

THE DYNAMIC CORRELATION BETWEEN OIL PRICES AND THE INDONESIAN OIL COMPANIES' STOCK PRICE

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Abstract

This study aims to analyze the correlation between oil prices and the Indonesian oil companies' stock price during the pandemic of COVID-19 by testing the effect of oil price changes on companies' stock return and stock volatility. Also, by considering the dynamic correlation between oil prices and the Indonesian oil companies' stock prices. The data were collected from secondary data at www.finance.yahoo.com, Oil prices, and the Indonesian oil companies' stock price period from January 2020 to June 2020 during the pandemic of COVID-19. Further, this study using the GARCH method to explain the effect of oil price changes on stock volatility and return. Also, the method used to explain the dynamic correlation between oil prices and the Indonesian oil companies' stock price is the DCC-GARCH method. The study found that the oil price changes did not have an effect on stock volatility and showed a positive dynamic correlation of oil prices with Indonesian oil companies' stock prices. By looking at the relationship between oil prices and Indonesian oil companies' stock prices, this study can be used as a guide for investors for their investments.

Keywords: oil price; Indonesia stock exchange (IDX); DCC-GARCH; covid-19

Abstrak

Penelitian ini memiliki tujuan untuk melakukan analisa antara harga minyak dengan harga saham perusahaan minyak Indonesia dalam masa pandemi COVID-19 melalui pengujian hubungan harga minyak terhadap return saham perusahaan dan volatilitas saham. Juga dengan memperhatikan korelasi dinamis antara harga minyak dengan harga saham perusahaan minyak Indonesia. Pengumpulan data dilakukan dari data sekunder di www.finance.yahoo.com, Harga Minyak, dan harga saham perusahaan minyak Indonesia periode Januari 2020 hingga Juni 2020 selama pandemi COVID-19. Selanjutnya penelitian ini menggunakan metode GARCH untuk menjelaskan pengaruh perubahan harga minyak terhadap volatilitas dan return saham. Selain itu, metode yang digunakan untuk menjelaskan korelasi dinamis antara harga minyak dengan harga saham perusahaan minyak Indonesia adalah metode DCC-GARCH. Penelitian ini menemukan bahwa perubahan harga minyak tidak berpengaruh terhadap volatilitas saham dan menunjukkan korelasi dinamis yang positif antara harga minyak dengan harga saham perusahaan minyak Indonesia. Dengan melihat keterkaitan antara harga minyak dengan harga saham perusahaan minyak Indonesia, penelitian ini dapat digunakan sebagai pedoman bagi investor dalam melakukan investasinya..

Kata kunci : harga minyak, bursa efek indonesia (BEI), DCC-GARCH, covid-19

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INTRODUCTION

There are a few things that have a critical effect on a country's economy. One of the important commodities which are utilized in nearly any angle in the economy is oil. Adam et al. (2015) explained that oil is the most imperative product within the worldwide financial market, so when both of them are in the same period with high volatility, it's exceptionally conceivable to make shock transmission between each market (Robiyanto, 2018). According to Sultan et al. (2019), domestic oil prices affected by domestic oil prices the year before, world oil prices, and Economic growth, the author also found economic growth and oil price have a simultaneous relationship. Several factors affect the oil price, one of them is supplied in the market. The consumer and producer countries certainly identify the signing key for oil and economic growth, because of that the need for oil is increasing (Riga et al., 2016). The technology that uses does not help to reach the oil deposits, Canada and the United States beat Saudi Arabia in high production of oil because of OPEC's actions to continue to boost oil yields to adjust the requirements and not to overproduce the supply of oil considering the oil price (Adam et al., 2015). Numerous literature in regards to changes in world oil prices to the stock market that have been conducted previously, mainly used a similar approach or approaches that test either the long term or short term relationships (Robiyanto, 2018). Another study conducted by Amalia and Purqon (2019) found oil price fluctuations have not affected Perusahaan Gas Negara (Persero) Tbk. A study conducted by Ramos and Veiga (2011) found that oil and gas supply-demand give a critical effect on the stock prices of oil companies in general, based on the study in International evidence. In more detail, Taungke and Supramono (2015) explained that the prices of Indonesian oil companies have been affected by the bid and offers in the

stock market, also they found that the dividend can be the factor that can give a significant effect on the prices of Indonesian oil companies.

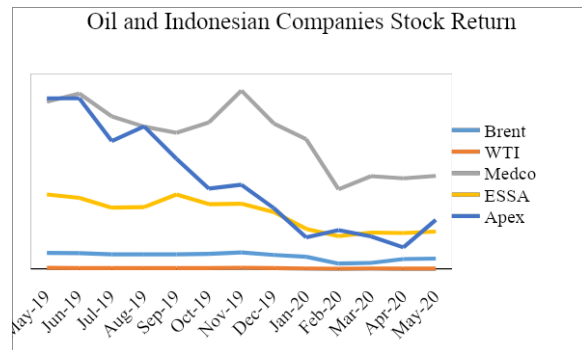


Figure 1. Oil and Indonesian stock return in 12 Month
Sources: www.finance.yahoo.com, processed

Figure 1 shows the stock return of oil and Indonesian oil companies. According to picture 1, the value of oil and Indonesian oil companies' stock return is decreasing from December 2019 until May 2020 and still has not reached the previous point before December 2019. Whereas in December 2019, is the first COVID-19 cases found.

Crude oil is a critical component of global production, and its dependence has been rising as the supply-demand ratio has changed. The changes in oil prices would give an overwhelming burden to the economy in general. Brent North Sea (Europe Brent) and West Texas intermediate are the two types of oil that are used as the international price references (Robiyanto, 2018). Adam et al. (2015) stated in the long-term and short term, The Indonesian composite index has a strong dynamical relationship with world crude oil prices, Riga et al. (2016) stated that there is a strong significant reaction between crude oil price to agriculture and consumer goods stock return. Another study conducted by Lumban Gaol et al. (2016) stated that In long-term relationships, crude oil price does not have a relationship with the Indonesian stock market. Robiyanto (2018) found that ASEAN's stock market correlation with

world oil prices is not static. A study by Abdelaziz and Cipollini (2008) explained that Kuwait, Oman, Saudi Arabia, and Egypt's capital markets have a relationship with world oil prices. Rusdi and Kumalasari (2015) founded that in the long and short-term world oil price changes have significantly influenced the South Korean stock market. In more detail, Shaeri and Katircioğlu (2018) examined the influence of world oil prices on the stock prices of oil companies that have been listed on the U.S Stock market. The results obtained from these studies are that world oil prices have a positive effect on the stock prices of oil companies in the U.S. However, from the research that has been done by Robiyanto (2018), Adam et al. (2015), Sultan et al. (2019), Riga et al. (2016), and Lumban Gaol et al. (2016) in which discussing oil prices can affect the combined index of a country, not by oil companies stock prices. Based on the phenomena that have occurred, analyzing the relationship between world oil and the company's stock price is one of the interesting topics to study in the future. The author believes that there is a possibility crude oil prices can affect the stock prices of oil and gas companies in Indonesia. This research does not choose a state-owned company where the state has a share buyback policy.

The author of this study wants to look at the dynamic correlation between oil prices (Brent and WTI) and the stock price of Indonesian oil companies, as well as the effects of oil price movements on the stock volatility of Indonesian oil companies. Whether the changes in oil prices have a negative or positive impact on the company's stock price during the COVID-19 Pandemic. A further purpose of this research is to explain how changes in oil prices influence the returns and volatility of Indonesian oil company stocks throughout a pandemic. The author will be using DCC-GARCH as the dynamic approach because of large time-

varying covariance matrices DCC-GARCH has proven successively estimates (Robiyanto, 2018).

LITERATURE REVIEW

In recent days, oil has also been a symbol of economic growth, contributing to the world's strong reliance on oil products. Also, Oil prices are of critical importance to the current global economy, knowing that it is the largest widely traded well in terms of value and volume (creating what some analysts have called a "hydrocarbon economy"). Moreover, carbon-intensive products and service aspects are associated with oil markets, where its oil represents the single most significant share. Ghalayini (2011) explained that the effect of global economic growth on the oil market is shown in the power of the oil market. Matter of fact, global economic development raises the need for oil that is driving up oil prices. Oil prices, then, appear to be unpredictable, at least with business cycle variations. Since the rise in GDP growth and increasing economic growth has contributed to increased demand for energy, there is a feedback relationship that can minimize this impact. The assumption of how oil price increases have a significant detrimental impact on economies is mainly focused on the nearest correlation between both the timing of oil price increases and economic downturns.

Kilian and Park (2016) found that oil price changes give an effect on U.S oil companies' stock prices, it is explained by the increasing demand for oil in the market that boosts the price of the oil. This finding gives a proves that changes in oil prices can give an effect on oil companies' stock prices. Another study conducted by Lake and Katrakilidis (2009) explains that from 1999 until 2007, the stock price movement of European oil companies was driven by the changes in prices of BRENT oil in the market.

Crude oil is the main object in transportation fuel production (diesel, kerosene, and gasoline), that give a huge impact on building blocks production for BTX, the petrochemical industry, and mainly light olefins (butadiene, butanes, propylene, and ethylene) (Corma et al., 2017).

The crude oil futures market is dominated by Brent crude and West Texas Intermediate (WTI), which have been the benchmark grades. Because of the benchmark, Brent and WTI become the reference price to other oil prices in the world. Brent crude, The Intercontinental Exchange (ICE) markets Brent, while the New York Mercantile Exchange (NYMEX) trades WTI. Brent and WTI both are in cross-list at the CME and ICE (Scheitrum et al., 2018). Economic factors such as imports and production and also export and consumption will influence the oil price (Sultan et al., 2019). In 2010 because of the fluctuations in global crude, the price of domestic oil increased (Shaari et al., 2013).

Another research conducted by Kang et al. (2015) found the changes in oil prices triggered by aggregate demand cause stock markets in the United States to spike, while those triggered by oil-market demand-specific shocks cause stock markets to fall in response to oil prices shocks. Vo (2011) Shows that the volatility between U.S. stocks and oil markets is Intermarket dependent and Arouri et al. (2012) found that oil gives a transmission of uncertainty to the European stock market. Spikes in oil prices due to higher overall demand greatly improve stock market volatility in Europe, although oil-specific demand shocks and supply-side shocks will not impact volatility (Degiannakis et al., 2014).

Robiyanto (2018) explain that before the subprime mortgage crisis, KLSE had a strong relationship with WTI. Shabbir et al. (2020) explain those Pakistan stock markets (KSE100) are positively affected by gold and

oil price changes. From research conducted by Ulusoy and Özdurak (2018) using the GARCH exponential method in explaining whether oil prices are questioned against oil and gas company stock prices in Europe and America, it is found that oil prices have a volatility effect on oil and gas company stock prices in Europe and America. Kang et al. (2016) It has been established that a significant shock to US crude prices has a major effect on US stock returns. Oil price and economic shock are of equal significance in describing real stock returns in the United States as demand shocks from the United States and outsider supply shocks. There is a positive effect between the oil price shock and U.S real stock returns that driven by supply and demand (Kilian et al., 2016). Based on the previous research, the hypothesis can be formulated as :

H_{1a} : WTI price changes have positive effects on the Indonesian oil companies' stock return.

H_{1b} : BRENT price changes have positive effects on the Indonesian oil companies' stock return.

Oil is one of the most important instruments in the oil and gas industry. Over time, where the demand for oil increases, causing oil companies in the world to increase production by increasing the location of drilling. The price of oil has a significant impact both on the company's finances and the company's stock prices. A study from Gupta (2016) stated that the changes in oil prices will give an effect on oil and gas company stock return because oil becomes the main core of production, especially for the oil company. Wattanatorn and Kanchanapoom (2012) explained that the increase in production cost is affected by the oil prices and when the oil prices change, it also will impact the return stock of oil and gas companies. The stock market prices also can

be affected by investment and company performance. The changes in oil prices also give a huge effect on China's oil and gas company stock prices (Chen et al., 2016).

Kelikume and Muritala (2019) found there is a significant effect between oil prices and the stock market in the long term in Vietnam. The percentage of increase is 1.3 percent and the volatility effect between gas company stock and oil price are highly persistent. Wattanatorn and Kanchanapoom (2012) evaluate the impact of oil prices on the performance, profitability in some sector businesses that have been listed on the Thailand Stock Exchange from 2001 to 2010. Using the regression method, it is found that world oil prices have a significant effect on profits from the energy sector and this is also accompanied by how oil prices affect the price of a company's stock in the energy sector. Wang and Zhang (2014) found that the petrochemical market in China has a "overreact" response to changes in world oil prices. This research was conducted by categorizing changes in oil prices into two, namely positive and negative to find out whether the reaction of the commodity market in China when oil prices rise and fall.

Other studies on oil prices and oil companies were also conducted by Scholtens and Yurtsever (2012) by examining the impact of oil prices on several industries in Europe in the 1983-2007 period. The result is that changes in different oil prices in a certain period also produce a significant impact on several industrial sectors in Europe, for oil and gas producing the oil shock gives a benefit. Based on previous research, where oil has an effect on the stock market both in the short or long term.

Degiannakis et al. (2018) founded that oil price changes have an impact on stock market volatility in Europe and also have an impact on the volatility of industrial sectors'. The return volatility in the financial and energy and material sector in Australia was

affected by the oil prices and the changes give a high return on both sectors. (Hasan and A. Ratti, 2012). Other studies on oil prices and stock volatility were also conducted by Lake and Katrakilidis (2009) by explaining the impact of oil prices on the various stock market returns such as Greek, the US, the UK, and German stock markets. Based on the explanation of previous research, it can be concluded the hypothesis as:

H_{2a} : WTI price changes have positive effects on the Indonesian oil companies' stock volatility.

H_{2b} : BRENT price changes have positive effects on the Indonesian oil companies' stock volatility.

Therefore, the author will examine whether there is a correlation between the Brent and WTI oil prices towards the Indonesian Oil Company stock price. Whereas companies that qualify are selected based on financial statements using the unit of dollars and already listed on the Indonesian stock exchange (IHSG).

METHODOLOGY

The data used in this research were the closing stock price on three Indonesian oil companies listed on the Indonesia Stock Exchange (IDX), companies that qualified are selected based on financial statements using the unit of dollars. These selected companies are PT Apexindo Pratama Duta Tbk (APEX), Medco Energi Internasional (MEDC), and Surya Esa Perkasa (ESSA) during period 1 January 2020-1 June 2020 and the closing oil prices of Brent Crude (Brent) and West Texas Intermediate. The closing price data of Indonesian oil companies is obtained from www.finance.yahoo.com, as well as for the BRENT and WTI oil prices. According to the research already done by Robiyanto (2018), this is the definition of the operational

variable. Return on the Indonesian oil company stock is obtained from the following formula :

$$R_{it} = \left[\frac{P_{it} - P_{it-1}}{P_{it-1}} \right]$$

Where the R_{it} represents the closing stock price of Indonesian oil companies' stock in t day and the $P_{(it-1)}$ is the closing stock price of Indonesian oil companies' observed in $t-1$ day.

From the previous calculation that's already done, it can be used to measure the conditional volatility of the Indonesian oil stock return. Daly (2011) found that conditional variance will reliably calculate and estimate the conditional volatility of a return since this model depends on the previous time. Another research from Engle's (1983) result, where large and small fallacies appear to occur in clusters, indicated a type of heteroscedasticity where the prediction of the variance of fallacy depended on the past disturbance. Therefore the ARCH model was invented using general mathematical characteristics of so-called conditional variance. Return on world oil prices is obtained from the following formula :

Return of West Texas Intermediate prices

$$R_{WTI,t} = \left[\frac{WTI_t - WTI_{t-1}}{WTI_{t-1}} \right]$$

Where the WTI_t is the closing oil price of WTI in t day and the WTI_{t-1} is the closing oil price of WTI oil in $t-1$ day.

Return of Brent Crude prices

$$R_{BRENT,t} = \left[\frac{BRENT_t - BRENT_{t-1}}{BRENT_{t-1}} \right]$$

Where the $BRENT_t$ is the closing oil price of BRENT in t day and the $BRENT_{t-1}$ is the closing oil price of BRENT in $t-1$ day.

This study uses DCC-GARCH (Dynamic Condition Correlation-

Generalized Autoregressive Conditional Heteroscedasticity) as the dynamic approach. These techniques have strong estimation advancements over multivariate GARCH models as the number of series to be compared. Different from the regular multivariate GARCH the Dynamic Condition Correlation (DCC) are offered the flexibility of univariate GARCH. Engle (2002) introduced the model of DCC-GARCH by the following specification:

$$\begin{aligned} r_t | t-1 &\sim N(0, D_t R_t D_t), \\ D_t^2 &= \text{Diag}\{\omega_i\} + \text{Diag}\{K_i\} \circ r_{t-1} r_{t-1}' \\ &\quad + \text{Diag}\{\lambda_i\} \circ D_{t-1}^2, \\ \varepsilon_t &= D_t^{-1} r_t, \\ Q_t &= S \circ (\iota \iota' - A - B) + A \circ \varepsilon_{t-1} \varepsilon_{t-1}' + B \circ Q_{t-1}, \\ R_t &= \text{diag}\{\rho_i\}^{-1} Q_t \text{diag}\{\rho_i\}^{-1}. \end{aligned}$$

The following is Log estimator:

$$\begin{aligned} L &= -\frac{1}{2} \sum_{t=1}^T (n \log \log (2\pi) + \log \log |H_t| + r_t' H_t^{-1} r_t) \\ &= -\frac{1}{2} \sum_{t=1}^T (n \log \log (2\pi) + \log \log |D_t R_t D_t| + r_t' D_t^{-1} R_t^{-1} D_t^{-1} r_t) \\ &= -\frac{1}{2} \sum_{t=1}^T (n \log \log (2\pi) + |D_t| + \log \log |R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t) \\ &= -\frac{1}{2} \sum_{t=1}^T (n \log \log (2\pi) + |D_t| + r_t' D_t^{-1} D_t^{-1} r_t - \varepsilon_t' \varepsilon_t + \log \log |R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t), \end{aligned}$$

Which is maximizable to the model's parameter. One of the aims of this model formulation was to make it simpler to forecast because the covariance matrix is quite large. A study from Newey and McFadden (1994) Stated that the model formulation highly qualified the accuracy and normality of asymptotic from those parameters. If an

additional parameter in R is noted with θ and D parameter is noted with ϕ , the number of partial volatilities and correlation can be stated as this follows:

$$L = (\theta, \phi) = L_v(\theta) + L_c(\theta, \phi)$$

The following is the term of volatilities:

$$L_v(\theta) = -\frac{1}{2} \sum_t (n \log \log (2\pi) + \log \log |D_t|^2 + r_t' D_t^{-2} r_t)$$

The Correlation components are:

$$L_c(\theta, \phi) = -\frac{1}{2} \sum_t (\log \log |R_t| + \varepsilon_t' R_t^{-1} \varepsilon_t - \varepsilon_t' \varepsilon_t)$$

Partial volatility of possibility is the number of GARCH probabilities in individual

$$L_v(\theta) = -\frac{1}{2} \sum_t \sum_{i=1}^n (\log \log (2\pi) + \log \log (h_{i,t}) + \frac{r_{i,t}^2}{h_{i,t}})$$

The result will be maximized if they are combined, which will be optimizing each term. The correlation parameter was done in the second part of probability. In the first-order condition, this squared residual was not bound by certain parameters because that must ignore it. DCC LL INT that uses an integrated model is the estimator result. The two-step method was used to maximize the probability of producing:

$$\theta = \arg \arg (L_v(\theta))$$

In the second step, the value will be used:

$$\phi \max \{L_c(\hat{\theta}, \phi)\}.$$

The study conducted by Robiyanto, Wahyudi, and Pangestuti (2017) used the DCC-GARCH model to explain if there is a dynamic relationship between the Malaysian stock market and the Indonesian stock market with the gold prices. Robiyanto (2018) in the studies of the dynamic correlation between the ASEAN-5 stock market and world oil prices used another GARCH model variation such as OGARCH (Orthogonal Generalized Autoregressive Conditional Heteroscedasticity). The author of these studies used a time-varying correlation by using the single time series to collect data on each oil company's stock prices. Moreover, this research also used the GARCH model to explain the effect of oil prices to the stock return. GARCH model can be written as follows:

$$R_{it} = \alpha + \beta_1 OIL_t + \sigma_t^2 + \varepsilon_t$$

With,

$$\varepsilon_t = \phi_t \varepsilon_{t-1} + \dots + \phi_t \varepsilon_{t-q} + \eta_t$$

$$\eta_t = \sigma_t \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_p \varepsilon_{t-p}^2 + \lambda_1 \sigma_{t-1}^2 + \dots + \lambda_q \sigma_{t-q}^2$$

Information:

R_{it} : Stock Returns

Oil: The changes of (WTI and BRENT) price

ε_t : Error standard

σ_t^2 : Conditional variance

$\alpha_1 \varepsilon_{t-1}^2$: Previous period of stock return (ARCH model component)

$\lambda_1 \sigma_{t-1}^2$: Previous period of stock return (GARCH model component)

Stock volatility is a metric that can be used to gauge the highs and lows of a stock's price. Conditional variance, which can be measured using Generalized Autoregressive Conditional Heteroscedasticity, was used to quantify stock volatility in this analysis (GARCH). The GARCH model was also used in this analysis to illustrate the effects of

oil prices on market volatility. GARCH model can be written as follow:

$$VOL_{it} = \alpha + \beta_1 OIL_t + \sigma_t^2 + \varepsilon_t$$

With,

$$\varepsilon_t = \phi_t \varepsilon_{t-1} + \dots + \phi_t \varepsilon_{t-q} + \eta_t$$

$$\eta_t = \sigma_t \varepsilon_t$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \dots + \alpha_p \varepsilon_{t-p}^2 + \lambda_1 \sigma_{t-1}^2 + \dots + \lambda_q \sigma_{t-q}^2$$

Information:

VOL_{it} : Stock Volatility

OIL_t : The changes of (WTI and BRENT) price

ε_t : Error standard

σ_t^2 : Conditional variance

$\alpha_1 \varepsilon_{t-1}^2$: Volatility in the previous period (ARCH model component)

$\lambda_1 \sigma_{t-1}^2$: Volatility in the previous period (GARCH model component)

RESULTS AND DISCUSSION

Descriptive Statistics Stock & Volatility

The mean, maximum, minimum, and standard deviation of data are determined using descriptive statistics. Table 1 displays the descriptive statistics used in this analysis.

Table 1. Descriptive Statistics of WTI, BRENT, MEDC, ESSA, and APEX

	N	Min	Max	Mean	Std.Dev
WTI	44	-0.2323	-0.2323	-0.0040	0.1112
BRENT	44	-0.2220	0.1797	-0.0128	0.0738
MEDC	44	-0.1954	0.1263	-0.0152	0.0599
ESSA	44	-0.1129	0.0965	-0.0131	0.0428
APEX	44	-0.1818	0.3000	-0.0078	0.0975

Sources: www.finance.yahoo.com, processed

WTI has a mean of -0.0040 and a standard deviation of 0.1112, as shown in Table 1. Meanwhile, the BRENT variable has a mean of -0.0128 and a standard deviation of 0.0738. The MEDC variable's mean is -0.0152, and its standard deviation is 0.0599.

The ESSA variable has a mean of -0.0131 and a standard deviation of 0.0428, while the APEX variable has a mean of -0.0078 and a standard deviation of 0.0975.

The Result of Stationary Data Test

Following the previous result, the data that has been obtained will perform a unit root test to prove whether the data is stationary or not. An augmented Dickey-Fuller test with 0.01 significant values is used in this study to do the stationary test. The result can be found in Table 2.

Table 2. Test Result of Stationarity test (First Difference)

Variables	ADF.	Prob.
BRENT	-5.4752	0.0000***
WTI	-7.1958	0.0000***
MEDCO	-6.3220	0.0000***
APEX	-6.6390	0.0000***
ESSA	-9.8632	0.0000***

Sources: www.finance.yahoo.com, processed
***significant at the level of 1% significance

From Table 2, all the variables are stationary, which the value of probability indicates are significant at the 1% significance level, indicating that BRENT, WTI, MEDC, APEX, and ESSA are stationary data. These variables are able to test using GARCH analysis.

The Result of GARCH Test

Table 3. Test Result of GARCH Test (WTI and BRENT towards APEX, MEDCO, and ESSA return)

Independent Variables	GARCH		
	Coef.	Z-Stat.	Prob.
APEX			
WTI	0.2831	2.2572**	0.0240
C	-0.0113	-1.1559	0.2477
GARCH(-1)	1.0906	1012.0***	0.0000
RESID(-1)^2	-0.1281	-138.59***	0.0000
MEDC			
WTI	0.1014	0.9709	0.3316
C	-0.0132	-1.2412	0.2145
GARCH(-1)	1.1681	2096.1***	0.0000
RESID(-1)^2	-0.0842	-0.6989	0.4846
ESSA			
WTI	0.1118	1.6615*	0.0966
C	-0.0108	-1.4362	0.1509
GARCH(-1)	1.1481	1206.1***	0.0000
RESID(-1)^2	1.0483	2.7470***	0.0060

APEX	0.1206	-0.5545	0.5792
BRENT	-0.0131	-0.9122	0.3616
C	1.1410	1493.6***	0.0000
GARCH(-1)	0.1824	-3.7539***	0.0002
RESID(-1) ²			
MEDC	0.5002	7.3392***	0.0000
BRENT	-0.0078	-1.0641	0.2872
C	0.5813	1.7944*	0.0727
GARCH(-1)	-0.1865	-3.4070***	0.0007
RESID(-1) ²			
ESSA	0.2871	4.9198***	0.0000
BRENT	0.0006	-0.9573	0.3384
C	0.9345	10.116***	0.0000
GARCH(-1)	-0.1509	-2.3296***	0.0198
RESID(-1) ²			

Sources: www.finance.yahoo.com, processed

***significant at the level of 1% significance

**significant at the level of 5% significance

*significant at the level of 10% significance

According to the result in Table 3, it can be concluded that H_{1a} about the WTI price changes have positive effects on the Indonesian oil companies' stock prices are accepted. Table 3 shown that WTI has a positive effect on APEX stock return at a 5% significance level and WTI also has a positive effect on ESSA stock return at a 10% significance level. But somehow, Table 3 shows that WTI does not have any effect on MEDC stock return as the probability of APEX is greater than the significance level. Based on the variance equation, All of the GARCHs are significant, indicating that the research model can follow the GARCH pattern. Table 3 indicates the outcome of the test, it can be concluded that H_{1b} about the BRENT price changes have positive effects on the Indonesian oil companies' stock prices are accepted. Table 3 shows that BRENT has a positive effect on MEDC and ESSA stock return with a 1% significance level while BRENT does not have any effect on APEX stock return as As the probability of APEX was greater than the significance point. According to the variance equation, all GARCHs are significant, assuming that the research model can follow the GARCH trend.

Table 4. Test Result of GARCH Test (WTI and BRENT towards APEX, MEDC, and ESSA volatility)

Independent Variables	GARCH		
	Coef.	Z-Stat.	Prob.
APEX.VOL			
WTI	0.1928	0.8500	0.3953
C	1.0880	32.662	0.0000
GARCH(-1)	-0.5906	-1.8983**	0.0577
RESID(-1) ²	-0.0929	-4.3363**	0.0000
MEDC.VOL			
WTI	-0.1304	-1.3592	0.1714
C	1.0041	75.688	0.0000
GARCH(-1)	1.1352	68.425***	0.0000
RESID(-1) ²	0.8567	1.6375**	0.0382
ESSA.VOL			
WTI	0.0564	0.2285	0.8192
C	1.5110	70.107	0.0000
GARCH(-1)	-0.0105	-0.0433	0.9655
RESID(-1) ²	0.6002	2.3484	0.8474
APEX.VOL			
BRENT	0.1921	0.9076	0.3641
C	1.0992	29.605	0.0000
GARCH(-1)	-0.5413	-2.8781***	0.0040
RESID(-1) ²	-0.2135	1.0135***	0.0031
MEDC.VOL			
BRENT	0.0349	0.1007	0.9197
C	1.0242	25.733	0.0000
GARCH(-1)	0.6095	1.2769	0.2016
RESID(-1) ²	-0.1306	-1.9063	0.9603
ESSA.VOL			
BRENT	0.1137	0.3447	0.7303
C	1.5078	69.665	0.0000
GARCH(-1)	-0.0291	-0.1104	0.9120
RESID(-1) ²	0.6945	0.5436	0.6241

Sources: www.finance.yahoo.com, processed

***significant at the level of 1% significance

**significant at the level of 5% significance

*significant at the level of 10% significance

It can be concluded, based on the results in Table 4, that H_{2a} about the WTI price changes that have positive effects on the Indonesian oil companies' stock volatility are rejected. According to Table 4, WTI does not have any effect on APEX, MEDC, and ESSA stock volatility as the probability of all the independent variables is greater than the significance level. But somehow, Table 4 shows that based on the variance equation, it can be seen that only ESSA cannot follow the GARCH pattern because the probability of ESSA is greater than the significant level. Table 4 shows the tests, and it can be concluded that H_{2b} about the BRENT price changes that have a positive effect on

Indonesian oil companies' stock volatility is presented. Table 4 shows that BRENT does not have any effect on Indonesian oil companies' stock volatility because the

All independent variables have a higher probability than the significant level. Furthermore, the data shows that only APEX is capable of following the GARCH trend.

Table 5. Hypothesis Testing Summary

no	Statement of Hypothesis	Conclusion
1	H_{1a} : WTI price changes have positive effects on the Indonesian oil companies'	Accepted for APEX and ESSA
2	H_{1b} : BRENT price changes have positive effects on the Indonesian oil companies'	Accepted for MEDC and ESSA
3	H_{2a} : WTI price changes have positive effects on the Indonesian oil companies' stock volatility	Rejected
4	H_{2b} : WTI price changes have positive effects on the Indonesian oil companies' stock volatility	Rejected

Sources: www.finance.yahoo.com, processed

Table 5 shows the summary of the hypothesis tested in this research. According to the result in Table 5, WTI and BRENT have a positive effect on Indonesian oil companies'. But somehow, Table 5 shows that WTI and BRENT do not have any effects on Indonesian oil companies' stock volatility.

Dynamic Correlation between Oil and The Indonesian Oil Companies to The Various Time

Following the previous result, the data that have been obtained will be used to explain the Dynamic Correlation between the

WTI and BRENT to the Indonesian oil companies that can be seen in figure 2 to figure 7.

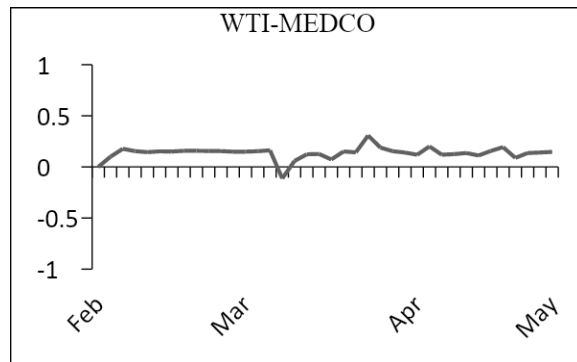


Figure 2. Dynamic Correlation between WTI and MEDCO

Sources: www.finance.yahoo.com, processed

Figure 2 shows the findings of a DCC GARCH Dynamic Analysis between WTI and MEDC. The value of DCC WTI and MEDCO during the research period was -0.1133 until 0.3072, according to the results. Early March 2020 saw the maximum DCC value of 0.3072. Meanwhile, in mid-March 2020, the lowest DCC value is -0.1133.

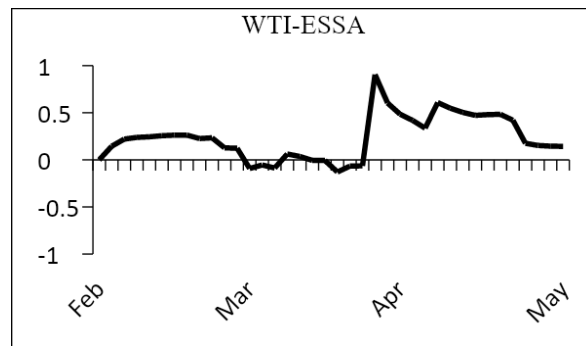


Figure 3. Dynamic Correlation between WTI and ESSA

Sources: www.finance.yahoo.com, processed

The result of the Dynamic Correlation analysis between WTI and ESSA using DCC GARCH is shown in figure 3. The value of DCC WTI and ESSA during the study period was -0.1289 until 0.9057, according to the findings. In mid-March 2020, the maximum DCC value is 0.9057. In the meantime, the

lowest DCC value of -0.1289 was registered in mid-March 2020.

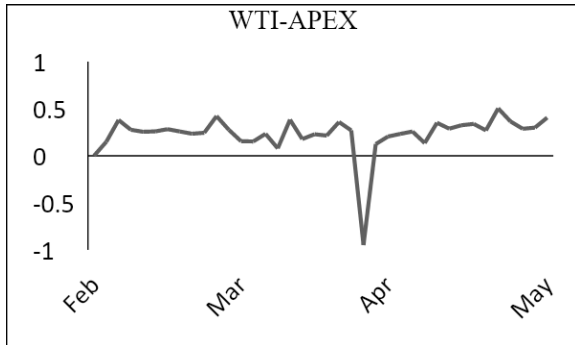


Figure 4. Dynamic Correlation between WTI and APEX

Sources: www.finance.yahoo.com, processed

The result of the Dynamic Correlation analysis between WTI and APEX using DCC GARCH is shown in figure 4. The value of DCC WTI and APEX during the study period was -0.9486 until 0.5030, according to the results. In late April 2020, the highest DCC value is 0.5030. Additionally, in mid-March 2020, the lowest DCC value is -0.9486.

According to figure 2 to 4, it can be found that during mid-March are the lowest DCC level between the WTI and Indonesian oil companies' stock return. It happened because, during that month, WTI prices experienced a significant decrease in value until early April that give a huge impact on Indonesian oil companies.

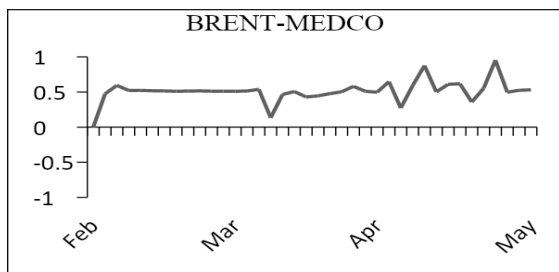


Figure 5. Dynamic Correlation between BRENT and MEDCO

Sources: www.finance.yahoo.com, processed

Figure 5 shows the result of the Dynamic Correlation analysis between BRENT and

MEDCO using DCC GARCH. The result indicates the value of DCC BRENT and MEDCO were -0.5370 and 0.9538 respectively during the study period. In late April 2020, the highest DCC value is 0.9538. Meanwhile, the lowest DCC value is 0.5370 in early May 2020.

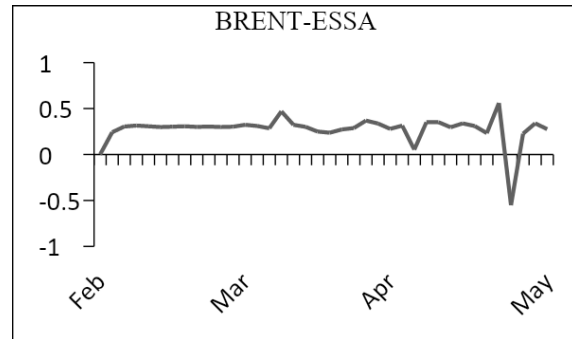


Figure 6. Dynamic Correlation between BRENT and ESSA

Sources: www.finance.yahoo.com, processed

Figure 6 shows the result of the Dynamic Correlation analysis between BRENT and ESSA using DCC GARCH. The result indicates During the research period, the value of DCC BRENT and ESSA was -0.5512 until 0.5608. In late April 2020, the highest DCC value is 0.5608. Meanwhile, the lowest DCC value is -0.5512 in late April 2020.

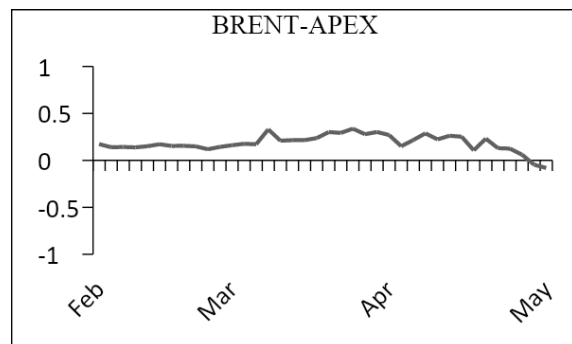


Figure 7. Dynamic Correlation between BRENT and APEX

Sources: www.finance.yahoo.com, processed

Figure 7 shows the result of the Dynamic Correlation analysis between BRENT and

APEX using DCC GARCH. The result indicates the value of DCC BRENT and APEX during the research period is -0.1079 until 0.3373. The highest DCC value is 0.3373 in early March 2020. Meanwhile, the lowest DCC value is -0.1079 in early May 2020.

Picture 4 to 7, show that the lowest DCC value between BRENT and Indonesian oil companies' stock return was found between late April until early May. It happened because from late April to early May, BRENT oil prices experienced a significant decrease in value.

Descriptive Statistics of Dynamic Condition Correlation Various Time

The mean, maximum, minimum, and standard deviation of data are determined using descriptive statistics. Tables 6 and 7 provide descriptive statistics of Dynamic Condition Correlation at varying periods.

Table 6. Descriptive Statistics of Dynamic Condition Correlation between WTI and APEX, MEDC, and ESSA

	N.	Min.	Max.	Mean
WTI-MEDC	44	-0.1133	0.3072	0.1384
WTI-ESSA	44	-0.1288	0.9057	0.2275
WTI-APEX	44	0.2501	0.5038	0.2383

Sources: www.finance.yahoo.com, processed

Table 6 show that the Dynamic Correlation between WTI and Indonesian oil companies' reaches the lowest minimum point of -0.1288 for WTI-ESSA and -0.1133 for WTI-MEDC. Meanwhile, for WTI-APEX the lowest point is 0.2501. It happens because of the effect on COVID-19 that becomes global attention and give a huge effect on sales of oil in the market.

Table 7. Descriptive Statistics of Dynamic Condition Correlation between BRENT and APEX, MEDC, and ESSA

	N.	Min.	Max.	Mean
BRENT-MEDC	44	-0.5370	0.9538	0.4821
BRENT-ESSA	44	-0.5512	0.5608	0.2795
BRENT-APEX	44	-0.0408	0.3841	0.1716

Sources: www.finance.yahoo.com, processed

In Table 7, can be found the Dynamic Correlation between BRENT on the Indonesian oil companies' reaches the lowest minimum point of -0.5370 for BRENT-MEDC, -0.5512 for BRENT-ESSA, and -0.0408 for BRENT-APEX. It happened because of COVID-19 that becomes global attention and this statement supported by Lake and Katrakilidis (2009) and Kilian et al. (2016) that important event can give an effect on Dynamic Correlation.

CONCLUSION AND RECOMMENDATION

According to the developmental hypothesis, the first hypothesis, H_{1a} about WTI price changes have positive effects on the Indonesian oil companies' stock return was accepted by WTI-APEX and WTI-ESSA. While for the H_{1b} about BRENT price changes have positive effects on the Indonesian oil companies' stock return was accepted by BRENT-MEDC and BRENT-ESSA, the analysis indicates that the changes in oil prices have affected the Indonesian oil companies' stock price return. For the second hypothesis, H_{2a} about WTI price changes have positive effects on the Indonesian oil companies' stock volatility and H_{2b} about BRENT oil price changes have positive effects on the Indonesian oil companies' stock volatility, the result is WTI and BRENT oil prices do not have any effect on Indonesian oil companies' stock volatility. However, all of the results are tested with various significant levels (1%, 5%, and 10%).

It happened because of the pandemic COVID-19 that makes the WTI and BRENT price change significantly and gives an effect on the stock of oil companies, especially in Indonesia. For the explanation in more detail, the changes in oil prices have a different effect on the stock return. From the analysis that was already done, WTI gave an effect to the APEX and ESSA. The BRENT, on the other hand, is influenced by price increases in ESSA and MEDC. This study's results were validated by Chen et al. (2016), Kelikume and Muritala (2019), and Ulusoy and Özdurak (2018) studies which explain that the changes in oil price take a positive effect on the return stocks. Another study by Ramos and Veiga (2011), Lake and Katrakilidis (2009), and Kilian and Park (2016) found that even the changes in oil prices give a positive effect on the stock return of oil companies however, the changes in oil prices did not have a significant effect towards the oil companies stock volatility.

The Dynamic Correlation between WTI and Indonesian oil companies is a positive and weak correlation, according to the mean value of Dynamic Correlation in Table 5. Similarly, the study by Degiannakis et al. (2018), Hasan and A. Ratti (2012), and Lake and Katrakilidis (2009) discovered a correlation between changes in oil prices with stock return and volatility in Europe, the US, and the UK.

The correlation between the BRENT and Indonesian oil companies is a positive and weak correlation, according to the mean value of Dynamic Correlation in Table 6. Similarly, the study by Shaeri and Katircioğlu (2018) in the U.S and the study by Scholtens and Yurtsever (2012) in Europe discovered a correlation between changes in oil prices and oil companies' stock return.

From this study, the author aims to find out the dynamic correlation between changes in oil prices and the Indonesian oil companies' stock price. GARCH and DCC

GARCH analysis were also used to look at the effects of oil price fluctuations and stock volatility during the COVID-19 pandemic. The result of this study finds that changes in oil prices only give a positive effect on Indonesian oil companies' stock return from January until June 2020 during the pandemic of COVID-19. Also in this research, can be found a weak and a positive correlation between WTI and BRENT towards the Indonesian oil companies' during the pandemic of COVID-19 based on DCC GARCH analysis.

CONCLUSION AND RECOMMENDATION

The result of this study finds that changes in oil prices only give a positive effect on Indonesian oil companies' stock return from January until June 2020 during the pandemic of COVID-19. Also in this research, can be found a weak and a positive correlation between WTI and BRENT towards the Indonesian oil companies' during the pandemic of COVID-19 based on DCC GARCH analysis. Further analysis should be performed using the time frame prior to the COVID-19 pandemic, as well as the period from the start of the pandemic to the end of the pandemic. So it can obtain more findings in detail about the effect of oil prices on the Indonesian oil companies' stock price.

This examination might be valuable as a kind of perspective for the speculators to observe the Indonesian oil companies' stock price during the pandemic of COVID-19. It ought to be considered since the Indonesian oil companies' stock price has a relationship with oil prices, additionally, the changes in oil prices have a critical impact on the stock volatility. For the traders of investors in commodities or the stock market, the author suggests that traders and investors must be aware of the changes in oil prices that give an impact on the stock prices, and prepare trading or investment strategies to follow the

market situation and to be able to achieve the goal of an investment.

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