DO OIL PRICES STILL MATTER?
THE CASE OF VIETNAMESE STOCK MARKET

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Abstract: *Using Vietnamese stock market index and West Texas Intermediate crude oil prices from January 2007 to April 2015, we investigate whether the Vietnamese stock market index still has long-run and short-run causal relationship with the crude oil prices. The results suggest that there is no long-run relationship between the movement of Vietnamese stock market index and the movement of crude oil prices. However, the movement of crude oil prices still has a short-term impact on the movement of Vietnamese stock market index.*

Keywords: Granger causality, oil prices, Vietnamese stock market index

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1. Introduction

Oil and gas industry benefits the economy and human life in many ways. Its products underpin modern life, supply energy to power industry and heat homes, fuel for transport vehicles and raw materials to produce many essential items for daily life. Along with the related industries, oil and gas industry uses hundreds of thousands of employees and makes a major contribution to the economy in terms of geophysical technology, tax revenues, and exporting activities. With an increasing demand of energy around the world, the importance of oil and gas industry becomes more significant and oil prices change should definitely have an impact on the economy. Previous literature proves that there is a connection between oil price shocks and stock market returns. The conventional wisdom shows that, on one hand, the high crude oil prices have a positive effect to the economic growth for oil exporting countries but, on another hand, reduce potential growth for oil importing countries. The high oil prices could increase the cost of production for non-oil producing companies; therefore, it could lead to a negative impact on the stock market returns.

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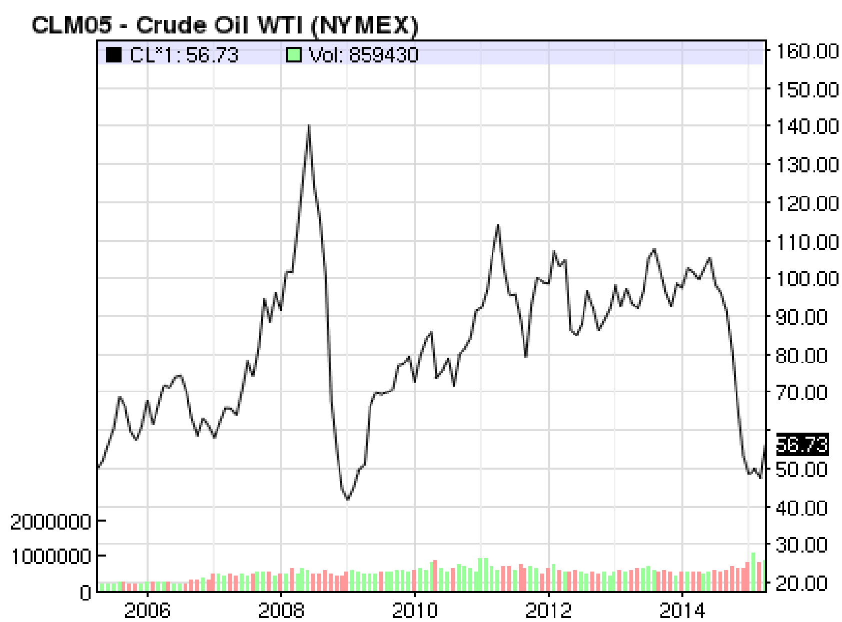
Moreover, the stock market returns also soften the global aggregate demand, which hurts demand for oil.

Within the last twenty-five years, the price of crude oil has been fluctuating significantly. From 1991 to September 2003, the price was stable under $45 for a barrel. During the year of 2003, it began to rise above $45 and reached $60 for a barrel by August 2005. In June 2008, the price hit a peak at $143.70 before dropping considerably to $43.35 in February 2009. Yet, there was a sharp increase when the price reached a high point of $114.88 for a barrel in April 2011. After that, it fluctuated slightly around $100 until mid-2014. From mid-2014 to February 2015, the crude oil price has fallen promptly to under $50 for a barrel. The period from 2007 to 2014, which includes much volatility in oil prices, is a great opportunity to re-examine the causality relationship between stock prices and stock returns.

Figure 1-1: Crude Oil WTI variation



It is the fact that the petroleum industry of Vietnam has a very important role, particularly, in the period of accelerated industrialization and modernization. Not simply income, oil sector has greatly contributed to Vietnam budget such as it balanced importing and exporting activities of international trade, enhanced sustainable development of Vietnam in national innovation's resolution. According to PetroVietnam's annual report in 2013, PetroVietnam's revenue accounted for approximately 20 percent of Vietnam's GDP on average. The decrease of world crude oil prices means Vietnam might reconsider the policy of crude oil's exports, face shortness of State budget revenues as well as a lot of direct and indirect effects on economy and society. According to the Ministry of Planning and Investment of Vietnam, if the price of crude oil falls $1 for a barrel of oil, Vietnam will lose 1,000 billion VND due to the loss of revenue from the sale of crude oil. The Ministry of Planning and Investment of Vietnam also predicts that the decrease of oil prices will have a negative impact on economic growth of Vietnam.

However, Vietnam is a net exporter of crude oil but a net importer of oil products. Therefore, the falling of oil prices might have a different implication. This study aims to examine the causal relationship between crude oil price changes and stock market returns in Vietnam during a period with great volatility in oil prices. We find that that there is no long-run equilibrium relationship between the movement of Vietnamese stock market index and the movement of crude oil prices. However, the movement of crude oil prices Granger causes the movement of Vietnamese stock market index.

2. Literature review

Over the last two decades, there are many studies examine the connection between crude oil price and the macroeconomic variables. According to Sadorsky (2008), there has been much more research that studies the relationship between oil price changes and economics activity than the number of studies conducted on oil price and stock returns relationship. This issue could be explained by the short period of crude oil price volatility, according to Kilian (2007), the short period of oil volatility could lead to the difficulties for the purpose of finding the relationship between crude oil prices and stock returns. However, analyzing the relationship between crude oil price and stock return has been a recent important domain of research in energy sector.

Over the years, there have been many researches on the relationship between crude oil prices and the stock market returns. On one hand, there are some studies showing the existence of the unidirectional causal relationship from crude oil prices to stock market returns. On the other hand, there are other studies which presented that the relationship between crude oil prices and stock market returns is bidirectional.

Huang and Masulis (1996) apply an unrestricted vector auto-regressive model to evaluate the relationship between stock market return for the United State and daily oil futures return. They found that there was a strong relationship between oil price changes and some oil company stock returns in United State. Nonetheless, they could not find evidence of causal relationship from daily oil futures return and American market indices such as the S&P500. Jones and Kaul (1996) study a larger scope in comparison with Huang and Masulis (1996). They tested the reaction of international stock markets including Japanese, Canadian, United Kingdom and United State stock markets to oil price shocks. Their paper demonstrated that, in the Canada and United State, this reaction of stock market can be accounted totally on the influence of oil price shocks on cash-flows. In the case of Japan and United Kingdom, the results were not concluded.

Park and Ratti (2008) investigate the linkage between oil price shocks and the stock market for 13 Europeans countries and the United State over the period January 1986 to December 2005. By using multivariate VAR analysis, they realized that oil price shocks affected negatively on stock markets in almost European countries and United State but the rise of oil prices has a positive impact on Norwegian stock market. In addition, Aloui and Jammazi (2009) examine the relationship between crude oil price changes and the stock markets returns in France, United Kingdom and Japan. Sample used included the crude oil prices in two oil markets Brent and WTI and the stock markets from December 1987 to January 2007. They find that the rise of net oil price had a great effect on the real returns of the stock markets.

Some researchers showed that higher oil price affects positively to stock market returns for oil-exporting countries. For example, Jordan and Amman (2009) find that the rise in oil price could have a positive impact on oil-exporting countries stock markets through higher income and wealth due to an increase of government revenues and public expenditure. In their research, they examine the relationship between oil prices and stock market returns in three markets – Turkey, Tunisia and Jordan. The conclusion was that there is a long-run equilibrium relationship between crude oil prices and stock market Indexes in Turkey and Tunisia. More particularly, in these countries, the stock markets were affected negatively by crude oil price changes.

Besides, there are some studies investigating the relationship between crude oil price changes and stock market returns in the Gulf cooperation Council (GCC) countries. "Since GCC countries are major world energy market players, their stock markets are likely to be susceptible to oil price shocks." (Mohamed and Julien, 2011). Mohamed and Julien (2011) test for long term linkages between oil prices and stock markets in Gulf cooperation Council countries. They use both asymmetric and linear cointegration into consideration to examine the long-run equilibrium between the crude oil prices and GCC stock markets over the period January 1996 to December 2007. Their empirical results indicate that "oil price shocks indeed affected the stock index returns in an asymmetric fashion".

Moreover, some researchers studied the linkages between oil price changes and stock market returns in major Asian, Latin American and European emerging countries. Based on the data from 1998 to 2004 in 22 emerging stock markets, Maghyereh (2004) examined the linkage between oil prices changes and stock return by employing VAR model. Yet, the result was not as expected. The author does not find any significant connection between oil prices and stock returns in these countries. The unit root test shows that none of variables was stationary (22 stock indices and oil price) while its first differences are stationary which are consistent with the result have been found in most of previous research.

Vietnamese stock market has an impressive growth but it is being confronted with many typical weaknesses of an emerging market. Vo (2014) investigates factors affecting Vietnamese stock price in the daily report from 2005 to 2012. He found that crude oil price was one of the major factors influencing Vietnamese stock market at that period of time. Narayan and Narayan (2010) also show that Vietnamese stock price and crude oil prices are co-integrated. It could be obviously seen that oil price impacted on stock market in positive way. They demonstrate their hypotheses by using empirical analysis with daily data for the period 2000 to 2008. Moreover, the authors have employed nominal exchange rate which was considered as an additional determinant of stock returns. Through Cointegration tests, they find that three variables: crude oil prices, nominal exchange rate and stock prices, are co-integrated, that means the existence of the long-run relationship between these variables. Employing long-run elasticity, the authors show that both nominal exchange rate and oil prices impact dramatically and positively on Vietnamese stock prices. Nevertheless, the short-run elasticity does not provide any effect from oil prices and exchange rates to Vietnamese stock prices.

3. Data and methodology

3.1. Data

In this paper, we use the Vietnamese Stock Index (VN-Index) and the crude oil prices from West Texas Intermediate traded on New York Merchantile Exchange to investigate the relationship between the stock returns and oil prices. The data are collected daily over the period of 7 years, from January 2007 to April 2015. The VN-Index is collected from HOSE's official reports whereas the crude oil prices are collected from public website of U.S Energy Information Administration. Because the Vietnamese stock market and New York Merchantile Exchange have different closing days; it is necessary to filter the data. The data collected for VN-Index and the crude oil WTI prices will be arranged to two time series called VN-Index and WTI.P. After applying the filter, there are 1998 observations.

3.2. Methodology

The study employs Granger causality test to examine the causality relationship between these two time series data. In reality, Granger causality test is only appropriate when these two time series are stationary. According to Gujarati (2003), the regression of two or more non-stationary time series could lead to the Spurious Regression Problem. Therefore, before using Granger causality test to examine the causal relation between VN-Index and WTI-P, the unit root test must be applied to these time series to test the stationary.

3.2.1. Unit Root Tests

Among a variety of methods to test the stationary of time series, we use Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to examine the stationary of VN-Index and WTI-P time series

3.2.2. Cointegration Test

There are many methods to examine the cointegration between two variables; two of the most popular methods to test this relation are Engle & Granger (1987) and Johansen (1988).

3.2.3. Granger Causality Test

According to Granger (1969), there are two stationary variables Y_t and X_t, Y_t is Granger-cause X_t, if using past values of Y_t for X_t prediction is more precise than not using past value of Y_t. Thus, if two stationary variables Y_t and X_t impact each other with distributed lags, the linkage between Y_t and X_t could be recorded by VAR model. In this study, the variable Y_t denotes the time series VN-Index and the variable X_t denotes time series WTI-P, whereas the empirical results describe a simple Granger causality test which examine whether VN-Index cause WTI-P or vice versa.

4. Results

4.1 Descriptive Statistics

Table 4.1 shows descriptive statistics for time series data VN-Index and WTI.P. The observations for both VN-Index and WTI.P are 1998 observations. The mean values are respectively 492.1 and 88.59 for VN-Index and WTI.P, respectively. The minimum and maximum of both VN-Index and WTI.P proved that the data set of variables sharply varied during the period January 2007 to April 2015. As can be seen from the table 1, the VN-Index varied from a minimum of 235.5 to 1170.7 while the WTI.P varied from 30.28 to 88.59 during the period under consideration. The standard deviation indicated that the VN-Index strongly exhibited variability from the mean (195.4%), which is much higher in comparison with the variability of the WTI crude oil prices.

Table 4.1:

Descriptive Statistics

	VN-Index	WTI.P
Mean	543.0523	85.49793
Median	492.1	88.59
Maximum	1170.7	145.31

Minimum	235.5	30.28
Std. Dev.	195.4229	19.68161
Observations	1998	1998

4.2. Unit Root Test

*** Augmented Dickey-Fuller Tests**

Table 4.2 shows that both VN-Index and WTI.P are non-stationary at the level since the p-values are o.35 and 0.29, respectively. Additionally, the results hold when applying both ADF tests with Constant and ADF test with Constant and Trend for robustness.

Table 4.1: **Augmented Dickey-Fuller test at the level**				
ADF tests with Constant				
Variables	T-statistic	Test critical value	P-value	Lag length
VN-Index	-1.855213	-2.567481	0.3539	4 **
WTI.P	-1.993304	-2.567479	0.2900	0 **
ADF test with Constant and Trend				
Variables	T-statistic	Test critical value	P-value	
VN-Index	-1.63617	-3.127945	0.7783	4 **
WTI.P	-1.772775	-3.127942	0.7178	0 **
** indicate the lag length determined automatic by EVIEWS based on Schwarz Info Criterion				

However, if the variables are non-stationary, it is necessary to look at their first order in order to determine whether the regression models are still reliable. Table 4.3 reports the results of ADF tests for first order differences of VN-Index and WTI.P respectively. The results indicate that VN-Index and WTI.P are integrated at the first order I(1).

Table 4.2: **Augmented Dickey-Fuller test for first order of differences**				
ADF tests with Constant				
Variables	T-statistic	Test critical value	P-value	Lag length
VN-Index	-19.35728	-3.433432 *	0.0000	3 **
WTI.P	-47.366	-3.433427 *	0.0001	0 **

ADF test with Constant and Trend				
Varialbes	T-statistic	Test critical value	P-value	
VN-Index	-35.60717	-3.127943 *	0.0000	3 **
WTI.P	-47.39386	-3.127943 *	0.0000	0 **
* indicate the critical value at the 1% significance level. ** indicate the lag length determined automatic by EVIEWS based on Schwarz Info Criterion				

*** Phillips-Perron test**

Table 4.4. and 4.5 report results of the Phillips-Perron tests. The results in these tables support the results from ADF tests which indicate that VN-Index and WTI.P are non-stationary at the level but they are integrated at the first order I(1).

Table 4.4: **Phillips-Perron Unit root test at the level**				
PP tests with Constant				
Variables	T-statistic	Test critical value	P-value	Bandwidth
VN-Index	-1.686346	-2.567479	0.4381	17 **
WTI.P	-1.894791	-2.567479	0.3350	3 **
PP test with Constant and Trend				
Varialbes	T-statistic	Test critical value	P-value	
VN-Index	-1.585945	-3.127942	0.7985	17 **
WTI.P	-1.682976	-3.127942	0.7587	4 **
**indicate Bandwidth (Newey-West automatic) using Bartlett kernel				

Table 4.5: **Phillips-Perron Unit root test for the first order differences**				
PP tests with Constant				
Variables	T-statistic	Test critical value	P-value	Bandwidth
VN-Index	-35.65987	-3.433427*	0.0000	12**
WTI.P	-47.34581	-3.433427*	0.0001	4**
PP test with Constant and Trend				
Varialbes	T-statistic	Test critical value	P-value	
VN-Index	-35.60717	-3962646*	0.0000	11**

WTI.P	-47.38280	-3962646*	0.0000	5**
* indicate the critical value at the 1% significance level. **indicate Bandwidth (Newey-West automatic) using Bartlett kernel				

4.3. Cointegration Test

*** Engle and Granger Test**

Both WTI.P and VN-Index are non-stationary and integrated the same order I(1). In order to make WTI.P and VN-Index cointegrated, theoretically, the residuals must be stationary. The results of ADF test for the residuals of equations are reported in table 4.6.

Table 4.3: **Augmented Dickey-Fuller test of the residuals**				
ADF tests with Constant				
Variables	T-statistic	Test critical value	P-value	Lag length
Residuals	-1.983668	-2.567 479	0.2942	0**
** indicate the lag length determined automatic by EVIEWS based on Schwarz Info Criterion				

The results in table 4.6 indicate that it could be impossible to reject the null hypothesis that the residuals have a unit root. When the residuals are non-stationary, it leads to the non-existence cointegration between WTI.P and VN-Index. In other words, there are no long-run relationship between VN-Index and WTI.P during the period of time under consideration.

*** Johansen Test**

As demonstrated that VN-Index and WTI.P are integrated in the first order, hence, the Johansen cointegration test could be applied for VN-Index and WTI.P. The results of Johansen test are reported in table 4.7.

Table 4.4: **Johansen cointegration test for VN-Index and WTI.P**				
Unrestricted Cointegration rank test (Trace)				
Hypothesis number of cointegration	Eigenvalue	Trace Statistic	5% Critical value	P-value *
None	0.004774	9.421676	15.49471	0.3278

At most 1	2.64E-05	0.051674	3.841466	0.8202
Unrestricted Cointegration rank test (Maximum Eigenvalue)				
Hypothesis number of cointegration	Eigenvalue	Max-Eigen Statistic	5% Critical value	P-value *
None	0.004774	9.370003	14.26460	0.2566
At most 1	2.64E-05	0.051674	3.841466	0.8202
Note: * denotesMacKinnon-Haug-Michelis p-values				

The Trace test and Maximum Eigenvalue show that there is no co-integration between VN-Index and WTI.P and the Maximum. Thus, the Johansen co-integration test supports the results from Engle and Granger.

4.4. Granger Causality Test

* Pairwise Granger Causality Test

The pairwise Granger causality test employed to check the causal relationship between two variables VN-Index and WTI.P. This method employed the following VAR model:

$WTI.P_t = a_0 + a_1 WTI.P_{t-1} + \ldots + a_p WTI.P_{t-p} + b_1 VN\text{-}Index_{t-1} + \ldots + b_p VN\text{-}Index_{t-p} + \varepsilon_t$

$VN\text{-}Index_t = c_0 + c_1 VN\text{-}Index_{t-1} + \ldots + c_p VN\text{-}Index_{t-p} + d_1 WTI.P_{t-1} + \ldots + d_p WTI.P_{t-p} + \eta_t$

For the first equation, the null hypothesis is H_0: WTI.P does not Granger cause VN-Index, that is equivalent to $b_1 = b_2 = \ldots = b_p = 0$.

For the second equation, the null hypothesis H_0: VN-Index does not Granger cause WTI.P, that is equivalent to $d_1 = d_2 = \ldots = d_p = 0$.

Table 4.8 shows results from Pairwise Granger Causality test. With the p-value of 0.0002, the null hypothesis "WTI.P does not Granger Cause VN-Index" could be rejected. In other words, the WTI.P Granger causes VN-Index. However, with the p-value of 0.0537, the null hypothesis "VN-Index does not Granger Cause WTI.P" could not be rejected. Thus, VN-Index does not Granger cause WTI.P.

Table 4.5: **Pairwise Granger Causality Test for VN-Index and WTI.P**			
Lags: 2			
Null Hypothesis	Observations	F-Statistic	P-value

WTI.P does not Granger Cause VN-Index	1998	11.1589	0.0002
VN-Index does not Granger Cause WTI.P	1998	0.42522	0.6537

* Toda and Yamamoto Granger causality

Since VN-Index and WTI.P are non-stationary and non-cointegration, the results from the standard Granger causality could be spurious and meaningless (Gujarati (2003)). It means that the results from the Pairwise Granger causality might be unreliable. However, Toda and Yamamoto (1995) introduce a new version of Granger causality which helps to avoid the problem of non-cointegration between VN-Index and WTI.P. Toda and Yamamoto (1995) employed VAR (k + d_{max}) where k: is the lag length and d_{max} is the order of integration between variables. Following Toda and Yamamoto (1995), the VAR (k + d_{max}) is employed as below:

- WTI.P t = a $+\sum_{i=1}^{k} bi$WTI.Pt-i $+ \sum_{i=k+1}^{k+dmax} bi$ WTI.Pt-i $+ \sum_{i=1}^{k} ci$ VN-Indext-i $+ \sum_{i=k+1}^{k+dmax} ci$ VN-Indext-i + µt
- VN-Index t = d $+\sum_{i=1}^{k} ei$ VN-Indext-i $+ \sum_{i=k+1}^{k+dmax} ei$ VN-Indext-i $+ \sum_{i=1}^{k} fi$WTI.Pt-i $+ \sum_{i=k+1}^{k+dmax} ci$WTI.Pt-i + εt

Where a, b, c, d, e, f are parameters of these models, μ_t and ε_t are the residuals of these models. ADF and PP test's results have been shown that the maximum order of integration between VN-Index and WTI.P is d_{max} equal 1. Hence, the VAR model using to examine the causality between VN-Index and WTI.P will add 1 extra lag. The next step of Todo Yamamoto method is determination of the optimal lag length k. Table 4.9 reports the lag values corresponding with the different criteria value.

Table 4.6:

Lag length criteria

Endogenous variables: VN-Index,WTI.P; Exogenous variables: C

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-22023.89	NA	14405070	22.15884	22.16447	22.16091

1	-11369.29	21277.04	319.9620	11.44396	11.46084	11.45016
2	-11306.84	124.5826	301.6903	11.38516	11.41330*	11.39549
3	-11294.76	24.08749	299.2460	11.37702	11.41642	11.39149
4	-11286.39	16.66626	297.9330	11.37262	11.42328	11.39123*
5	-11279.51	13.67908	297.0718	11.36973	11.43164	11.39247
6	-11274.23	10.48038*	296.6911*	11.36845*	11.44162	11.39532
7	-11271.67	5.093746	297.1194	11.36989	11.45432	11.40090
8	-11270.19	2.922199	297.8756	11.37243	11.46812	11.40757
9	-11268.94	2.479764	298.7004	11.37519	11.48214	11.41447
10	-11266.44	4.960843	299.1495	11.37670	11.49490	11.42011

Note: * indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5%level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

As can be seen in table 4.9, the optimal lag length is 6 which was selected by 3 of 5 criteria (LR, FPE and AIC). As a result, the lag length which will be used in Toda Yamamoto Granger causality is $(k + d_{max}) = 7$.

After determining the optimal lag length, the Toda and Yamamoto (1995) method estimated the Granger causality through modified Wald test. Table 4.10 reports the empirical results from modified Wald tests by presenting the Chi-square distribution with 7 degrees of freedom, which associates with the lag length.

Table 4.7:

Toda Yamamoto Granger Causality Results (Wald tests)

Dependent variable: VN-INDEX			
Excluded	Chi-sq	Df	Prob.
WTI_P	28.77592	7	0.0002
All	28.77592	7	0.0002
Dependent variable: WTI.P			
Excluded	Chi-sq	Df	Prob.

VN_INDEX	10.74723	7	0.1500
All	10.74723	7	0.1500

Similar to the results from Pairwise Granger Causality test, WTI.P Granger causes VN-Index and VN-Index does not Granger causes WTI.P. In conclusion, there is a unidirectional Granger causality from WTI.P to VN-Index.

5. Conclusion

Using Vietnamese stock market index and West Texas Intermediate crude oil prices from January 2007 to April 2015, we find that there is no long-run equilibrium relationship between the movement of Vietnamese stock market index and the movement of crude oil prices. Because of the decreasing in oil prices and (perhaps) in petroleum reserve in Vietnam, oil prices do not have a long-run impact on the Vietnamese stock market during this period. Accounted for around 10 percent of the total market capitalization of Vietnam stock market, the size of firms in Oil and Gas industry dominate Vietnamese Index. Moreover, most Oil and Gas listed companies, such as PetroVietnam Drilling and Well Services Joint Stock Company (PVD) and PetroVietnam Gas Joint Stock Corporation (GAS), are among the highest liquid stocks on the market. Thus, the world oil price's fluctuations should, at least, have a short-term impact on the Vietnamese stock market. In fact, there is a short-run relationship between WTI.P and VN-Index. Specifically, WTI.P Granger causes VN-Index.

Since Vietnam is a net exporter of crude oil but a net importer of oil products, there are arguments that oil prices have limited impact on Vietnam stock market. However, according to the results from this paper, Vietnamese government should at least pay attention to the short-term impact of oil price on the stock market in particular and the economy in general. It will be ideal if the Government uses short-term solutions to deal with oil price volatility.

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