickey-Fuller t-statistics

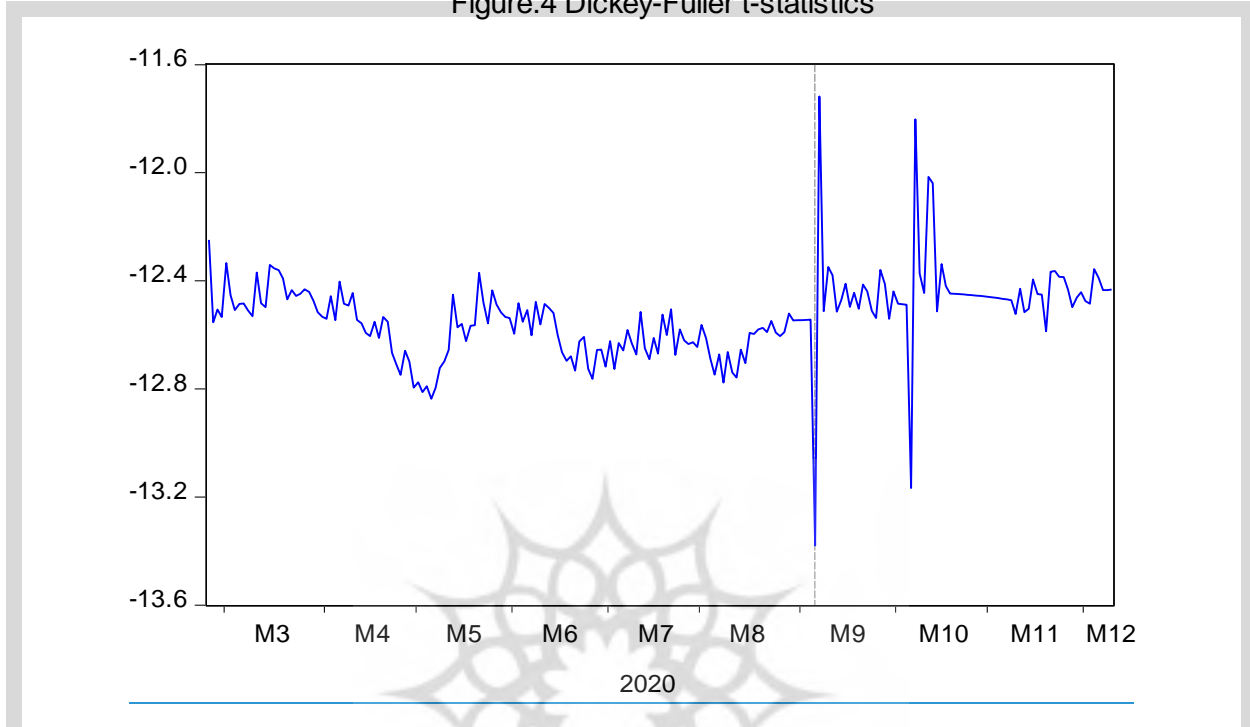


Figure 4. Dickey-fuller t-statistics.

To analyze the effect of pandemic on oil companies at TSE, first we performed ARCH effect test. The results approve ARCH effect in index returns. Then we estimated an E-GARCH (2, 1) model. We integrated change in daily new cases as a proxy for Covid-19 outbreak into the mean equation in E-GARCH model.

We assumed a generalized distribution for mean equation disturbance term. Results for estimated model is reported in table (3).

Table 3. Results for estimated model.

Mean Eq. : $r_t = \alpha_0 + \beta_1 r_{t-1} + \beta_2 cov19_t + \varepsilon_t$				
β_1	β_2	R^2	$D.W$	
0.193 (0.078)	-0.052 (0.0196)	0.015	2.025	
GARCH EQ. : $Ln(h_t) = \alpha_0 + \alpha_1 \left \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} \right + \gamma \frac{\varepsilon_{t-1}}{\sqrt{h_{t-1}}} + \theta \frac{\varepsilon_{t-2}}{\sqrt{h_{t-1}}} + \beta_1 Ln(h_{t-1})$				
α_0	α_1	γ	θ	β_1
-0.430955 (0.104006)	-0.141 (0.034)	0.162 (0.060)	-0.243 (0.060)	0.914 (0.185)

Source: Researchers Calculations

All estimated parameters are significant. As it shown, Covid-19 outbreak variable has significantly negative

effect on dependent variable in mean equation. It shows that one percent increase in the number of new cases will decrease the return of oil companies index, -0.052 which is consistent with the behavior of market. Accordingly,



covid-19 has negative effect on oil markets in Iran. On one side, government policies coping with Covid-19 outbreak decreased demand for oil products. On the other side, restrictions on international trade, decreased supply of oil product to the regional markets. Although first and second-type sanctions against Iran, especially oil-sanction have been limited export of oil, but during the sanction time, some private companies exported a significant volume of oil products to region markets, like Afghanistan and Iraq. Therefore, our results support the idea of negative effect of Covid-19 outbreak on oil markets. Regarding the goodness of fitness of model, systematic risk in TSE is significant. It shows that a high percentage of change in the index return can be attributed to shocks other than Covid-19 and volatilities in the oil index return. Investigations show that during 2019-2020 there have been a number of shocks determine the behavior of stock market. First of all fresh money into the market increased transaction of stocks especially oil related industries. On the other side, exchange rate volatilities had a significant effect on stock market. During the study period, government encouraged people to invest in stock market. Increase in number of market participant could also be considered as a significant determinant of asymmetric change in the model dependent variable. According to table. (3), coefficient of positive shocks has negative effect on volatilities. It means that in some cases the stocks have been overprices because of herd mentality behavior privileged in the market. Panic behavior also can have a significant effect on the market.

5. Concluding Remarks

This paper investigated the effect of Covid-19 outbreak on oil companies registered at TSE. To do this we applied an asymmetric GARCH model, using daily data of Covid-19 new cases as a proxy for virus outbreak. The results show negative effect of outbreak on this section of stock market. Restrictions on public sector transport, as well as decrease in gasoline and gas oil demand, pushed down the return of companies prices. Although there were a set of positive shocks that pushed the index up, but the general effect of outbreak on economic activities resulted in negative effect on oil companies. Fresh money in stock market, government policies to encourage people to invest in stock market, alongside of new IPOs can justify the share of systematic risk in Tehran Stock market during the period of the study.

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