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Fariz Rahmanto
Faculty of Economics and Business, Universitas Indonesia

Muhammad Hira Riga
Faculty of Economics and Business, Universitas Indonesia, hirariga@gmail.com

Vika Indriana
Faculty of Economics and Business, Universitas Indonesia

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The Effects of Crude Oil Price Changes on the Indonesian Stock Market: A Sector Investigation

Fariz Rahmanto, Muhammad Hira Riga*, Vika Indriana
Faculty of Economics and Business, Universitas Indonesia, Indonesia

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This article contributes to country specific result on the responses of sector stock indices to crude oil price changes. Using linear and asymmetric models and by studying the association of crude oil and stock price, this article aims to explain about the short-term responses of Indonesian sector stock indices to crude oil price changes. Besides, we also try to figure out whether there are asymmetric responses within. Our findings suggest that the strength and the sensitivity of this association vary across sectors, and the effects are positive for all sectors. We also find strong significance of asymmetry reactions for Agriculture and Consumer Goods sector stock returns due to changes in crude oil price.

Keywords: *Asymmetric Reaction; GARCH; Oil Prices; Sector Stock Market; Short-term Analysis*

JEL classification: G10, C32

Introduction

Crude oil has significant role in global economy. As the basic input for productions all around the world, the dependence of this natural resource has been increasing through its supply-demand equilibrium. The strategic importance of oil and economic development is quickly realized by producer and consumer countries, so that they become more dependent on the oil (Kapusuzoglu, 2011).

Since the changes in oil price have roles in global economy, the economy of a country therefore can be affected by it (Cuepers & Smeets, 2015). The effect may come from its impact on stock market returns within that country. In theory, the value of a stock derives from the discounted sum of expected future cash flows, which reflect economic conditions of that a country. Economic condition such as inflation, production costs, consumer and investor confidence and the restare then affected by macroeconomic events that may be effected by changes in oil prices (Arouri, 2011). For oil exporting countries, stock price will respond positively for an increase in oil price, since it will raise public revenue, spending, and investment, which in turn will increase the production. However, the opposite conditions apply to oil importing countries (Filis, Degiannakis, & Floros, 2011).

Stock price can be affected by the changes in oil price through several channels. Hamilton (1983) and Jones, Lelby, and Paik (2004) argues that the oil price changes may influence the supply-side effect by investment costs and also the availability of basic production input, on the terms of trade and wealth transfer from

* Corresponding author's email: hirariga@gmail.com

oil importers countries to oil exporter countries, on firms' production structures and unemployment, on monetary policies, on interest rates and inflation, on consumption opportunities, and lastly, by the demand-side effect through costs and confidence and demand from consumers. Align with the explanation, Gisser and Goodwin (1986) also explain that an increase in oil price will increase production cost when there is no substitute for oil as basic production input, and this increasing in production cost will affect the cash flow and lowering stock price. The effects on stock price due to changes in oil price will differ depending on the role that a firm takes related to oil itself, in other words whether the firm is consumer or producer of oil or oil products (Iscan, 2010). It seems to apply not only in firm level, but also in country level.

However, the studies about oil price changes on the stock of individual sectors are still very few, and they do not provide global perspective since most of them are country specific. Motivation of this study is to investigate the short-term responses of individual stock sectors price in Indonesia to oil price changes, and investigate the possibility of asymmetric response for each sector. Moreover, this study also aims to look for sensitivity and causality between oil price and individual stock sectors price in Indonesia. Indonesia is a developing country that has oil distillations where crude oil is produced. However, since 2003 Indonesia has become the net importer of crude oil (Wang, Wu, & Yang, 2013). It is because the insufficiency of country's crude oil production, which makes Indonesia has to suffice the domestic demand by importing oil every year from other countries (Toharso, 2010).

Thus, it is intriguing to find out about the relationship between oil prices and sector indices in Indonesia for some reasons. First, sectors in a nation could be asymmetrically affected by the changes of oil prices, some could be worse off than the others when the oil prices fluctuate. Second, in the perspective of portfolio managers or market participants, by identifying the sector sensitiveness, portfolio managers could get the idea of diversification through the sectors in times of oil prices swing. Lastly, the fact that countries become more dependent to crude oil, including Indonesia, and the fact that oil price may be fluctuated any time are the main reasons why we have interest in this study. We hope this study can contribute for the other researchers who have similar research related to this topic, for regulators in making the regulation related to macroeconomic condition, and especially for market participants in rebalancing their portfolio withthe their anticipation of coming changes in world crude oil price.

Literature Review

Considerable amount of studies had looked at the association between oil price and stock price, but the results of those studies are not homogenous. Jones and Kaul (1996), using standard cash flow dividend valuation model, investigated the response of stock returns to oil price fluctuations in four developed countries (UK, Japan, Canada, and US). For US and Canada, they found negative association between oil price changes and stock returns, while for Japan and UK the results were inconclusive. Huang, Masulis, & Stoll (1996) found that there was not any relationship between oil price shocks and the S&P500 market index. Using American monthly data for 1947-1996 and unrestricted VAR-GARCH model, Sadorsky (1999) found that there was negative short-term effect of oil price volatility on the aggregate stock return. Park and Ratti (2008) investigated the effect of oil prices shocks on stock exchange returns in the scope of US and 13 European countries using data from 1986-2005. Using VAR model, the findings were the stock exchange returns in Norway also increased as the oil price increased, and as the volatility of oil price in many European countries increased, the stock exchanges returns were affected negatively, but not for US.

Study in Indonesia, using LVAR model, had already been conducted by Adam, Rianse, Cahyono, and Rahim (2015). The findings suggested that there was long term and short term positive dynamic relationship between crude oil price with West Texas Intermediate (WTI) as the proxy and stock market in Indonesia.

Another study which covered Indonesian market conducted by Hersugondo, Wahyudi, and Muharam (2015) using monthly WTI closing prices and stock index closing prices during January 2003 to December 2013 and GARCH model, reveal that in ASEAN-5 market, the impact of oil price fluctuation only significant in Malaysia capital market (KLCI) and Thailand capital market (SET) with positive effect. Even though not significant, oil price fluctuation has potential negative effect to Indonesia capital market index (JKSE).

Further examinations of sector indices, Sadorsky (2001) and Boyer and Filion (2007) have found that an increase in oil price has positive effect on stock returns of Canadian oil and gas companies. Nandha and Faff (2008) used global data from 35 industries and found that an increase in oil price affected positively all sectors, except the oil and gas industries. Cong, Wei, Jiao, and Fan (2008) investigated the effect of individual stock sectors in China to oil price changes with monthly data and VAR model. Their findings showed that there was no significant effect, except for manufacturing and oil industries. Finally, Arouri (2011), using linear and asymmetric model, also investigated the short-term relationship between oil price and individual stock sector price in Europe stock markets and found that there was significant relationship between oil price and stock prices for mostly stock market in Europe, but the effect and the sensitivity varied for each sectors.

Research Methods

Data and sources

We use weekly data from world crude oil prices and the sector stock indices over the period of August 6th, 2007 until October 19th, 2015. Sector stock indices used in this research based on the division of sectors listed on the Indonesia Stock Exchange website that classified into nine sectors: *Agriculture, Mining, Basic Industries, Miscellaneous, Consumer Goods, Properties, Financials, Trade, and Utilities*. World crude oil type used in this research is the West Texas Intermediate (WTI) or also known as Texas Light Sweet. Period used in this study based on consideration that the period over August 2007 to June 2010 was the period when fluctuations of crude oil price and stocks are high as a result of the subprime mortgage crisis which impact is felt by almost the entire world, while the period over July 2010 to October 2015 was a period that has been freed from the past crisis. All data both crude oil prices as well as the sector indices obtained from Thomson Reuters' Datastream database.

Preference to use sector stock indices rather than the aggregate index only is based on alleged differences in the response by the business sector to changes in oil prices and the response of each sector may be asymmetric when there is a change in oil prices due to differences in sensitivity (Arouri, 2011). Sectors that used in this research are *Agriculture* (crops, plantations, animal husbandry, fisheries, and forestry), *Mining* (Coal, oil & gas, metals and other minerals and rocks), *Basic Industries* (cement, ceramics, porcelain, glass, metal and the like, chemicals, plastics and packaging, fodder, timber and processing, and pulp & paper), *Miscellaneous* (Machinery & heavy equipment, automotive & component, textile and garment, footwear, cables and electronics), *Consumer Goods* (Food & beverages, cigarettes, pharmaceuticals, and cosmetics and household appliances), *Properties* (Properties and real estate, and construction & building), *Financials* (Banks, financial institutions, securities companies, and insurance), *Trade* (Trade of the goods production, trade retail, tourism, hotels, restaurants, advertising, printing, media, health, services of computers and other hardware, and investment companies), and *Utilities* (Energy, toll roads, airports, ports and the like, telecommunications, transportation and construction of non-building).

Preliminary analysis

In determining the order of integration we employ three unit root test: Augmented Dickey-Fuller test(ADF), Phillips Peron test(PP), and Kwiatkowski et al. test (KPSS). Our test results are presented in Table 1. In the ADF and PP test,

Table 1. Unit Root Test

	Level			First Difference		
	ADF	PP	KPSS	ADF	PP	KPSS
World Crude Oil	-1.6875	-1.9223	0.1863*	-21.4417*	-21.4735*	0.1397
JKSE	-1.0142	-1.0563	2.3557*	-23.7899*	-23.6705*	0.1070
Agriculture	-2.2693	-2.6860	0.1522*	-19.6601*	-19.8145*	0.0562
Basic Industries	-1.3925	-1.3925	2.1868*	-22.5529*	-22.5444*	0.2046
Consumer Goods	-0.4733	-0.4461	2.5766*	-25.7247*	-26.0437*	0.0990
Financials	-0.8554	-0.9611	2.4530*	-23.5704*	-23.5996*	0.0535
Mining	-1.2526	-1.6729	0.8696*	-20.1823*	-20.5716*	0.1290
Miscellaneous	-1.5148	-1.4506	2.2028*	-22.3952*	-22.6755*	0.1994
Properties	-0.4084	-0.4374	2.1920*	-20.7273*	-20.7320*	0.1840
Trade	-0.4074	-0.4219	2.4049*	-23.3970*	-23.2228*	0.1732
Utilities	-1.1441	-1.3680	1.8026*	-24.2659*	-24.2451*	0.1248

Notes: Oil price and sector indices are in natural logarithm. ADF is Augmented Dickey-Fuller test, PP is Phillips-Perron test, dan KPSS is Kwiatkowski-Phillips-Schmidt-Shin test. *, **, and *** denotes significance at 1%, 5%, and 10% respectively.

Table 2. Descriptive Statistics of Return Series

	Mean	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Correlation with JKSE	Correlation with Oil
World Crude Oil	-0.0011	0.0579	-0.2086	10.6255	1040.0910	0.36	1.00
JKSE	0.0017	0.0356	-0.8038	8.2646	540.3588	1.00	0.36
Agriculture	0.0001	0.0525	-0.6702	8.5067	572.8079	0.76	0.30
Basic Industries	0.0015	0.0410	-0.6577	6.8940	301.2577	0.85	0.26
Consumer Goods	0.0038	0.0314	-0.4669	6.5424	239.3251	0.76	0.22
Financials	0.0025	0.0413	-0.0066	6.7436	249.9315	0.92	0.32
Mining	-0.0012	0.0535	-0.5180	6.5594	245.0777	0.82	0.39
Miscellaneous	0.0028	0.0508	-0.2299	6.8560	268.9318	0.83	0.27
Properties	0.0017	0.0378	-0.7841	5.0085	115.7928	0.78	0.22
Trade	0.0020	0.0359	-1.1929	7.5660	473.3032	0.86	0.35
Utilities	0.0003	0.0345	-0.7789	10.9443	1168.7630	0.85	0.29

the null hypothesis used is data contained unit root while the KPSS test the null hypothesis is data that used is not contained unit root. Based on the results of tests performed, all the data is integrated in the first order which is return or first log-difference of the data level.

Descriptive statistics on return presented in Table 2. Based on the descriptive statistics, all data is not normally distributed. This is indicated by the level of kurtosis of all the data is above 3, negative skewness in all the data, and the Jarque-Bera value indicating that the data is not normally distributed. Compared to other sectors, *Mining* is the most volatile sector. However, the crude oil price is more volatile compared to the stock prices throughout all sectors.

The correlation between oil price changes and all sector stock returns has positive value. This indicate that when the oil price increase, return received by investors also increasing. *Mining* held the highest correlation with level of correlation of 39%. This is a reasonable result since oil companies classified into this sector and rising oil prices will generate a higher profit margin for oil companies. Sector with the lowest correlation between the sector indices and the oil price is *Properties* and *Consumer Goods* with a 22% of correlation. The correlation value between sector stock indices and composite indices is quite high. The lowest correlation observed is *Agriculture* (76%) and the highest is the *Financials* (92%).

Empirical model

We examined the short-term relationship between crude oil price by proxy of West Texas Intermediate (WTI) and the return of the sector indices on the Indonesia Stock Exchange (IDX) in recent years to add the last crisis in 2008 as a variable. We started a multifactor analysis of asset pricing models to analyze the sensitivity of the return of the sector indices in IDX with changes in world oil prices and a composite index. Then, we examine the relationship of non-

linearity between changes in crude oil prices and stock prices. Finally, to prove whether there is a short-term causal relationship among them we use the Granger Causality Test.

Stock returns, changes in world oil prices, and market sensitivity

We use multi-factor model to see whether Indonesia sector stock returns are sensitive to oil price changes and Indonesian market changes. This model is based on a previous study by Arouri (2011). The following Equation 1 is:

$$r_{it} = a + b \times roil_t + c \times rjakcomp_t^0 + d \times D_t + \varepsilon_{it} \quad (1)$$

$$\varepsilon_{it} \rightarrow N(0, h_{it})$$

$$h_{it}^2 = \alpha + \sum_{k=1}^{q} \beta_k \times \varepsilon_{i,t-k}^2 + \sum_{l=1}^{p} \gamma_l \times h_{i,t-l}^2$$

where r_{it} is the weekly stock return in sector i (first log difference of sector index i), $roil_t$ is the weekly rate of return from West Texas intermediaries as a proxy for world crude oil (first log difference of sector index i), $rjakcomp_t^0$ is the weekly return of the composite index of Indonesia (first log difference of the composite index IDX) as filtered by the return of oil prices. D_t is a dummy variable equal to 1 when the crisis period (August 2007-June 2010) and has 0 value afterwards. More precisely, $rjakcomp_t^0$ is the residual from the OLS regression of the composite index on the return of oil prices ($roil_t$):

$$rjakcomp_t = \alpha + \beta\, roil_t + rjakcomp_t^0 \quad (1.1)$$

Asymmetric reaction to changes in oil prices

Several previous studies (Hamilton, 2003; Zhang, 2008) said that the association between oil prices by economic activity does not run in a linear fashion that when the oil price rises have a greater effect than when the oil prices fell. According Arouri (2011), there are three possible explanations that could explain this asymmetrical relationship: a government policy that is counter-inflationary when oil prices rise, investment uncertainty and shock deployment mechanism in each sector. To test the asymmetric reaction in the stock price of Indonesia, we follow Arouri (2011) on non-linear asymmetric approach specification, which has a model that had been developed by Hamilton (2003) and Mork (1989).

Asymmetric specification

According to Equation 2, the rise and decline of world oil prices are considered two separate variables. As stated earlier, that the reaction of the stock price is expected to move nonlinear (Hamilton, 2003; Mork, 1989). That is:

$$r_{it} = a + b^+ \times roil_t^+ + b^- \times roil_t^- + c \times rjakcomp_t^0 + d \times D_t + \mathcal{E}_{it} \quad (2)$$

$$\varepsilon_{it} \rightarrow N(0, h_{it})$$

$$h_{it}^2 = \alpha + \sum_{k=1}^{q} \beta_k \times \varepsilon_{i,t-k}^2 + \sum_{l=1}^{p} \gamma_l \times h_{i,t-l}^2$$

where $roil_t^+$ and $roil_t^-$ is the world's positive oil price returns and negative oil price returns, respectively. Therefore, b^+ dan b^- is a coefficient that affects the oil price increases and decreases, respectively. Then we conduct the test with null hypothesis: $b^+=b^-$. In addition, we also tested the hypothesis of non-asymmetry and null sensitivities on the rise and the decline in world oil prices: $b^+=b^-=0$. This test uses the Wald test to give restriction on the model.

Causality tests

To understand more about the relationship between crude oil price and the Indonesian stock market returns, we continue our analysis to the Granger causality test, to determine the direction of therelationship between the variables used in these models. Stock price return that we use in this test based on aggregate stock and sector indices stocks. There are four possibilities about the results from this test: Unidirectional causality from *roil* to r_i, Unidirectional causality from r_i to *roil*, Feedback or bilateral causality between r_i and *roil* and Independenceor no causality between r_i and *roil*. We imply the test based on linear and our non linear definition of oil price changes (the asymmetric).

Table 3. Estimation results-linear model Equation 1

	a	b	c	d
Agriculture	0.0005	0.2743*	1.1089*	-0.0004
	(0.0043)	(0.0538)	(0.0858)	(0.0068)
Basic Industries	0.0013	0.1991*	1.0314*	0.0004
	(0.0010)	(0.0170)*	(0.0271)	(0.0015)
Consumer Goods	0.0028**	0.1369*	1.0314*	0.0003*
	(0.0011)	(0.0147)	(0.0267)*	(0.0017)
Financials	0.0026*	0.2389*	1.0867*	-0.0006
	(0.0005)	(0.0109)	(0.0191)	(0.0013)
Mining	-0.0029***	0.3385*	1.1776*	0.0042
	(0.0015)	(0.0242)	(0.0405)	(0.0029)
Miscellaneous	0.0014	0.2300*	1.2222*	0.0040***
	(0.0013)	(0.0210)	(0.0345)	(0.0024)
Properties	0.0045*	0.1643*	0.9566*	-0.0070*
	(0.0012)	(0.0214)	(0.02803)	(0.0021)
Trade	0.0033*	0.2301*	0.8783*	-0.0031**
	(0.0009)	(0.0138)	(0.0224)	(0.0016)
Utilities	0.0009	0.1538*	0.7854*	-0.0026
	(0.0007)	(0.0144)	(0.0216)	(0.0016)

Notes This table reports the results from estimating Equation 1. Numbers in parentheses are robust standard errors. *, **, and *** denotes significance at 1%, 5%, and 10% respectively.

Results and Discussions

Stock Returns, Changes in World Oil Prices, and Market Sensitivity

Table 3 shows the value of the parameters. Coefficient relating to the return sector in composite returns filtered (coefficient c) is significant for all sectors, vary from 0.78 (defensive sectors) for Utilities to 1.37 (aggresive sector) for *Miscellaneous*. Coefficient d has negative value in most sectors, explaining the negative effect of the recent global financial crises in 2007-2010 on stock returns, but the connection is weak. Andwhat makes it even more interesting is that the coefficient explaining the return of oil prices (coefficient b) were significant in all sectors, meaning that is has significant short-term effects of world crude oil price fluctuations on stock prices of Indonesia sectors. For all nine sectors, it was found that the return of world crude oil prices to have a significant positive relationship, where *Mining* has the highest coefficient, and the *Consumer Goods* has the lowest coefficient.

With the model we use to estimate, seems to fit the data adequately. Table 4 shows GARCH model from estimation result-linear for Equation 1. ARCH and GARCH coefficients are both significant. Moreover, we observed that, in many cases, conditional volatility has not changed very drastically, because ARCH coefficient is comparably small. Conversely, volatility has a tendency to fluctuate gradually from time to time because of large GARCH coefficient.

In short, our analysis shows a strong relationship between changes of world oil prices and the sector return in Indonesia during the predetermined period. Sign and intensity of this relationship is different from a sector to another. In the following part, we examine the result about asymmetric response to the return sector in Indonesia to the crude oil price changes.

Asymmetric reaction to changes in oil prices

Results from our asymmetric specification Equation 2 are summarized in Table 5. Wald tests show that the hypothesis $b^{+}=b^{-}=0$ is rejected for all sectors, which confirms that oil price changes as a significant factor to affect the sector returns in Indonesian stock market. The findings are constant with the results that that reported in Table 3. This Wald test also suggests that hypothesis $b^{+}=b^{-}$, which means the reactions to oil price changes for those sectors are asymmetric, is rejected for *Agriculture* and *Consumer Goods*.

Table 4. Estimation results-linear model Equation 1, GARCH model

	α	β	γ	Adj R^2	AIC	LB
Agriculture	0.0007	0.1500	0.6000	0.57860	-3.7416	3.5420
	(0.0007)	(0.1660)	(0.3906)			
Basic Industries	0.0001*	0.2136*	0.4956*	0.73650	-4.9422	9.5690
	(0.0000367)	(0.0422)	(0.1020)			
Consumer Goods	0.0001*	0.2138*	0.5326	0.57420	-4.9221	6.1940
	(0.00003)	(0.0428)	(0.0975)			
Financials	0.00000466**	0.0876*	0.8946*	0.72703	-5.6215	10.920
	(0.0000022)	(0.0242)	(0.0263)			
Mining	0.0000617**	0.1292*	0.8044*	0.68310	-4.2661	3.7100
	(0.0000308)	(0.0375)	(0.0646)			
Miscellaneous	0.0000236***	0.0975*	0.8781*	0.69600	-4.3790	8.9870
	(0.0000131)	(0.0278)	(0.0290)			
Properties	0.0000477*	0.1263*	0.7857*	0.60650	-4.7514	5.8719
	(0.0000176)	(0.0345)	(0.0558)			
Trade	0.0000135**	0.0837*	0.8687*	0.74530	-5.3061	5.6243
	(0.00000567)	(0.0213)	(0.0331)			
Utilities	0.00000431**	0.0549*	0.9277*	0.72380	-5.3284	8.6310
	(0.00000215)	(0.0142)	(0.0149)			

Notes: This table reports the results from estimating Equation 1. Numbers in parentheses are robust standard errors. LB is Ljung-Box tests for autocorrelation in the considered order for the standardized residuals. ARCH test is the LM ARCH test for heteroskedasticity conditional to the considered order for the standardized residuals and differs between sectors. AIC is the Akaike Information Criterion. For the Basic Industries, Financials, Miscellaneous, and Utilities sectors, the model is estimated with an AR(1) because the latter is significant. The orders for the GARCH model are determined based on information criteria. *, **, and *** denotes significance at 1%, 5%, and 10% respectively.

Table 5. Estimation results- non linear model, Equation (2)

	Roil+	Roil -	Roil + = Roil - = 0	Roil + = Roil -
Agriculture	0.1471*	0.3624*	**45.28300**	**6.6289**
	(0.0567)	(0.0460)	**(0.00000)**	**(0.0104)**
Basic Industries	0.1960*	0.1977*	**73.31700**	0.0012
	(0.0320)	(0.0255)	**(0.00000)**	(0.9718)
Consumer Goods	0.1867*	0.0963*	**45.24100**	**5.5348**
	(0.0231)	(0.0268)	**(0.00000)**	**(0.0191)**
Financials	0.2635*	0.2174*	**222.55600**	2.4568
	(0.0166)	(0.0209)	**(0.00000)**	(0.1178)
Mining	0.2793*	0.3842*	**91.79180**	1.8935
	(0.0469)	(0.0440)	**(0.00000)**	(0.1695)
Miscellaneous	0.2595*	0.2073*	**66.82690**	1.3237
	(0.0283)	(0.0331)	**(0.00000)**	(0.2506)
Properties	0.1513*	0.1724*	**27.98079**	0.1406
	(0.0362)	(0.0349)	**(0.00000)**	(0.7079)
Trade	0.1970*	0.2596*	**132.94900**	2.2948
	(0.0273)	(0.0230)	**(0.00000)**	(0.1306)
Utilities	0.1336*	0.1715*	**52.33820**	0.8135
	(0.7815)	(0.0220)	**(0.00000)**	(0.3676)

Notes: For coefficients: robust standard errors are in parentheses. For hypothesis tests, p-values are reported into parentheses. Models are estimated with AR(1) term when latter is significant. Bold indicates rejection of null hypothesis. *, **, and *** denotes significance at 1%, 5%, and 10% respectively.

Causality between Oil Price and Stock Price

The results of causality test between oil price and stock price are contained in Table 6. It shows that there is a strong two-way relationship in the short-term between Indonesian composite index and world crude oil prices. Similar results were also obtained in the sectors of *Agriculture*, *Mining*, *Miscellaneous*, *Trade*, and *Utilities* and apparently, *Basic Industries* and *Consumer Goods*. However, it was found that there is a one-way relationship in the *Financials*, the sector returns have causality to refund the price of oil and this indicates that the returns on this sector is considered to have the effect of macroeconomic that strong enough to be able signalling to the return of world crude oil price. Lastly, there is no causal relationship

Table 6. Symmetric and asymmetric short-term Granger causality test results

	2	8		2	8		2	8
JKSE								
$r_i \rightarrow Roil$	**0.0031**	**0.000006**	$r_i \rightarrow Roil^+$	**2E-07**	**0.0003**	$r_i \rightarrow Roil^-$	**0.0019**	**0.0008**
$Roil \rightarrow r_i$	**0.0407**	**0.0528**	$Roil^+ \rightarrow r_i$	0.8598	0.9455	$Roil^- \rightarrow r_i$	**0.0702**	0.2076
Agriculture								
$r_i \rightarrow Roil$	**0.0033**	**5E-09**	$r_i \rightarrow Roil^+$	**0.0045**	**0.00001**	$r_i \rightarrow Roil^-$	**0.0001**	**0.000003**
$Roil \rightarrow r_i$	**0.0075**	**0.0273**	$Roil^+ \rightarrow r_i$	0.0515	0.0218	$Roil^- \rightarrow r_i$	**0.0381**	0.2322
Basic Industries								
$r_i \rightarrow Roil$	0.4656	**0.0076**	$r_i \rightarrow Roil^+$	0.1035	**0.0252**	$r_i \rightarrow Roil^-$	0.5586	**0.0786**
$Roil \rightarrow r_i$	0.1000	**0.0875**	$Roil^+ \rightarrow r_i$	0.2832	0.2715	$Roil^- \rightarrow r_i$	0.1475	**0.0874**
Consumer Goods								
$r_i \rightarrow Roil$	0.1449	**0.0065**	$r_i \rightarrow Roil^+$	0.1064	**0.0642**	$r_i \rightarrow Roil^-$	0.1484	**0.0117**
$Roil \rightarrow r_i$	0.56	**0.0796**	$Roil^+ \rightarrow r_i$	0.1937	0.2127	$Roil^- \rightarrow r_i$	0.8845	**0.0902**
Financials								
$r_i \rightarrow Roil$	**0.0199**	**0.002**	$r_i \rightarrow Roil^+$	**0.0065**	**0.0038**	$r_i \rightarrow Roil^-$	**0.0079**	**0.0193**
$Roil \rightarrow r_i$	0.4982	0.1845	$Roil^+ \rightarrow r_i$	0.566	**0.0703**	$Roil^- \rightarrow r_i$	0.6508	0.1732
Mining								
$r_i \rightarrow Roil$	**0.0004**	**0.000007**	$r_i \rightarrow Roil^+$	**0.0084**	**0.0001**	$r_i \rightarrow Roil^-$	**0.0001**	**0.0008**
$Roil \rightarrow r_i$	**0.0152**	**0.0575**	$Roil^+ \rightarrow r_i$	0.1518	**0.0232**	$Roil^- \rightarrow r_i$	**0.0302**	0.3184
Miscellaneous								
$r_i \rightarrow Roil$	**0.0852**	**0.0009**	$r_i \rightarrow Roil^+$	**0.0918**	**0.0083**	$r_i \rightarrow Roil^-$	**0.0196**	0.8824
$Roil \rightarrow r_i$	**0.0314**	0.1358	$Roil^+ \rightarrow r_i$	**0.0177**	**0.0027**	$Roil^- \rightarrow r_i$	0.7903	0.9518
Properties								
$r_i \rightarrow Roil$	0.3171	0.3445	$r_i \rightarrow Roil^+$	**0.0212**	0.1303	$r_i \rightarrow Roil^-$	0.3945	0.9936
$Roil \rightarrow r_i$	0.6258	0.4551	$Roil^+ \rightarrow r_i$	0.8518	0.6892	$Roil^- \rightarrow r_i$	0.6437	0.7443
Trade								
$r_i \rightarrow Roil$	**0.0224**	**0.0006**	$r_i \rightarrow Roil^+$	**0.0106**	**0.0061**	$r_i \rightarrow Roil^-$	**0.0336**	**0.0169**
$Roil \rightarrow r_i$	**0.0035**	**0.0196**	$Roil^+ \rightarrow r_i$	0.132	**0.0792**	$Roil^- \rightarrow r_i$	**0.0008**	**0.0617**
Utilities								
$r_i \rightarrow Roil$	**8E-07**	**5E-09**	$r_i \rightarrow Roil^+$	**0.000002**	**1.0E-06**	$r_i \rightarrow Roil^-$	**4E-07**	**2E-07**
$Roil \rightarrow r_i$	**0.0578**	**0.0932**	$Roil^+ \rightarrow r_i$	0.5239	**0.0879**	$Roil^- \rightarrow r_i$	**0.026**	0.2571

Notes: This table provides the p-values of rejection of the null hypothesis. The results were estimated by the two-week lagged and eight-week lagged returns.S→O is the null hypothesis of no causality from stock market returns to oil price changes. O→S is the null hypothesis of no causality from oil price changes to stock market returns. Bold indicates rejection of the null hypothesis.

on *Properties* sector.

Causality test on non-linear changes in oil prices also have similar results. However, the intensity and significance levels vary depending on the definition of changes in the oil price. The causality test resulted in two statements. First, there is a dynamic relationship between stock returns in Indonesia stock market and world crude oil prices. Second, previous research has revealed that the exogeneity on world oil prices on the economy, including the stock price, which turns our study is similar to Arouri (2011) study that there is an inverse relationship.

To put it altogether, our results show significant short-term relationship between the rate of return sector in Indonesia and changes in world crude oil prices. Plus, there is strong evidence of asymmetric reactions stock returns in several sectors of the oil price shocks, and in all cases the value and sensitivity of stock returns to changes in oil prices vary significantly in almost all sectors.

Discussion of Results for Each Sector

Results for Agriculture sector shows that the reactions of the stocks in this sector are positive and asymmetric in the short term to changes in the price of world crude oil. Asymmetric response to the *Agriculture* in this case shows that when a decline in the price of world crude oil, the impact on stock prices will be greater than the impact given when there is an increase in the world crude oil price. This sector consists of company-based food crops, plantations, animal husbandry, fisheries, and forestry. The increase in the world crude oil price possibly gives the

demand-side effect is greater, in which consumers can further have the ability to make purchase commodities in this sector, which in turn increases the demand and stock prices in the *Agriculture* sector in the short term.

For *Basic Industries*, it shows a positive reaction and symmetrical in the short term to changes in the price of World Crude Oil. The sector consists of companies that the fundamental of their business is related to cement, ceramics, porcelain, glass, metal and the like, chemicals, plastics and packaging, fodder, timber and processing, and pulp & paper. This sector has similar characteristics to the *Mining* sector as in the case of extractive activities (Arouri, 2011). The increase in the world crude oil price may increase the demand for products in this sector and make companies beneficial of the greater effect of demand-side gain.

Results for *Consumer Goods* show positive and asymmetric reactions in the short term to changes in the price of world crude oil. Asymmetric response to the *Consumer Goods* sector in this case shows that an increase in the price of world crude oil, its influence on the stock prices of this sector will be greater than the influence exerted when the price of world crude oil is declining. This sector consists of companies that base their business in the food & beverages, cigarettes, pharmaceuticals, and cosmetics and housewares. Although this sector raw materials are mostly imported, increased demand and the level of consumer confidence in the purchase of goods of daily consumption is likely to be the reason for the positive effect obtained this sector when an increase in the price of world crude oil, in other words the same with the previous explanation that the sector has a greater demand-side effect.

For *Financials* which consists of banks, financial institutions, securities companies, and insurance, the rate of return on stocks incorporated in this sector shows the relationship to be positive and symmetrical in short term to changes in oil prices. It is believed to be the impact of demand-side effect where the increase in oil prices affects the level of trust and demand of *Financials* sector shares (Arouri, 2011).

Mining stocks shows a positive and symmetrical relationship. This is normal because the fact that oil company's shares belong to this sector. When oil prices rise, profits margins would also be increased so that the value of shares also increased. Companies that are in this sector include coal companies, oil & gas, metals and other minerals, and rocks.

Miscellaneous sector, which consists machinery and heavy equipment, automotive and component, textile and garment, footwear, cables, and electronics, shows positive correlation and symmetrical with respect to changes in oil prices. This is surprising because the rising oil prices lead to higher cost of logistics. This is made possible because of the risk management that is applied by automotive companies, which are familiar with the risk, were able to avoid losses due to rising oil prices.

In the *Properties* sector, with sub-sector consists of properties and the real estate, and construction, shows that stock returns in this sector are positive and symmetrical in the short term to changes in the price of world crude oil. It appears that when the price of oil rises, the price of stocks in the sector will also increase. This result is similar to the description by Barsky and Killian (2004) and Killian (2009) that the increase in world crude oil prices will boost consumer confidence and lead to increased demand. Barsky and Killian (2004) and Killian (2009) did research in Europe for customer service stocks in Europe.

For *Utilities*, with the sub-sectors of energy, highways, ports, airports and the like, telecommunications, transportation, and construction of non-building, has a positive relationship and symmetrical on short-term price changes of world crude oil. In line with the research of Arouri (2011) that indeed, for oil and gas companies that their values are driven by oil prices. Lower oil prices mean capital spending is reduced and lower profit margins, while higher oil prices mean higher profit margins and capital spending possibly, increased. Therefore, the rise in oil prices increases the value of the company's stock price of oil and gas, which explains the positive response of *Utilities* stock returns on oil price changes. And in sub-sectors such as transport and non-building construction

in the operations closely related to the world crude oil, it is estimated that companies in this sub-sector has already anticipated world crude oil price increases, because of their operational areas are closely related to the use of oil.

Lastly, *Trade* sector, with the sub-sector consists of restaurants, hotels, and tourism, health, trade retail, great trade for production, advertising, printing, and media, investment companies, and computer services and devices, shows that stock returns in this sector are positive and symmetrical in the short term to changes in the world price of world crude oil. Companies in this sector does not have a great exposure to changes in oil prices unless the sub-sector great trade for production, which makes the increase in oil prices is a factor that triggers the confidence of investors as in research Barsky and Killian (2004) and Killian (2009).

Conclusions

Crude oil as the important commodity has significant role, and the fluctuation on its price may affect the economy of a country through its stock market. In this article, we investigate the short-term responses of Indonesian sector stock indices to crude oil price changes, in the aggregate as well as sector by sector. Besides, we also try to figure out whether there are asymmetric responses within. Our results show that the strength of this association varies across sectors, and the effects are positive for all sectors. However, the sensitivity to response the world crude oil price changes also vary for each sector. We also find strong evidence of significant asymmetry reactions for Agriculture and Consumer Goods sector stock returns due to changes in crude oil price for Agriculture and Consumer Goods sector.

Our findings have interesting implication, especially through its country specific result on the responses of individual stock sectors to crude oil price changes. Our findings provide recommendation for market participants who interest to invest on stock in Indonesia stock market, and can be a recommendation in rebalancing their portfolio with their views of coming changes in oil price. These findings show that diversification can be achieved with the respect of sector indices sensitivity and oil price changes itself, because all sectors respond positively to crude oil price changes. We also hope that it may become a contribution for regulators and other researcher as well.

There are several possible extensions of this article. First, investigation in the longer period can be conducted to have a better result. Second, effect of exchange rates and the effect of other world factors can be taken as the considerations in investigating the links between oil price changes and sector indices price. Lastly, the method we use in this article can be applied to investigate other energy commodities to investigate the links, sensitivity, and possibility of asymmetric reaction between those commodities price and stock price.

References

Adam, P., Rianse, U., Cahyono, E., & Rahim, M. (2015). Modeling of the Dynamics Relationship between World Crude Oil Prices and the Stock Market in Indonesia. *International Journal of Energy Economics and Policy, 5* (2), 550-557.

Arouri, M. E. (2011). Does Crude Oil Move Stock Markets in Europe? A Sector Investigation. *Economic Modelling*, 1716-1725.

Barsky, R., & Killian, L. (2004). Oil and the Macroeconomy Since the 1970s. *Journal of Economic Perspectives*, *18*, 115–134.

Boyer, M. M., & Filion, D. (2007). Common and Fundamental Factors in Stock Returns of Canadian Oil and Gas Companies. *Energy Economics*, *29* (3), 428–453.

Cong, R. G., Wei, Y. M., Jiao, J. L., & Fan, Y. (2008). Relationships Between Oil Price Shocks and Stock Market: An Empirical Analysis from China. *Energy Policy*, *36*, 3544-3553.

Cuepers, L., & Smeets, D. (2015). How Do Oil Changes Affect German Stock Returns? *International Journal of Energy Economics*

and Policy, 321-334.

Filis, G., Degiannakis, S., & Floros, C. (2011). Dynamic Correlation between Stock Market and Oil Prices: The Case of Oil-Importing and Oil-Exporting Countries. *International Review of Financials Analysis*, *20*, 152-164.

Gisser, M., & Goodwin, T. H. (1986). Crude Oil and the Macroeconomy: Tests of Some Popular Notions. *Journal of Money, Credit and Banking*, *18* (1), 95-103.

Hamilton, J. D. (1983). Oil and the Macroeconomy since World War II. *Journal of Political Economy*, *91*, 228–248.

Hamilton, J. D. (2003). What is an Oil Shock? *Journal of Econometrics*, *113*, 363–398.

Hersugondo, R., Wahyudi, S., & Muharam, H.. (2015). The World Oil Price Movement and Stock Returns in Several Southeast Asia's Capital Market. *International Journal of Applied Business and Economic Research*, 527-534.

Huang, R.D., Masulis, R.W., & Stoll, H.R. (1996). Energy Shocks and Financials Markets. *Journal of Futures Markets,16*, 1–27.

Iscan, E. (2010). Petrol Fiyatının Hisse Senedi Piyasası Üzerindeki Etkisi. *Maliye Dergisi*, *158*, 607-617.

Jones, C.M., & Kaul, G. (1996). Oil and the Stock Markets. *Journal of Finance*, *51* (2), 463–491.

Jones, D.W., Lelby, P.N., & Paik, I.K. (2004). Oil Prices Shocks and the Macroeconomy: What Has Been Learned Since. *The Energy Journal*, *25*, 1–32.

Kapusuzoglu, A. (2011). Relationships between Oil Price and Stock Market: An Empirical Analysis from Istanbul Stock Exchange (ISE). *International Journal of Economics and Finance*, 99-106.

Killian, L. (2009). Not All Oil Price Shocks are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market. *American Economic Review*, *99* (3), 1053–1069.

Mork, K. (1989). Oil and the Macroeconomy When Prices Go Up and Down: An Extension Of Hamilton's Results. *Journal of Political Economy*, *91*, 740–744.

Nandha, M., & Faff, R. (2008). Does Oil Move Equity Prices? A Global View. *Energy Economics*, *30*, 986–997.

Park, J., & Ratti, R.A. (2008). Oil Price Shocks and Stock Markets in the US and 13 European Countries. *Energy Economics*, *30*, 2587–2608.

Sadorsky, P. (1999). Oil Price Shocks and Stock Market Activity. *Energy Economics*, *2*, 449–469.

Sadorsky, P. (2001). Risk Factors in Stock Returns of Canadian Oil and Gas Companies. *Energy Economics*, *23*, 17–28.

Toharso. (2010). Kebijakan Impor Crude Oil. Perpustakaan Online Bappenas. Retrieved from http://www.perpustakaan.bappenas.go.id/.

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*, 1220-1238.

Zhang, D. (2008). Oil Shock and Economic Growth in Japan: A Non linear Approach. *Energy Economics*, *30* (5), 2374–239.