Januri

Article

Global prices of crude oil and the stock market nexus in Indonesia

International Journal of Energy Economics and Policy

Provided in Cooperation with:
International Journal of Energy Economics and Policy (IJEEP)

Reference: Januri (2021). Global prices of crude oil and the stock market nexus in Indonesia. In: International Journal of Energy Economics and Policy 11 (1), S. 551 - 557.
https://www.econjournals.com/index.php/ijeep/article/download/10690/5638.
doi:10.32479/ijeep.10690.

IJEEP

INTERNATIONAL JOURNAL OF ENERGY ECONOMICS AND POLICY

EJ EconJournals

ISSN: 2146-4553

International Journal of Energy Economics and Policy

ISSN: 2146-4553

available at http: www.econjournals.com

International Journal of Energy Economics and Policy, 2021, 11(1), 551-557.

EJ EconJournals

Global Prices of Crude Oil and the Stock Market Nexus in Indonesia

Januri Januri

Faculty of Economic, Universitas Muhammadiyah Sumatera Utara, Jl. Kapten Muchtar Basri No. 3, Medan, Sumatera Utara 20238, Indonesia. Email: januri@umsu.ac.id

Received: 26 August 2020 **Accepted:** 08 November 2020 **DOI:** https://doi.org/10.32479/ijeep.10690

ABSTRACT

The research intends to analyze the connection among the global prices of crude oil and stock market of Indonesia for the period of 2010 to 2019. The international prices for crude oil attributed to the prices of West Texas Intermediary (WTI) crude oil, whereas the Indonesian stock indices were considered as stock exchange factors in Indonesia. Daily data have been examined using the causal model for LVAR. The findings of the test demonstrated that a cogent and dynamic connection exists between global crude oil prices and the composite indices of Indonesia, in the long as well as short run. The dimensions of this association seem to be positive and thus the composite index also rises (fall) unless the global price of crude oil increases (decreases). Such a result is a required factor for the government's economic policies of Indonesia as well as in the management of its investment patterns by the investors.

Keywords: Crude oil, Stock market, Global prices
JEL Classifications: E3, R5

1. INTRODUCTION

In the global economy, oil would have a vital role. To satisfy production, transportation, and energy demands, all states require oil. Because of the central position of the oil as resources, all states having no oil production must purchase oil to satisfy everyone's domestic oil needs. This still refers to petroleum-producing countries with low production. Along with the impact of some kind of small oil supply as well as the OPEC syndicate, demands on international oil imports may influence global oil prices (Moebert, 2007).

As a result, fluctuations in the prices of oil might influence the country's economy (Cueppers and Smeets, 2015). Increasing prices of oil that would impact the economy in the following formats: transitions of wealth from the oil-using to the oil-producing states, increases in goods and services manufacturing cost, inflationary impacts, the trust of consumer and financial sectors (Nandha and Faff, 2008). A rise in the costs of production would lower the business income (Lee and Zeng, 2011). It results in a decrease in dividend payments and a decline in the inventory price. Petroleum prices should enable central banks to control inflation by an increasing interest-rate strategy (Benada, 2014). The rise in the rate of interest would lead investors to move assets as of the stock market to the bond market, dragging down inventory requirements furthermore ultimately dropping prices of shares (Basher and Sadorsky, 2006). Oil-exporter states will raise their public revenues, expenses, and investment that would result in increased production and lesser labour. Oil-exporter countries have a major impact on oil prices. In these cases, share prices should react favourably. But the reverse applied to the states which import oil (Filis, 2010).

Along with the background of the price of oil, WTI crude oil prices have fluctuated, and since 1948 there seems to be a growing trend (Williams, 2011). Specifically, the prices of WTI crude oil went up at the start of January 2007 around US$ 32.7 per barrel to US$ 98.2 per barrel at the end of 2013. On 2nd July 2008, the peak price was 145.3 dollars for each barrel (www.tonto.eia.gov). Prices of raw oil were subsequently increased as stock prices rose in some states. The SP500 index varies in the United States. While the stock index dropped dramatically at SP500 816.2 at the end of 2008, the SP500 index was rising from 1191.4 at the start of 2004 to 2058.90 at the end of 2013 (www.google. com/finance). The compound price index (CSPI) had as well go up and down in Indonesia and rise from 493.8 in 2004 to 4291.9 in 2013 (www.duniainvestasi.com).

Several analysts in the economic and finance sector have been drawn to the increase in oil prices. Researches regarding the oil prices and stock prices nexus would have been included: (Arouri and Rault, 2014; Chen et al., 1986; Filis, 2010; Fowowe, 2013; Guesmi, 2013; Huang et al., 1996; Jones and Kaul, 1996; Kling, 1985; Lee and Zeng, 2011; Mohanty et al., 2011; Narayan and Narayan, 2010). Multiple surveys show that oil prices and stock prices have a positive association (Arouri et al., 2014; Mohanty et al., 2011; Narayan and Narayan, 2010). Other, nevertheless, mention that the link among prices of oil and inventory prices is adverse (Filis, 2010; Jones and Kaul, 1996). There seemed to be no connection of prices of oil with inventory prices in further research conclusions (Chen et al., 1986; Fowowe, 2013; Huang et al., 1996; Kling, 1985; Samadi et al., 2012). The possible structural (break) variations and the international oil prices shock may result in these disparities at a certain point during the timeframe of the research (Lee and Zeng, 2011; Rashid and Kocaaslan, 2013). The structural adjustment relates toward the dispersion of the research duration, such that the disparity in study findings will come after the shock of oil price during each sub-phase of the analysis. The study was performed in multiple stages in China by Lin, Fang, and Cheng (2010) and Kang and Ratti (2015) and gathered various findings. Accordingly, Nwosa (2014) would also have published research in Nigeria that has shown a unique association of the long- and short-run findings. Studies have typically transpired in developed states on oil and stock price links, among some other Mohanty et al. (2011) and Sukcharoen, Zohrabyan, Leatham, and Wu (2014) but in developing states, only a few types of research have been done such as Narayan and Narayan (2010) and Nwosa (2014).

Indonesia, being an emergent state would have oil purifiers that produced raw oil. Nevertheless, the state hasn't yet produced enough crude oil to satisfy domestic needs, even though Indonesia needs to import petroleum from some of the other states annually (Toharso, 2010). Indonesia would also have fallen within the class of raw oil-importing states (Wang et al., 2013) till 2003, due because of its decreasing crude oil making as well as increasing requirements for worldwide raw oil (EIA, 2014).

The purpose of this analysis is to investigate the direction of the association among the prices of raw oil plus the inventory market in Indonesia throughout the start of January to end of December, as well as to develop a long- and shorter-term framework for the connection. An analytical tool employed is LVAR causal framework developed by the Agung (2009). The dimensions of the relation are examined in short-run, first of all by dividing the timeframe 2004-2013 into ten time periods, beginning on 1 January to 31 December, each of which has 1 year. The association dimensions were further analyzed in each sub-period utilizing dummy variable. So this relationship can also be acquired through using the signal relationships as initiated in Cahyono (2014), in which the dimensions are predicted by implementing the dimensions trend Cahyono (2014) as well as density function of temporary probabilities (Adam et al., 2014).

2. THE LITERATURE OF RELATED STUDIES AND THEORIES

In theory, cash flow frameworks could indeed demonstrate the association among prices of oil and stock. Prices of stocks (p) could be explained as reduced cash flow value, i.e.

$$P = \frac{E(c)}{E(r)} \quad (1)$$

Whereby c is the stream of dividends and r is the rate of discount. Moreover, the stock return (R) would be:

$$R = \frac{DP}{p} = \frac{d(E(c))}{E(c)} - \frac{d(E(r))}{E(r))} \quad (2)$$

There the difference operator is represented by d (.), (Huang et al., 1996). It is identified by (1) so as a rise (decline) in the existing prospects of dividends E(c) would raise (diminish) stock prices (p). Accordingly, a rise (decline) within the expectations of discount rate E(r) might reduce (up) the stock price (p). That could furthermore be shown through (2) that a rise (decline) in the price (p) of the share would raise (diminish) the rate of return (R). Also, prices of oil will impact stock prices by adjusting both the cash flow expectations and the discount rate expectations (Ratti and Hasan, 2013). Oil is an element in a manufacturing cycle that an organization needs to run. Greater manufacturing costs would result in a rise in goods and services prices. The goods and services demand are then decreased and company earnings are dropped, which all leads to a decline in stock prices. Inflation would be a result of a rise in goods prices caused by an increase in the prices of oil. The discount rate, which influences the inventory prices negatively (Basher et al., 2012; Narayan and Narayan, 2010) raised by the higher inflation expectations. An increase in oil prices is also viewed towards a sign of imminent inflation and therefore a central bank in a state may raise rates of interest. Increased rates would make investments in bonds more appealing overstock investment, allowing stock prices to drop (Halaç et al., 2013). In the oil-exporting countries, shocks of oil price affect stock-price supply positive but in other importing countries they harm demand (Cashin et al., 2014; Degiannakis et al., 2011).

Lin et al. (2010) in almost the same timeframe under January 1996 and December 2007, have also examined the association among oil price shocks and stock markets in China. To evaluate monthly data the multivariate vector auto-regression approach would be used. The analytical findings demonstrate that although the stock indices of non-oil companies have not been affected by the oil price shock, they have affected the stock index of oil companies. Along with contexts of demand and supply shock, Lin et al. (2010) discussed the relation from July 1997 to September 2008 among the oil prices shocks and the stock market for china. The outcome of the research employing the monthly evaluation of the SVAR data revealed that the impact of the price shocks on stock prices was distinct in the three states (China, Taiwan, HongKong). The oil-demand shock in China didn't affect the stock market in any significant way. Oil prices had a positive impact on the stock market in Hong Kong and China, in contexts of the supply shock. From 1998 to 2011, the latest research has been undertaken by Kang and Ratti (2015), about the connection between oil prices and stock prices. The test outcomes using the VAR framework showed that the impact of the oil demand shock on stock return had been negative.

During the time from January 1985 to April 2010, Nwosa (2014) examined the link between internal and global oil and inventory prices in Nigeria. The findings of the test using the VECM estimation on quarterly data showed that the two variables, i.e. domestic oil prices, have a unidirectional relation in the longer term, affecting the stock price. There had been, however, no short-run relation among internal and overseas price of petroleum and stock prices. Effiong (2014) also checked during the same time from the start of 1995 to the end of 2011, the impact of oil price shocks on the stock market's demand and supply of Nigeria. The findings indicated that even though the reaction of the stock market on the oil supply shock would have been negative, it reacted positively to oil demand shock using the structural vector autoregression for data analysis.

From the time frame of March 2005 to November 2008, Horng and Chang (2010) looked at the effect of oil prices on stock market returns in Thailand as well as the Philippines. While employing the IGARCH data analyzing methods, they identified that somehow the relation between prices of oil and inventory in each of these states had been positive and significant.

The impact of asymmetrical oil prices on S&P500 stock price in the USA from 1 January 1992 to seventh November 2006 have been investigated by Lee and Hao (2012). The researchers have revealed, by using MTAR data analysis frameworks, that prices of oil plus stock had been co integrated asymmetrically. Also, the two variables have established a unidirectional relation, i.e. the price of oil influenced the stock price.

The research about the impact of crude oil price shock on stock price in Kuwait plus Saudi Arabia was carried out by Azar and Basmajian (2013). They revealed that oil prices have had a positive effect on stock markets in each of these states.

Throughout the time frame of October 16, 2006 to October 7, 2012, Dagher and Hariri (2013) examined the impact of oil price shocks on the stock market of Lebanon. The outcome of the VAR and the Granger causal test demonstrated a positive impact of the shocks of oil price on inventory prices.

3. ESTIMATION TECHNIQUES AND DATA

3.1. Data

Data from global crude oil prices and stock price index data had been composed as such an index to the Indonesian stock market in this research. Raw oil prices data attributed to prices of WTI per barrel USD unit while data of Indonesia's stock price indexes had been obtained by CSPI. The WTI crude oil data had been collected through www.tonto.eia.gov and the stock price index data were gathered by www.duniainvestasi.

The WTI price of crude oil is indicated in x0, and the stock price index data is indicated in y0. During the period of the first January to 31 December 2019, the x0 and y0 both variables would have been daily data. As the two kinds of data on vacations (Sundays) were not recorded, Cohen (2011) suggested a linear spline interpolation to supplement the data. For example, the formula for interpolating stock price index (x0) data is

$$x_1^0 = \frac{x_1^0 - x_1^0}{t_2 - t_1} t + \frac{t_2 x_1^0 - t_1 x_1^0}{t_2 - t_1}, t_1 < t < t_2$$

In that x1 0 relates to stock price index data on the day t1, x2 0 to inventory price index data on the day t2, whereas xt0 to inventory price index data derived through linear day interpolations In this instance, first January 2010 had been recognized by day t=0, second January 2011, by t=1, and going on So, the day t=3653 had been granted for December 31, 2019. This duration was hence called the 2010-2019 phase from first January 2010 to December 31, 2019, and that was long term timeframe.

3.2. Estimation Method

The LVAR (p, q) causal method suggested by Agung (2009) is an econometric analytical technique used for examining dimensions of global prices of raw oil as well as stock price index association. The framework of the dimension of long term connection is as follows

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{sit-in} + \sum_{j=0}^{q} b_j x_{t-j} + \varepsilon_t \quad (1)$$

Here x=ln(x^o), $y = ln$ (y^o), p and q are time lags and ε_t shows the error term of the t time. Enders and Balensiefer (2004) suggested a distinct framework as of (1), that is

$$y_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + z_t \quad (2)$$

There z_t could be one of the aggregates of various quarters in $\sum_{j=0}^{q} b_i y_{t-i} + \varepsilon_t$

The forcing procedure is termed Quarter z_t. If global crude oil prices and the inventory price index trends are integrated, then model one and two will be supplemented by a quarter error correction. In causal framework 1 (Heij et al., 2004), the multiplier (l) from the independent variable x to the dependent variable (y) is

$$\lambda = \frac{\sum_{i=0}^{q} b_i}{1 - \sum_{i=1}^{p} \alpha_i} \quad (3)$$

A positive dimension of association is denoted by the value of $\lambda > 0$ and negative association is indicated by $\lambda < 0$.

Through separating the time frame 2010-2019 into ten sub-periods the evaluation of the dimensions of the short-run relation had been carried out. The time interval k (k=1, 2,…, 10) is explained mathematically in $(t_k, t_k+1) = \{t \setminus t_k < t_k + 1)$, in which time point t is discreet and in k the time intervals are sub-extracted. This time tk comprises a time t value of 0.366 731, 1096, 1461, 1828, 2193, 2558, 2923, 3289, 3653, following first January of every year. These were considered the sub-periods of time: 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018 and 2019. So that, at every subinterval of – k time (k = 1,…, 10) it is essential to clarify a dummy variable in Dkt (t time) with the given equations:

$$D_{ki} = \begin{cases} 1, t \in (t_k, t_{k+1}) \\ 0, t \notin (t_k, t_{k+1}) \end{cases}$$

The dynamic framework of the connection among global raw oil prices (x) plus stock price index (y) along with the dummy variable is

$$y_t = \sum_{k=1}^{10} (\alpha_{k0} + \sum_{i=1}^{p} \alpha_{ki} y_{t-1} + \sum_{j=0}^{q} b_{kj} x_{t-j} + (\varepsilon_t)) D_{kt} \qquad (4)$$

When both the global raw oil (x) and index of stock price (y) trends have been combined through every time subinterval, so an error correction variable would be placed to model (4). Moreover, Moreover, if the inserted quarter (4) appears in the y_k, (k = 1,2,… ,10), then

$$y_t^k = \alpha_{k0} + \sum_{i=1}^{p} \alpha_{ki} y_{t-i} + \sum_{j=0}^{q} b_{kj} x_{t-j} + \varepsilon_t, t \int (t_k, t_{k+1}) \qquad (5)$$

is a dynamic framework of associations at sub-intervals time k among the price of international raw oil as well as inventory price index. The model of dynamic relations (5) is considered a short term dynamic model. Based on the indication of l received in (3), the essence of the connection could become positive or negative.

The different stages had been expected to take to analyze the direction of the association. First, the Modified Dickey-Fuller test had been used to check data stationarity of the variables. For instance, an evaluation of the stationary data series for the global price of crude oil (x) takes place by considering the significance of the equation's r parameter:

$$D(x_t) = \alpha_1 + \delta_1 t + p_1 x_{t-1} + \sum_{i}^{m} \varnothing_i D(x_{t-i}) + (\varepsilon_t)$$

Where $D(x_t)$ shows the global price of crude oil variable (x) at t time of the first transformation gap. Within that test, the x variable seems to be stationary unless the absolute ADF value is greater than the absolute ADF value at the significance level a (1% or 5%). Second, a test of co-integration had been carried out using the test of two steps Engle granger. The first stage in the regression equation among x and y variables as per Noriega and Ventosa-Santaulària (2012) is to define a regression variable. The next stage is to check the error variable stationarity. Unless the error variables have been stationary, these would co-integrate both x and y values. Third, the connection dimensions are evaluated through the estimate of model 1 and by the administration of the statistical test for all its parameters for the P values of F-stats as well as the P-value of t-statistic test for every parameter of regression. For the validation of the long-term association, the following equation has been employed

H_0: All $b_j = 0$, j = 1, 2,…, q (no association exist)

H_1 : There is somewhat $b_j \neq 0$, j = 1, 2,…, q (an association exist)

While the hypotheses equation for testing the short-run association is

H_0 : All $b_{kj} = 0$, j = 1, 2,…, q; k = 1, 2,…, 10 (a connection exist)

H_1 : There is somewhat $b_{kj} \neq 0$, j = 1, 2,…, q; k = 1,2,…,10 (an association exist)

Directions of relationships are established by the P values of F-stats or through the P-value of t-statistic criterion which has been below the significant P value at the significance level a (1% or 5%).

Two stages for the evaluation of relationship dimensions have been performed: (a) an estimate for the model (1) to the extent that the significant outcome of the assessment is acquired by the P-value F standard and also that the x-variable coefficient is significant in conformity by the P-value t-test criterion; (b) a re-estimate which eliminates non-significant variables. Such a test takes a decision based on a non-spurious relation (not faulty regression) criterion, which is, the coefficient of determination (R2) lesser than the stats of Durbin Watson. The testing procedure as well brings the best specification criterion under the Akaike Information Criterion.

4. RESULTS AND DISCUSSIONS

4.1. Stationarity Check

Table 1 summarizes the findings of ADF evaluation checks on global crude oil markets and inventory price indexes. The absolute value of ADF stats from the international price of crude oil and stock market index series data is above the absolute value of ADF critics, as shown in Table 1. Thus, both during the period 2010-2019 and in all sub-phases, the global price of raw oil and the index of stock price have been on the first difference.

4.2. Test of Co-integration

The error variables from the findings of estimates by regression equations among global prices of crude oil and stock price index for the 2010-2019 time period as well as all sub-phases include as Res0, Res1st, Res2nd, Res3rd, Res4th, Res5th, Res6th, Res7th, Res8th, Res9th and Res10th. Table 2 summarizes the estimated results of the test of the cointegration of the global prices of crude oil and stock price index.

ADF statistics are given an absolute value such as Res0, Res1st, Res3rd, Res4th, Res5th, Res6th, Res7th, Res8th, Res9th and Res10th that would be smaller than ADF critics. All these variables were therefore non-stationary. Only factor Res2nd at

Table 1: Empirical findings of the evaluation test on stationary of study variables

Periods	Variables	t-stats	Critical values 1%	Critical values 5%	P*
2010-2019	$D(x_t)$	−57.7596	−3.43196	−2.86213	0.0001
	$D(y_t)$	−12.7400	−3.43196	−2.86214	0.0000
2010	$D(x_t)$	−18.8961	−3.44811	−2.86926	0.0000
	$D(y_t)$	−17.2443	−3.44811	−2.86926	0.0000
2011	$D(x_t)$	−18.5858	−3.44816	−2.86929	0.0000
	$D(y_t)$	−7.4814	−3.44841	−2.86940	0.0000
2012	$D(x_t)$	−18.2856	−3.44816	−2.86929	0.0000
	$D(y_t)$	−12.0600	−3.44821	−2.86931	0.0000
2013	$D(x_t)$	−19.8236	−3.44816	−2.86929	0.0000
	$D(y_t)$	−17.9914	−3.44816	−2.86929	0.0000
2014	$D(x_t)$	−7.31181	−3.44847	−2.86942	0.0000
	$D(y_t)$	−3.30499	−3.44894	−2.86963	0.0154
2015	$D(x_t)$	−10.2116	−3.44831	−2.86935	0.0000
	$D(y_t)$	−11.8370	−3.44821	−2.86931	0.0000
2016	$D(x_t)$	−17.1496	−3.44816	−2.86929	0.0000
	$D(y_t)$	−12.1524	−3.44826	−2.86933	0.0000
2017	$D(x_t)$	−12.2514	−3.44821	−2.86931	0.0000
	$D(y_t)$	−14.2243	−3.44826	−2.86933	0.0000
2018	$D(x_t)$	−3.54591	−3.44889	−2.86961	0.0074
	$D(y_t)$	−13.2642	−3.44821	−2.86931	0.0000
2019	$D(x_t)$	−17.7541	−3.44816	−2.86929	0.0000
	$D(y_t)$	−16.02229	−3.44816	−2.86929	0.0000

*McKinnon (1996) One-sided p values

Table 2: Statistical findings of a co-inclusion evaluation check of the global prices of raw oil and inventory price index

Time period	Variables	t-stats	Critical values 1%	Critical values 5%	P*
2010-2019	Res0	−1.38394	−3.43196	−2.86214	0.5917
2010	Res1st	−1.39373	−3.44806	−2.86924	0.5858
2011	Res2nd	−3.28144	−3.44816	−2.86929	0.0165
2012	Res3rd	−1.00150	−3.44816	−2.86929	0.7538
2013	Res4th	−1.02990	−3.44811	−2.86926	0.7435
2014	Res5th	−2.80180	−3.44806	−2.86924	0.0590
2015	Res6th	−2.72428	−3.44811	−2.86926	0.0709
2016	Res7th	−2.35853	−3.44826	−2.86933	0.1544
2017	Res8th	−0.44890	−3.44826	−2.86933	0.8976
2018	Res9th	−1.49436	−3.44816	−2.86929	0.5356
2019	Res10th	0.62095	−3.44811	−2.86926	0.9902

*McKinnon (1996) One-sided values

the stage of 5% had been stationary. Thus, in the sub-period 2011, the global price for crude oil and stock prices co-integrated to a significance level of 5%. All variables have not been co-integrated during the 2010-2019 and other sub-periods.

4.3. Results of Co-Integration Test

Table 3 summarizes the estimates of causal model 1 or 2 throughout the time of 2010-2019 and sub-periods of the relational dimensions between the International Crude oil prices and the inventory price index. An overview of relationship dynamics is given below. D(xt) was 5% significant during the 2004-2013 period, the D(xt) and D(xt-2), and the D(xt-2) respectively, were 1% significant and the multiplier had been l=0.14. Thus, a dynamic long-term link between the global price of crude oil and the stock price index existed.

$D(x_t)$ Was 5% significant during the 2010-2019 period, the $D(x_t)$ and $D(x_{t-2})$, and the $D(x_{t-2})$ coefficients were 1% significant and the multiplier was $\lambda = 0.14$. Hence, a dynamic long-term link among the global price of raw oil and the stock price index existed. The essence of that relationship had been positive and suggested as, when the world prices of raw oil went up (down), the index of inventory prices went up (down). On 1 January 2010, the dynamics in this relationship started (time lag q = 0). This dynamic long-run association is based on the following pattern:

$$D(y_t) = 0.0004 + 0.1517D(y_{t-1}) + 0.0190D(x) + 0.0853D(x_{t-1}) + 0.0334D(x_{t-2})$$

In the sub-phase of 2010, the $D(x_{t-9})$ coefficient with multiplier l=0.08 had been signed by 5%. During the sub-period of 2011, $D(x_{t-7})$ with multiplier λ=0.10% had been 1% level of significance. The $D(x_{t-1})$. The coefficient in the 2012 substage was 1% significant along with the λ=0.122 multiplier. The coefficient $D(x_t)$ in 2013 would have been 5% level of significance as well as the coefficient $s(x_{t-1})$ with multiplier λ=0.23 was 1% significant. Within the 2014 sub-phase, with the multiplier λ=0.11, the $D(x_{t-1})$ coefficient would have been significant by 1%. The coefficient $D(x_{t-1})$ had been significant by 1% in the 2015 sub-stage with the multiplier λ=0.06.The $D(x_{t-1})$ coefficient would have been 1% level of significance for the sub-phase of 2016 with the λ=0.25 multiplier. In the 2017 sub-stage, with the multiplier λ=0.34, the coefficient $D(x_{t-1})$ and $D(x_{t-2})$ were significant by 1%. The coefficients (x_{t-1}) and $D(x_{t-2})$ had been 1percent level of significance in the 2018 sub-period with the multiplier λ=0.13. Thus it could be inferred that, in the short term, a dynamic connection had been prevailing between the international crude oil price and the stock price index, as within the sub-period of 2017 the coefficient $D(x_{t-2})$ had been 1% level of significance with the multiplier λ=0.24. The natural order of such connection would have been positive and showed that the stock price index was rising (dropping) unless the global crude oil price grew (fell). The framework of the dynamic association that was developed by the estimates are

Table 3: Empirical findings on the dynamic association between global raw oil prices and stock price index

Period	Variables	Coefficients	t- stats	P	R^2 and DW
2010-2019	C	0.00038	2.09785	0.0360	R^2: 0.053
	$D(y_{t-1})$	0.15168	9.29467	0.0000	DW: 2.011
	$D(x_t)$	0.01896	1.97040	0.0489	
	$D(x_{t-1})$	0.08528	8.84863	0.0000	
	$D(x_{t-2})$	0.03340	3.43109	0.0006	
2010	$D(y_{t-1})$	0.33378	6.70356	0.0000	R^2: 0.115
	$D(x_{t-9})$	0.05336	1.98722	0.0477	DW: 1.95
2011	$Res2_{t-1}$	-2.11E-05	-2.15739	0.0316	R^2: 0.086
	$D(y_{t-1})$	0.23690	4.63264	0.0000	DW: 2.023
	$D(x_{t-7})$	0.07882	3.09925	0.0021	
2012	C	0.00123	2.45529	0.0145	R^2: 0.03
	$D(x_{t-1})$	0.12232	3.33410	0.0009	DW: 1.86
2013	$D(y_{t-1})$	0.16933	3.30066	0.0011	R^2: 0.051
	$D(x_t)$	0.08446	2.17987	0.0299	DW: 1.987
	$D(x_{t-1})$	0.10230	2.64887	0.0084	
2014	$D(y_{t-1})$	0.22613	4.46548	0.0000	R^2: 0.07
	$D(x_{t-1})$	0.08511	2.85575	0.0045	DW: 2.04
2015	C	0.00156	2.67462	0.0078	R^2: 0.02
	$D(x_{t-1})$	0.06070	2.63814	0.0087	DW: 1.82
2016	C	0.00094	2.05485	0.0406	R^2: 0.15
	$D(x_{t-1})$	0.24569	7.97537	0.0000	DW: 2.02
2017	$D(x_{t-1})$	0.16603	5.05676	0.0000	R^2: 0.13
	$D(x_{t-2})$	0.17175	5.22824	0.0000	DW : 1.99
2018	$D(x_{t-1})$	0.06976	3.13969	0.0018	R^2: 0.04
	$D(x_{t-2})$	0.05777	2.60131	0.0097	DW: 1.91
2019	$D(y_{t-1})$	0.12843	2.49139	0.0132	R^2: 0.042
	$D(x_{t-2})$	0.20741	3.19157	0.0015	DW: 1.978

$$
\begin{aligned}
D(y_t) = &\left[0.334D(y_{t-1}) + 0.053D(x_{t-1})\right] \\
D_{1t} + &\left[-2.11*10^{-5}\,Res2 + 0.2369D(y_{t-1}) + 0.0788D(x_{t-1})\right]D_{2t} + \\
&[0.0012 + 0.1223D(x_{t-1})]D_{3t} + [0.1639D(y_{t-1}) + 0.0845D(x_t) + \\
&0.1023D(x_{t-1})]D_{4t} + [0.2261D(y_{t-1}) + 0.0851D(x_{t-1})]\ D_{5t} + \\
&[0.0016 + 0.6107D(x_{t-1})]D_{6t} + [0.0016 + 0.2457D(x_{t-1})]D_{7t} + \\
&[0.166D(x_{t-1}) + 0.1718D(x_{t-2})]D_{8t} + [0.07D(x_{t-1}) + \\
&0.0578D(x_{t-2})]D_{9t} + [0.1284D(y_{t-1}) + 0.2074D(x_{t-2})]D_{10t}
\end{aligned} \quad (6)
$$

It would be noted here that a time-break around 0 and 9 days would have been necessary to maintain the dynamic connection among the global prices of raw oil as well as the stock price index. For instance, the dynamic association among global price of raw oil plus stock price index took place later than a gap of nine days during the 2011 sub-period, while it took place with little or no interruption during the 2012 sub-period.

5. CONCLUSION

This research set out to investigate, among 2010 to 2019, the dimensions of the connection among the international price of crude oil and Indonesian stock markets. Crude oil prices data have been extracted by WTI's average crude oil price. The Indonesian stock market factor would be used as daily data regarding prices of the composite stock. The general LVAR technique would have been used to estimate association dynamics. Period I had been assumed to be the long-run period from January 1 to December 31, 2010, since every sub-period had been regarded as the short-period between January 1 and 31 December 31.

The outcome of the test indicates that global raw oil prices as well as inventory prices seemed to be the first difference stationary in the long run as well as in the short run. The co-integration analysis results also indicate that the trends of both global crude oil and inventory price indices would have been cointegrated in the sub-stage of 2011. The patterns among these two variables had not been jointly integrated in the period 2010-2019 and the other periods.

Summing up, a finding of the test show that there had been significant dynamics in terms of the relation among the international prices for crude oil and the Indonesian inventory price index in the long run as well as short run. Such a connection would have been positive in that the stock price index also has gone up (lowered) if the price of crude oil went up (lowered). The long-term relationship dynamics have been observed after 1 January 20010 based on the study period whereas the short-run relationship dynamics had changed. This finding is important in the interests of the Indonesian Government and of investors in managing their investments portfolio in their economic policies.

REFERENCES

Adam, P., Gubu, L., Cahyono, E. (2014), Statistical characteristics of Jakarta composite index dynamics based on short term data represented in candles. International Journal of Economics, 2(2), 138-142.

Agung, I. (2009), Time Series Data Analysis Using Eviews. Singapore: John Wiley & Son.

Arouri, H.E.M., Rault, C. (2014), An econometric analysis of the impact of oil prices on stock markets in gulf cooperation countries an econometric analysis of the impact of oil prices on stock markets in gulf coorporation countries. In: Emerging Markets and the Global Economy: A Handbook. Oxford, UK: Elsevier. p371-382.

Azar, S.A., Basmajian, L. (2013), The impact of global oil price shocks on the Lebanese stock market. International Journal of Economics and Financial Issues, 3(2), 294-304.

Basher, S., Sadorsky, P. (2006), Oil price risk and emerging stock markets. Global Finance Journal, 17(2), 224-251.

Basher, S.A., Haug, A.A., Sadorsky, P. (2012), Oil prices, exchange rates and emerging stock markets. Energy Economics, 34(1), 227-240.

Benada, L. (2014), Science direct effect of crude oil on the prague stock exchange. Procedia Social and Behavioral Sciences, 109, 1316-1321.

Cahyono, E. (2014), On the linear relation of signals. WSEAS Transactions on Signal Processing, 10, 555-560.

Cashin, P., Mohaddes, K., Raissi, M., Raissi, M. (2014), The differential effects of oil demand and supply shocks on the global economy. Energy Economics, 44, 113-134.

Chen, N., Roll, R., Ross, S. (1986), Economic forces and the stock market. Journal of Business, 59(3), 383-403.

Cohen, H. (2011), Springer news 5/2011 mathematics. In: Numerical Approximation Methods. New York: Springer.

Cueppers, L., Smeets, D. (2015), How do oil price changes affect German stock returns? International Journal of Energy Economics and Policy, 5(1), 321-334.

Dagher, L., Hariri, S.E. (2013), The impact of global oil price shocks on the Lebanese stock market. Energy Economics, 63, 266-274.

Degiannakis, S., Filis, G., Floros, C. (2011), Dynamic correlation between stock market and oil prices: The case of oil-importing and oil-exporting countries. In International Review of Financial Analysis, 20(3), 152-164.

Effiong, E.L. (2014), Oil price shocks and Nigeria's stock market: What have we learned from crude oil market shocks? OPEC Energy Review, 38(1), 36-58.

EIA. (2014), Energy Information Administration (EIA). Country Analysis Brief Overview. EIA. Available from: http://www.eia.gov/countries/country-data.cfm?fips=ID. [Last accessed on 2020 Jun 08].

Enders, D., Balensiefer, T. (2004), Nucleophilic carbenes in asymmetric organocatalysis. Accounts of Chemical Research, 37(8), 534-541.

Filis, G. (2010), Macro economy, stock market and oil prices: Do meaningful relationships exist among their cyclical fluctuations? Energy Economics, 32(4), 877-886.

Fowowe, B. (2013), Jump dynamics in the relationship between oil prices and the stock market: Evidence from Nigeria. Energy Economics, 56, 31-38.

Guesmi, K. (2013), Comovements and volatility spillovers between oil prices and stock markets: Further evidence for oil-exporting and oil-importing countries. In: Emerging Market and Global Economy: A Handbook. Oxford, UK: Academic Press. p371-382.

Halaç, U., Taşkın, F.D., Çağlı, E.Ç. (2013), The Turkish stock market integration with oil prices: Cointegration analysis with unknown regime shifts. Panoeconomicus, 60(4), 499-513.

Heij, C., De Boer, P., Frances, P.H., Kloek, T., Van Dijk, H.K. (2004), Econometric Methods with Application in Business and Economics. Clareendon: Oxford University Press.

Horng, W.J., Chang, J.C. (2010), An Influence of the High Oil Price Periods for Two Stock Market Returns: Empirical Study of the Thailand and the Philippine's Stock Markets. IEEE Computer Society. Available from: https://www.ieeexplore.ieee.org/abstract/document/5592895.

Huang, R., Masulis, R., Stoll, H. (1996), Energy shocks and financial markets. Journal of Futures Markets, 16(1), 1-27.

Jones, C.M., Kaul, G. (1996), Oil and the stock markets. Journal of Finance, 51(2), 463-491.

Kang, W., Ratti, R.A. (2015), Oil shocks, policy uncertainty and stock returns in China. Economics of Transition, 23(4), 657-676.

Kling, J. (1985), Oil price shocks and stock market behavior. Journal of Portfolio Management, 12(1), 34-39.

Lee, C., Zeng, J. (2011), The impact of oil price shocks on stock market activities: Asymmetric effect with quantile regression. Mathematics and Computer Simulation, 81(9), 1910-1920.

Lee, Y.H., Hao, F. (2012), Oil and S&P 500 markets: Evidence from the nonlinear model. International Journal of Economics and Financial Issues, 2(3), 272-280.

Lin, C.C., Fang, C.R., Cheng, H.P. (2010), Relationships between oil price shocks and stock market: An empirical analysis from greater China. China Economic Journal, 3(3), 241-254.

McKinnon, R.I. (1996), The Rules of the Game: International Money and Exchange Rates. United States: MIT Press.

Moebert, J. (2007), Darmstadt Discussion Papers in Economics Crude Oil Price Determinants Crude Oil Price Determinants. Available from: https://www.econstor.eu/handle/10419/32075.

Mohanty, S.K., Nandha, M., Turkistani, A.Q., Alaitani, M.Y. (2011), Oil price movements and stock market returns: Evidence from gulf cooperation council countries. Global Finance Journal, 22(1), 42-55.

Nandha, M., Faff, R. (2008), Does oil move equity prices? A global view. Energy Economics, 30(3), 986-997.

Narayan, P., Narayan, S. (2010), Modelling the impact of oil prices on Vietnam's stock prices. Applied Energy, 87(1), 356-361.

Noriega, A.E., Ventosa-Santaulària, D. (2012), The effect of structural breaks on the Engle-Granger test for cointegration. Estudios Económicos, 27(1), 99-132.

Nwosa, P.I. (2014), Oil prices and stock market price in Nigeria. OPEC Energy Review, 38(1), 59-74.

Rashid, A., Kocaaslan, O.K. (2013), Munich personal repec archive does energy consumption volatility affect real GDP volatility? An empirical analysis for the UK. International Journal of Energy Economics and Policy, 3(4), 384-394.

Ratti, R.A., Hasan, M.Z. (2013), Oil price shocks and volatility in australian stock returns. Economic Record, 89(1), 67-83.

Samadi, S., Bayani, O., Ghalandari, M. (2012), The relationship between macroeconomic variables and stock returns in the Tehran stock exchange. International Journal of Academic Research in Business and Social Sciences, 2(6), 559.

Sukcharoen, K., Zohrabyan, T., Leatham, D., Wu, X. (2014), Interdependence of oil prices and stock market indices: A copula approach. Energy Economics, 44, 331-339.

Toharso. (2010), Crude Oil Import Policy. Indonesia: Bappenas Online Library.

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

Williams, J. (2011), Oil Price History and Analysis. WTRG Economics. Available from: http://www.Wtrg.Com.