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World Oil Fluctuation and Vietnamese Stock Market Index

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Abstract The purpose of this paper is to investigate the effects of world oil price on Vietnamese stock market index. Using an Autoregressive Distributed Lag model (ARDL model) on the monthly data during the period over Jul 2000- Jun 2019, collected from Stock markets and Finance News and Vndirect joint stock company news. Evidence from the study shows that world oil price does not only impact on Vietnamese stock market index in short run but world oil price on Vietnamese stock market index also have a long-run equilibrium relationship. In short run, world oil price shows sometimes a negative, sometimes a positive influence on Vietnamese stock market index. While in long run, the nexus of world oil price on Vietnamese stock market index is steadily positive.

Keywords: *world oil price, Vietnamese stock market index, Autoregressive Distributed Lag Model*

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1. Introduction

Over the recently two decades a plentiful literature, investigating the interrelations between oil and stock markets has appeared. In this context, early dominant studies have identified a negative nexus between oil prices and stock market returns [1]. On the other hand, various studies reveal that the responses of stock markets to oil shocks depend on the net position of the country in the global oil market and the driving forces of the oil price shocks. Therefore, researchers suggest that positive relationship between oil and stock market returns concerned to oil-exporting countries, while negatives ones are referred to oil-importing countries [2]. In addition, the oil market represents a profitable alternative choice for such many investors and financial institutions regarding the low correlation between oil prices and traditional asset classes and the positive co-movement with inflation [3]. Furthermore, recent studies suggest that oil and stock markets are likely to become highly linked due to the financialisation of the oil market, resulting from increased participation and speculation of hedge funds in this market [4].

Recently, a variety of studies has conducted on the correlation between oil and stock returns [5] given that correlations (covariance) have significant implications for portfolio optimization and asset allocation. Universally, in spite of the fact that the increased interest in the oil-stock relationship, the literature has remained relatively silent about the role of oil prices in deriving linkages between stock markets. That means, there is lack of empirical evidence about the role of oil fluctuation in effecting the stock market changes, especially for emerging Asian countries. Thus the main contribution of this study is to fill this gap. In this context, we analyze the role of world oil price in relationship with stock market index in an example of emerging Asian countries - Vietnam. At first, we investigate the correlation between world oil prices and Vietnamese stock market index. Second, we use these oil-stock correlation to examine the world oil price influential role in impacting the Vietnamese stock market index. Then, an accurate understanding of the interrelationship between these markets (oil and stock markets) will be useful for investors and policymakers since oil prices represent an information flow. Therefore, it is often well-known that risky assets seem to be usually correlated in the stressful period, which can magnify the risk of collapse [6]. As a result, in order to help investors in emerging countries to reduce future losses in their portfolios, it is essential to investigate the influence of world oil price shocks on stock market index for these countries.

The structure of the study is as follows. Section 2 discussed the literature review. Section 3 described the data and methodology of this study. The empirical analysis is presented in section 4. Section 5 covers the conclusion.

2. Literature Review

There have not too numerous previous studies examining the nexus of world oil price and stock market index been conducted in developing and developed countries all over

the world, especially in a particular countries such as emerging market economies in Asia, including Vietnam. There exists different empirical results in the previous works consistent with the link between foreign direct investment and tourism development in various situations. Prior literature reviews both a negative and positive nexus between oil prices and the stock market. The explanation of a positive relationship is supported by the argument that rising oil prices are interpreted as a positive signal by investors, especially when the rise in oil prices is associated with a higher demand for oil. Consequently, rising oil prices lead stock prices above their fundamental values and that they subsequently correct.

Using three different stratagems, Willem [7] found that supply-driven oil price increases lowered United State stock returns in many sectors before the shale oil revolution but not after. It was also reported that oil prices were a priced factor in a multi-factor asset pricing model both before and after the shale revolution. While oil prices mattered in both periods, the beneficial influences of oil price increases on the United State stock market had risen and the deteriorative effects had fallen since United State oil production soared after 2010.

Similarly, Paulo et al. [8] conducted on the nexus between oil price and Brazilian stock market. The author had found that crude oil remained an extreme essential product not only because of its regular usefulness, but also because it was indeed an important financial asset, influencing the economy as a whole. Thanks to the paper result, Paulo et al. [8] assessed how WTI oil price shocks were correlated to the Brazilian economy, but also with each of the listed companies in Ibovespa, searching for the interrelations with many economic activities. With the Detrended Cross-Correlation Analysis correlation coefficient, which allowed the authors to investigate the influences for different time scales, it was concluded unsurprisingly that the most affected sectors are those most related with the use of oil. However, another important result was the significant correlation between oil price shocks and the returns of the financial sector, showing this particular sector's exposure to oil, i.e., this was one of the sectors most correlated with oil returns. This was relevant not only for individual investors but also for policymakers, since possible future oil shocks could have a high influence on the Brazilian financial sector.

For a broader ranges of countries in Africa, Grakolet et al. [9] investigated the co-movement between oil prices of Organization of Petroleum Exporting Countries and the six biggest African stock markets. The authors used wavelet coherence to examine the evolution of this nexus both in time and by frequency. Empirical results demonstrated that the co-movement between African stock markets and oil prices is at a relatively low level, with the exception of emerging stock markets such as South Africa and Egypt. For most of the African stock markets, the co-movement occurred over large time scales and both during and after the United State financial crisis. For small scales, African stock markets could represent a means of capital diversification for active investors in the oil market.

With the same ideas, but for Gulf Cooperation Council countries, Abdullah et al. [10] studied the dynamics of the co-movement of Gulf Cooperation Council stock market returns with global oil market uncertainty, using an ARMA-DCC-EGARCH model and time varying Student-*t* copula models. Empirical results showed that oil uncertainty had significant influences on the Gulf Cooperation Council stock returns. The Gulf Cooperation Council stock returns were found to be negatively impacted by oil market uncertainty for almost the entire period under consideration. More amazingly, the authors found that the influence of oil price uncertainty varies across Gulf Cooperation Council member states. The results also demonstrated that the stock markets of Oman and Bahrain were relatively less sensitive to the oil uncertainty factor. Similarly, Gulf Cooperation Council countries were once again to be considered but with a different methodology in Besma et al. [11]. This research investigated the extent of volatility between oil price and sectoral indices in the Gulf Cooperation Council countries by using quantile regression analysis for the return's series during the period between 2006 and 2017. Four considered sectors were found to offer diversification opportunities during a high market at 90th quantile. All the sectors were found to be interdependent of oil price fluctuation; however, the insurance and bank sectors were unrelated to oil price volatility during the 10th, 25th and 75th quantiles. Moreover, quantile regression analysis results for wavelet nonlinear denoising with a soft-thresholding series showed that all the sectors were interdependent of oil price fluctuation but that the aggregate market index, transport and telecommunication sectors are insensitive to oil price fluctuation during the 75th and 90th quantiles. This emphasised the usefulness of denoising the financial returns series when applying quantile regression analysis. Furthermore, the contagion and interdependence between the oil price and stock returns sectors were estimated by frequency domain causality.

Seeking for the answer to an interesting question whether sharp movements in oil prices matter for stock markets, Yensen [12] discovered that sharp changes, including sharp rising or sharp falling of oil prices, might cause stock market fluctuations depending on investors' attitudes elated. The results exploited newly trading performance when a sharp fall or rise in oil prices appears. The author revealed some interesting findings by investigating the constituent stocks of DJ 30, FTSE 100, and SSE 50 as typical samples. Firstly, investors may profit from trading stocks after over 10% rise in oil prices because such an increase may be regarded as a positive signal of a phenomenon of momentum. Secondly, continuous 2.5% and 5% fall in oil prices for two or even three days can be regarded as positive signals for China because the country is considered as the biggest oil importing country. Thirdly, trading these constituents' stocks after over 10% fall in oil prices may cause in a stock price rebound.

As we can see that, world oil price on Vietnamese stock market index have been involved in various studies, but rarely the situation of Vietnam has been considered. Besides, the methodology of using Autoregressive Distributed Lag Model has not been applied in a wide range of research. For a new situation of Vietnam, with a timeliness and novelty, we execute the study on influence of world oil price on Vietnamese stock market index with a technique proposed by Pesaran et al. [13] to fill the gap in empirical study.

3. Data and Methodology

3.1. Data

The study attempts to examine the causal nexus of world oil price on Vietnamese stock market index with an evidence from Vietnam by employing a monthly time series data spanning from Jul 2000 to June 2019 using the Autoregressive Distributed Lag (ARDL) Model. World oil price, indeed crude oil WTI in USD per barrel, was employed from the Stock markets and Finance News (investing.com) while Vietnamese stock market (VNINDEX) was collected from Vndirect joint stock company news (vndirecct.com). World oil price and Vietnamese stock market index will be denoted, respectively, by WOIL and VNINDEX.

3.2. Research Model

Impact of world oil price on Vietnamese stock market index has been investigated in a large amount of empirical studies in the world. Based on theoretical consideration, it is evident that the study is used a model for time series with Granger causality, co-integration test, panel Granger causality approach and autoregressive distributed lag model bounds testing approach, etc. In this study, we will investigate time series thanks to ARDL model. This model was proposed by Pesaran et al. [13].

The mathematical form of the ARDL model used in the article is as follows:

$$D(VNINDEX)_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i D(VNINDEX)_{t-i} + \sum_{i=1}^{n} \beta_i D(WOIL)_{t-i} + u_t, \quad (3.1)$$

where D is the difference operator; α_i, β_i are the regression coefficients, and u_t is the residual which has a simultaneous correlation but no correlation with its lags and all independent variables. So the right side of the regression equation consists of the lags of independent and dependent variables.

The ARDL model estimation process can be summarized through the following steps:

Step 1, the stationarity of the WOIL and VNINDEX are verified.

Step 2, the optimal lag for the ARDL model is selected: This is an important step before estimating the ARDL model.

Step 3, the best ARDL model selected in the above step is estimated.

Step 4, the result of ARDL model estimation is back tested:

+ the test in which show that the model is well specified or not: Using Ramsey RESET test;

+ the test of the stability of ARDL model thanks to the cumulative sum of residuals (CUSUM: Cumulative Sum of Recursive Residuals).

+ the test the residual of ARDL model without autocorrelation thanks to Lagrange Multiplier test (abbreviated as LM test).

If the estimated ARDL model is appropriate, then the ARDL model can be used to describe the impact of world oil price on Vietnamese stock market index in the short term.

Step 5, to see whether there exists a co-integration between world oil price and Vietnamese stock market index or not, we implement the Bound Test.

Details of the ARDL model can be found in Chapter 17 of Gujarati [14].

4. Results of Economic Modeling

4.1. Descriptive Statistics

Table 1. Descriptive Statistics

	WOIL	VNINDEX
Mean	63.17386	502.9158
Median	60.49500	482.7500
Maximum	140.0000	1169.300
Minimum	19.44000	101.5500
Std. Dev.	26.35679	259.1884
Skewness	0.303821	0.664585
Kurtosis	2.211560	2.732697
Jarque-Bera	9.413228	17.46234
Probability	0.009035	0.000161
Sum	14403.64	114664.8
Sum Sq. Dev.	157692.4	15249549
Observations	228	228

Source: Result from the analysis

Table 1 presents data description including 228 observations of each variable over a period from July2000 to June 2019.

4.2. Correlation Analysis

Table 2. Correlation Coefficents between Variables

	WOIL	VNINDEX
WOIL	1	
VNINDEX	0.309667 (0.0000)	1

Source: Result from the analysis

It is evident that there may be a correlation existence between two variables since the correlation coefficient is positive by 0.309667 with a very ideal probability value which is very close to zero. That suggests a medium level positive relationship between world oil price and Vietnamese stock market index at a significance level of 0.05. We exceed to further study to investigate the relationship in detail.

Another test we used in the study is that the analysis needs to check the station of time series. We transform time series which are non-stationary to station ones. It means that after being transformed, times series have expectation, variance and covariance is constant over time. The time series in ARDL model must be stationary.

Station character is an important concept when studying time series. However, in fact, most financial data series are non-stationary. To test the station, we use unit root tests, thanks to a common test Augmented Dicky-Fuller test (ADF test) and Phillips-Perron. We use the unit root test with the order of lag is automatically selected according to Schwarz criterion, with intercept is included in test equation. ADF tests for the initial time series, and their first difference will be performed. Usually, after taking the first difference, we get the stationary time series. The use of the first difference of time series is not only to obtain stationary time series, but also the first difference series provide information about increasing or decreasing trend (depending on the sign of the difference) rather than focusing on providing information about the real value of the time series.

The results in Table 3 shows that both initial TOUR and FDI are non-station at level, but their corresponding first different level series are station at a significance level of 1%. Therefore, we can put both first different level series in to ARDL model for study.

4.3. Discussion of Estimation Models

First of all, Hannan-Quin information criterion value is used to choose the most appropriate model. The traditional way to select the optimal lag is to estimate the ARDL model multiple times with descending lags to 0. Among the estimated ARDL models, we choose the one with smallest Hannan-Quin information criterion value. In this article, the authors try out up to the top 12 lags and selects the recommended model according to Hannan-Quin criterion. The image depicting Hannan-Quin's criterion value for the best twenty models, including the best model. Thanks to this Hannan-Quin information criterion, the best ARDL selected is that ARDL(1,2).

Table 3. ADF Stationarity test results of the time series

Variable	Augmented Dicky-Fuller test		Phillips-Perron		Conclusion
	Statistical value	Corresponding probability	Statistical value	Corresponding probability	
WOIL	- 2.3664	0.1525	- 2.3662	0.1526	Non-stationary
D(WOIL)	- 11.7726	0.0000	- 11.8018	0.0000	Stationary
VNINDEX	- 1.9563	0.3062	- 1.7692	0.3952	Non-stationary
D(VNINDEX)	- 11.6584	0.0000	- 11.6863	0.0000	Stationary

Source: Result from the analysis

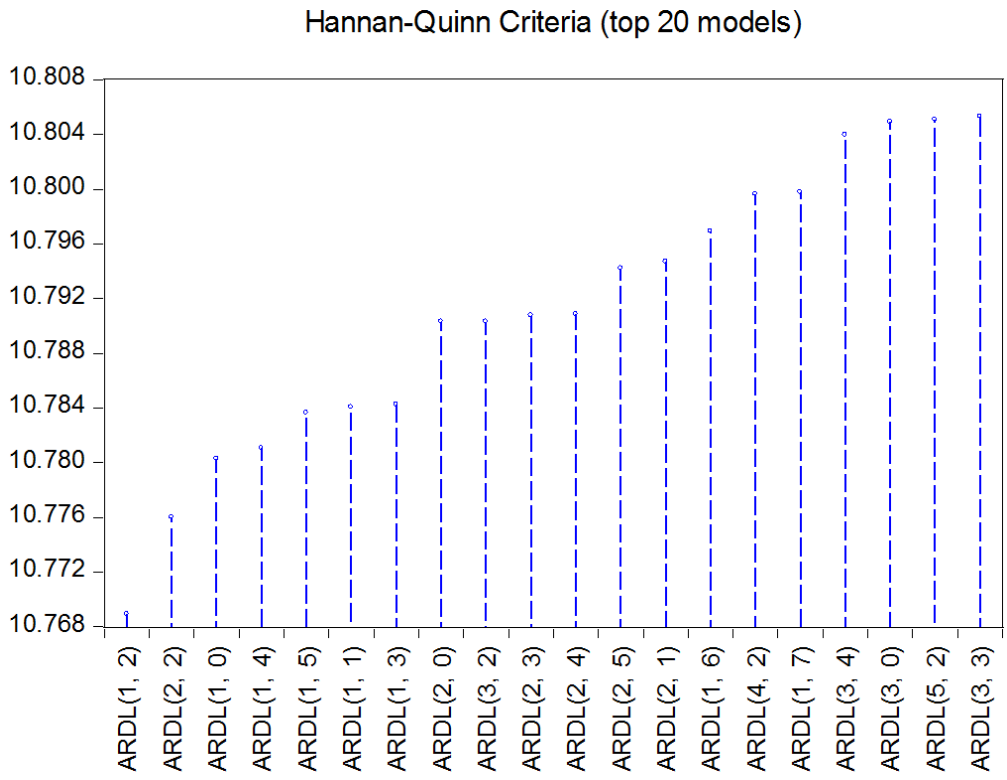

Figure 1. Hann-Quin's Criteria for the twenty Best Models (*Source: Result from the analysis)*

4.4. Results of Econometric Modeling

ARDL(1,2) is estimated as in the following Table 4.

Table 4. Results of ARDL(1,2) model estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(VNINDEX(-1))	0.262508	0.064468	4.071916	0.0001
D(WOIL)	0.894420	0.579194	1.544249	0.1240
D(WOIL(-1))	-1.269669	0.597884	-2.123605	0.0348
D(WOIL(-2))	1.506166	0.585215	2.573698	0.0107
C	2.426653	3.430984	0.707276	0.4801

Source: Result from the analysis

a. Autocorrelation test

Based on the Breusch-Godfrey Serial Correlation LM Test, we have:

- The Null hypothesis H0: no first order autocorrelation
- The Alternative hypothesis Ha: existence of an autocorrelation

At this stage, autocorrelation test used for null hypothesis: "no first order autocorrelation", the Breusch-Godfrey Serial Correlation LM Test is used. According to the results in Table 5, the p-value of the ARDL(1,2) model is far from zero. They are all larger than 0.05 so that null hypothesis is not rejected, which indicated that there is no autocorrelation between variables in the model.

Table 5. LM test for the residual of the ARDL model

F-statistic	1.140479	Prob. F(2,218)	0.3216
Obs* R-squared	2.329822	Prob. Chi-Square(2)	0.3120

Source: Result from the analysis

b. Model specification Test

To test for model specification of ARDL(1,2), the Ramsey Reset test is performed. In the theory, if the test result with p-value over0.05, so the model is well specified at the significant level at 5 percent. In a result, Table 6 indicates that the test results with p-values are all over 0.05, which proved that the model is well specified.

Table 6. Model specification Test

	Value	df	Probability
t-statistic	0.607798	219	0.5440
F-statistic	0.369419	(1, 219)	0.5440

Source: Result from the analysis

c. Stability test

The next back testing is that the stability of ARDL model thanks to the cumulative sum of residuals. If the cumulative sum of the residuals is within the standard range at the 5% significance level, then it can be concluded that the residual of the model is stable and thus the model is stable.

To go further to investigate the long-run relationship among the above considered variables, we use cointegration test thanks to Bound test.

Table 7. Test of long-run relationship between the variables

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	65.79716	1
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	4.04	4.78
5%	4.94	5.73
2.5%	5.77	6.68
1%	6.84	7.84

Source: Result from the analysis

According to Table 7, the test statistic value is larger than every critical Value Bounds at every significance levels. Therefore, there exists a long run relationship between world oil price and Vietnamese stock market index. That long-run from is presented in Table 8.

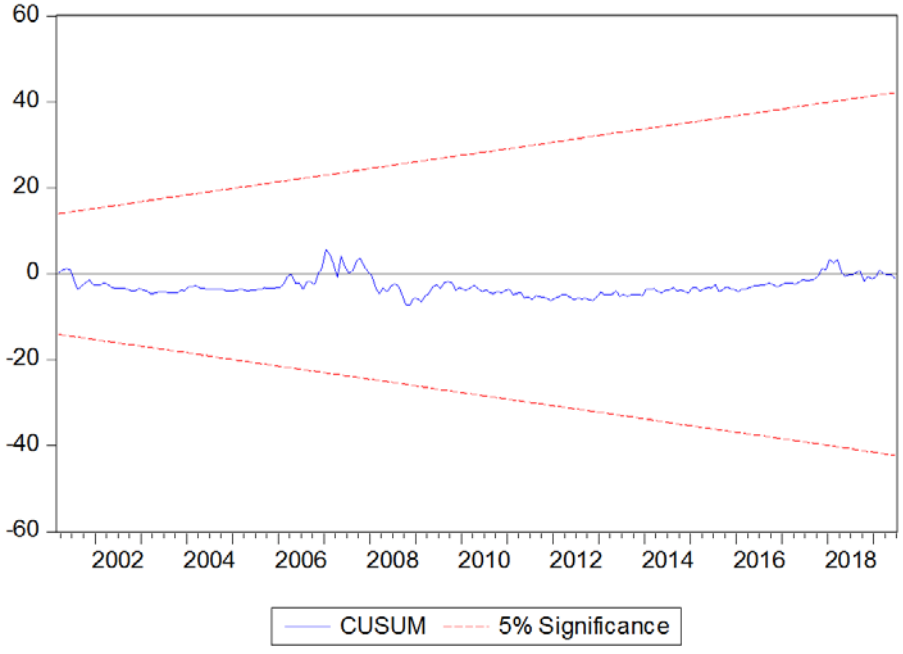

Figure 2. The cumulative sum of recursive residuals of the ARDL model at a 5% significance level (*Source: Result from the analysis)*

Table 8. Long-run relationship between the variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(WOIL, 2)	0.894420	0.579194	1.544249	0.1240
D(WOIL(-1), 2)	-1.506166	0.585215	-2.573698	0.0107
Coint Eq (-1)	-0.737492	0.064468	-11.439676	0.0000
Coint eq = D(VNINDEX) - (1.5335*D(WOIL) + 3.2904)				
Long Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(WOIL)	1.533463	1.127167	1.360459	0.1751
C	3.290412	4.640653	0.709041	0.4790

Source: Result from the analysis

In the co-integration test, the co-integration regression coefficient is negative (- 0.737492) and is statistically significant at 5% (with a probability value which is very close to zero) indicating that co-integration relationship exists between variables. That is, in the long term when the system is in equilibrium, when a shock occurs, the variables in the model tend to move, "pull" the whole system "back" to the equilibrium, which means a reverse movement tendency (the negative sign of the co-integration regression coefficients) compared to those fluctuations. The co-integration equation, or equation that represents the long-run equilibrium relationship among the variables is as follows:

$$DVNINDE\ X_t = 1.5335 * DWOI\ L_t + 3.2904 + u_t \quad (4.1)$$

5. Conclusion

According to Figure 1, the estimation of the ARDL(1,2) is finally selected as the best model to discuss. Regarding the estimation results, our analysis shows the relationship of world oil price and Vietnamese stock market index- in the case of Vietnam, we have the result in short run in the following Table 9:

Table 9. Short-run impacts of world oil price on Vietnamese stock market index at first differential

Variables	Regression coefficients
D(VNINDEX(-1))	0.262508** (0.0001)
D(WOIL)	0.894420 (0.1240)
D(WOIL(-1))	-1.269669* (0.0348)
D(WOIL(-2))	1.506166* (0.0107)
C	2.426653 (0.4801)

Note: the number in ( ) is the probability value of test of estimated coefficients' significance.
*,** indicates significance level of 5%, 1%
Source: Result from the analysis

Thanks to results in Table 9, we can see that an increase Vietnamese stock market index this month cause an increase in itself in the next month. In other words, if Vietnamese stock market index this month decreased by 1, Vietnamese stock market index the following month would decrease by 0.2625. At the same time, the fluctuation of world oil price in a month could not cause any changes in Vietnamese stock market index right in the month, but could cause change in the next month and two months later. In concrete, the increase of world oil price this month may decrease the Vietnamese stock market index in the following month, but increase the Vietnamese stock market index after two months.

Regarding the long-run equilibrium relationship among the variables is as in equation (4.1), in which, a 1 USD per barrel increase in world oil price will rise the Vietnamese stock market index in the long run by 1.5.

In conclusion, this paper investigates the impact of world oil price on Vietnamese stock market index between July 2000 and June 2019. The empirical reveals that in the short run, there is a directional relationship running from world oil price to Vietnamese stock market index, with a slightly lag. Results even show that there is a co-integration between variables in the long run, with a positive impact of world oil price on Vietnamese stock market index.

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