Print ISSN: 2288-4637 / Online ISSN 2288-4645
doi:10.13106/jafeb.2021.vol8.no6.0553

Asymmetric Effects of Oil Price Shock on Stock Markets in Vietnam: An Empirical Investigation Based on SVAR Model and NARDL Model

Tri M. HOANG[1]

Received: March 10, 2021 Revised: May 08, 2021 Accepted: May 15, 2021

Abstract

This research uses a combination of the SVAR model and the non-linear ARDL (NARDL) to investigate the long-term and short-term asymmetric effect of oil price structural shocks on the index of the Ho Chi Minh stock exchange and Hanoi stock exchange. The data selected include the world crude oil output, the imported crude oil price, the real economic activities index, the index of Ho Chi Minh stock exchange (Vn-Index), and the index of Hanoi stock exchange (HNXI). Data frequency is monthly periods from October 2011 to October 2020. The SVAR results show that a demand shock has a major long-run effect on Vietnamese stock markets, while a supply shock has no such impact. The NADRL's finding reveals that only positive and negative aggregate demand shock imposes strong effects on Vietnam stock indices in the long run. In terms of asymmetry features, the Wald coefficient test for NADRL shows that the supply shock and oil market-specific demand shock have asymmetric effects on the index of the Ho Chi Minh stock market in the long run. Major findings suggest that market controllers have to speed up their development of the domestic oil market. Investors have to pay attention to the demand information.

Keywords: Oil Price, Structural Shocks, Vietnamese Stock Markets, Asymmetric Effects, Structural Vector Autoregressive (SVAR), Non-linear ARDL (NARDL)

JEL Classification Code: G12, D53, C32

1. Introduction

Since 1990, crude oil has been an integral part of Vietnam exports that helps Vietnam become a net exporter of energy. However, Vietnam's growing economy along with the increase in population lead the country to become a net importer of energy. Data from the World Bank provides GDP estimates, which progressively improve during 1990–2000, but have significantly increased since 2000. The population estimates also swell up one-fourth of the 1990 value. The analysis projections from PricewaterhouseCoopers (PWC), an advisory agency, provide a positive outlook for the Vietnamese economy as the greatest mover in the GDP ranking (PricewaterhouseCoopers, 2021). Therefore, Vietnam soon became a net oil importer in 2014 with a projected oil dependency of 66% in 2035 (Asia-Pacific Economic Cooperation, 2013). See Figure 1 for details.

With its volatile nature, the crude oil price will undeniably have impacts on the Vietnamese economy and financial markets. The dividend discount model regards crude oil as a manufacturing factor in real economic activities that affect production costs of firms and net profits which is accounted for in the stock prices (Hu, Liu, Pan, Chen, & Xia, 2017). Due to the effects of crude oil on financial markets, risk estimations for the crude oil trades attract attention from academicians (Wei, Liu, Lai, & Hu, 2017). Gong, Wen, Xia, Huang, and Pan (2017) examined the temporal risk-return relationship in the crude oil futures market and found volatility risk, downside risk, or jump risk. Further, as crude oil is a popular commodity for asset allocation, its price risk is seen as an impact factor in the stock market (Chiang, Hughen, & Sagi, 2015; Gorton & Rouwenhorst, 2006). The previous literature focuses on the underlying forces of oil price and its effect on the stock market, but less research is conducted to explore the asymmetric impact of oil price

[1]First Author and Corresponding Author. [1] Ph.D. Student, School of Finance, University of Economics Ho Chi Minh City, Ho Chi Minh City, Vietnam [2] Lecturer, Faculty of Finance and Commerce, Ho Chi Minh City University of Technology (HUTECH), Vietnam [Postal Address: 59C Nguyen Dinh Chieu Street, District 3, Ho Chi Minh City, Vietnam]
Email: trihoang.ncs2019034@st.ueh.edu.vn; hm.tri@hutech.edu.vn

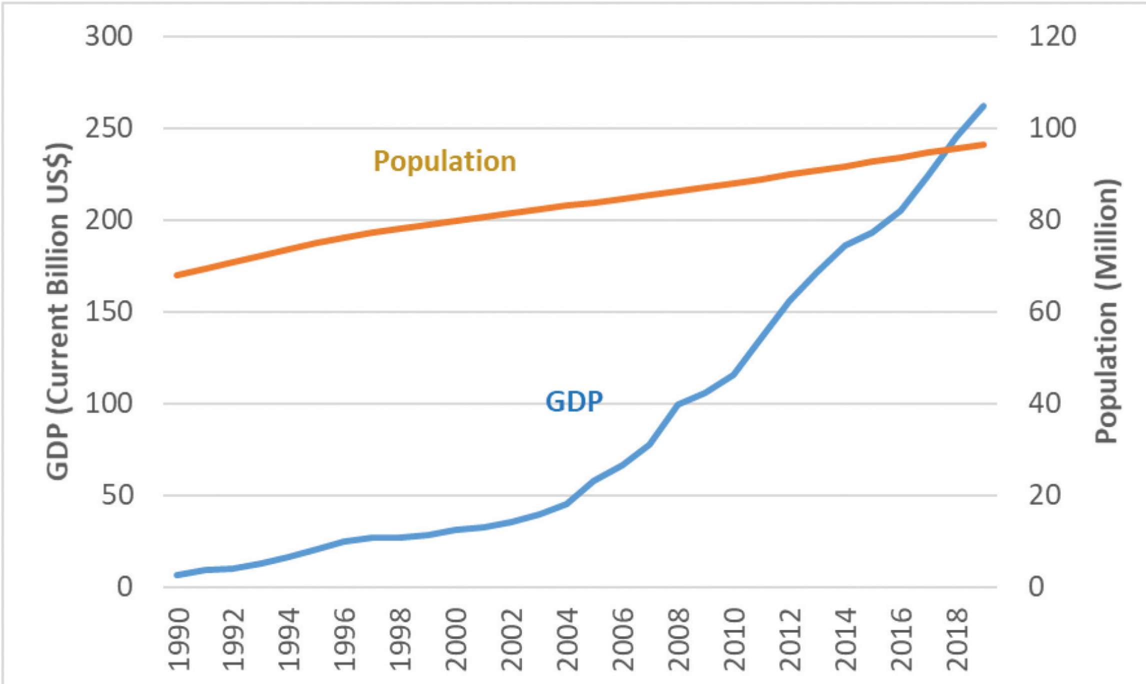

Figure 1: Vietnam's Population and GDP 1990–2019 (The World Bank, 2021)

shocks at different time intervals. Further, distinct shock factors of oil price have different impacts on the stock market. Yet, no research on the asymmetric impact of shock components on the Vietnamese stock markets has been done.

This research applies the SVAR model, proposed by Kilian (2009), and nonlinear ARDL (NARDL), employed by Shin, Yu, and Greenwood-Nimmo (2014), to examine the long-run and short-run asymmetric impact of oil price shocks on the Vietnamese stock market. The SVAR model is employed to separate three demand-and-supply shocks: the construction of oil price shocks, the aggregate demand shocks, and the Vietnamese-specific oil shocks. Also, the NARDL framework is used to study the influence of such shocks on the Vietnamese stock price.

This study discloses the asymmetric impacts of implied oil price shocks on the Vietnamese stock markets, thereby giving new evidence for the resilience of Vietnamese stock markets from the volatilities generated by oil price shocks.

2. Literature Review

2.1. The Association Between Oil Price Fluctuations and Financial Markets

The influence of oil price fluctuations on the economy has been studied (Ozturk & Cavdar, 2021; Smyth & Narayan, 2018). Hamilton (1983) found that oil price fluctuations have a negative relationship with the growth of the US economy, but there is no supporting evidence for the growth of the U.S economy at a low oil price. Numerous studies also support the significant non-linear correlation between the oil price and macro variables (Herrera, Karaki, & Rangaraju, 2019; Kilian, 2008). Further, the stock market is considered a weatherglass of the national economy through the study of interest rate, inflation, and cash flow (Fifield, Power, & Sinclair, 2002). Several studies focused on the oil price fluctuation effects on the stock market (Vu Ngoc & Dat Thanh, 2020). Because crude oil is the blood of economic activities in Vietnam, the variations in oil price have a robust impact on inflation (Nguyen, Cavoli, & Wilson, 2012), interest rate (Abbott & Tarp, 2012), and economic growth and unemployment. Eventually, the oil price change is likely to influence the movements of stock prices (Arouri & Nguyen, 2010). In particular, the cash flow pricing model indicates that the oil price fluctuations have a positive relationship with production costs, thereby reducing the profit margin (You, Guo, Zhu, & Tang, 2017), and decreasing the firm's expected cash flow, which devaluates share prices (Basher, Haug, & Sadorsky, 2018). Further, escalation in oil prices drives up inflation (Taghizadeh-Hesary, Rasoulinezhad, & Yoshino, 2019), which makes market liquidity tighter, thus applying downward pressure on stock price (Haroon & Rizvi, 2020; Su, Khan, Tao, & Nicoleta-Claudia, 2019).

2.2. The Impact of the Oil Price Shock Components on Stock Markets

Even though the impact of crude oil price variations on the stock price has been widely studied, an explicit answer has yet to be arrived at. Previous studies support the negative influence of oil price shocks on the stock market (Kang, Ratti, & Yoon, 2015). Papapetrou (2001) also points out that this negative relationship falls back at four months. In contrast, other research confirms the positive relationship between oil price shocks and stock price (Bodurtha, Cho, & Senbet, 1989; He, Chen, Zhou, Zhang, & Wen, 2020). Zhu, Li, and Yu (2011) verify positive relationships between crude oil prices and Asian stock markets. Besides, the impact of oil price uncertainty on the stock market is based on different economic contexts (Zhang, 2017). Besides, some studies posit an insignificant relationship between the stock market and oil price change (Apergis & Miller, 2009). Ferrer, Shahzad, López, and Jareño (2018) found that crude oil price is not the key determinant of stock prices of renewable energy firms. However, evidence provide indicate that oil prices and oil stock price are an integral part of stock markets in transition economies like Vietnam and China, as blue-chip oil stock price like Petro Vietnam has an imminent effect on the stock market. (Narayan & Narayan, 2010; Rachna & Sudipa, 2021).

2.3. Asymmetric Effects of Oil Price on The Stock Market

Previous studies give strong supports for the asymmetry in the influence of oil price fluctuations on the stock market (Cheema & Scrimgeour, 2019). Therefore, the non-linearity relationships of financial markets should be considered by investors to make reasonable financial decisions. To illustrate, Sadorsky (1999) find oil price change is better than the interest rate in explaining forecast errors of returns, and such changes have asymmetric on the economy and the stock market. Ajmi, El-montasser, Hammoudeh, and Nguyen (2014) report a nonlinear Granger causality between the oil price uncertainty and the stock market movements in the Middle Eastern and North African (MENA) countries. However, few studies consider the coexistence of long-run co-integration and dynamic interactions when they investigate the relationship between oil price shocks and market movements. Such studies are for the Chinese markets in which the relationship between an oil price change and the stock market is proven negative (Hu et al., 2017). Such examinations for markets in which the relationship between an oil price change and the stock market is positive should be accounted for. To resolve this gap in the literature, this research employs Shin et al. (2014)'s nonlinear ARDL, which is applied in studies for China market and studies in other fields.

Most studies take the oil price shock as an exogenous factor of oil price change, and they do not provide fundamental reasons for such price volatility. Kilian (2009) proves that underlying factors cause changes in oil price. The real oil price is therefore deconstructed into three mutual elements: crude oil price shocks, world demand shock for industrial commodities; and world demand shock to the crude oil market. Kilian and Park (2009) work on the impact of structural oil price shock on the US stock market movements. This study proves that oil supply shocks have no relation with market movements in which the market-specific demand shock has the most visible influence on the stock return. Besides, Kang, Kang, and Yoon (2009) posit that demand shocks of oil price have a negative influence on the covariance of the return and equity. Sim and Zhou (2015) also confirm quantiles of oil price shocks positively affect US equities at high quantiles of US returns and the asymmetric relationship between oil prices and stock prices.

2.4. Hypothesis Development

The non-linear impact of crude oil price on the market movements is widely studied, but little research is conducted to investigate the asymmetric impact of time-varying shocks of oil price. Because each shock element has a different effect on the stock market, this research fulfills the above-mentioned gap in the literature by first exploring the shock components of oil price and hypothesizing that:

H1: *Components of structural oil price shocks have asymmetric effects on the stock market.*

3. Research Method

This study aims to examine the asymmetric effects of oil price shocks on the Vietnamese stock markets in two phases. It first employs Kilian (2009)'s SVAR model to separate three supply and demand shocks. In the second step, The NADRL framework is used to investigate the effects of such shocks on Vietnamese stock markets.

3.1. Structural Vector Autoregressive (SVAR) Model

Kilian (2009) propose an SVAR model to detect the components of oil price shocks: supply shocks, aggregate demand shocks, and market-specific shocks. Demotions for equation (1) are as follows: O_t stands for the change of monthly crude oil output; k_t denotes the global activity index; p_t means the percentage changes in the monthly real price of crude oil. The VAR model is specified as follows:

$$A_o X_t = \alpha + \sum_{i=0}^{n} A_i X_{t-i} + \varepsilon_t \quad (1)$$

Where $X_t = (o_t, k_t, p_t)'$, $e_t = (e_{ot}, e_{kt}, e_{pt})'$. The residual e_t is not correlated with variables at different lag lengths. In the equation, $e_t = A_o^{-1}\varepsilon_t$, A_o is multiplied at both sides. The recursively-structural VAR model is derived by using the Cholesky decomposition. The model is stated as below:

$$e_t = \begin{pmatrix} e_{ot} \\ e_{kt} \\ e_{pt} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_{ot} \\ \varepsilon_{kt} \\ \varepsilon_{pt} \end{pmatrix} \tag{2}$$

As defined by Kilian (2009), ε_{ot} is named the supply shock, ε_{kt} is the aggregate demand shock, and ε_{pt} stands for market-specific demand shock. The stated assumption in equation (2) makes several claims. First, crude oil output does not react to the aggregate demand shock and market specific-shock in the same period. The economic effects that are assumed for crude oil output adjustments in the short term generate excessive costs. To illustrate, crude oil producers are not willing to raise (reduce) their oil output to react to the rise (reduction) in the short-term demand. Because the changes in the demand create volatilities, and the incurred profits from the output adjustment do not cover the input expenses. This presumption indicates that the residual error $e_{ot} = \varepsilon_{ot}$ in the reduced form of the equation. Secondly, the restriction imposed on the aggregate demand relies on the assumption of slow changes in global real economic activities. Normally, economic activities do not enlarge or shrink greatly in the short term, and variations in prices of commodities are not accounted for directly in economic activities at the same time. Finally, the equilibrium of supply and demand establishes the commodity values. The crude oil price fluctuates accordingly to the shocks of oil supply and demand.

3.2. Nonlinear ARDL (NARDL) Model

The dynamic correction model is widely used to examine the association among the first-order integrated variables. The error correction model (ECM) is hypothetically helpful to determine the short-term and long-term mutual impacts of time series. The model is built on the belief that the last period's departure from a long-term equilibrium affects the short-term dynamics. The ECMs calculate the rate at which a dependent variable comes back to equilibrium after modifications in other variables. The ECM model is stated that:

$$\begin{aligned} \Delta y_t &= u + \rho_y y_{t-1} + \rho_x x_{t-1} \\ &\quad + \sum_{i=0}^{\rho-1} \alpha_i \Delta y_{t-i} + \sum_{i=1}^{q-1} \beta_i \Delta x_{t-i} + \varepsilon_t \end{aligned} \tag{3}$$

Where x is the independent variable and y is the dependent variable. Granger and Yoon (2002) suggest that hidden co-integration exists between dependent and independent variables. Therefore, the examination of the non-linear relationship between variables requires the independent variables for asymmetric effects in the long-term and short-term to be deconstructed into positive and negative variables (Choudhry, Ul Hassan, & Papadimitriou, 2014). On top of previous studies, Shin et al. (2014) introduce the NARDL model to investigate the long-term and short-term asymmetric impacts among variables. Because shocks come from the increasing contribution of the positive and negative shocks deconstructed from series, they have to follow the first-order integration process. The formula is stated that:

$$\begin{aligned} x_t^+ &= \sum\nolimits_{j=1}^{t} \Delta x_j^+ = \sum\nolimits_{j=1}^{t} \max\ (\Delta x_j, 0); \\ x_t^- &= \sum\nolimits_{j=1}^{t} \Delta x_j^- = \sum\nolimits_{j=1}^{t} \max\ (\Delta x_j, 0); \end{aligned} \tag{4}$$

$$\begin{aligned} \Delta \text{price}_{it} &= a_{i0} + \text{price}_{i-1} + a_{i1}^+ oo_{t-1}^+ + a_{i1}^- oo_{t-1}^- \\ &\quad + a_{i2}^- ko_{t-1}^+ + a_{i2}^- ko_{t-1}^- + a_{i3}^- po_{t-1}^+ \\ &\quad + a_{i3}^- ps_{t-1}^- + \sum\nolimits_{z=1}^{n} b_{iz} \text{price}_{i,t-1} \\ &\quad + \sum\nolimits_{z=0}^{q1} (c_{iz}^+ + c_{iz}^- \Delta oo_t^-) \\ &\quad + \sum\nolimits_{z=0}^{q2} (d_{iz}^+ \Delta ko_t^+ + d_{iz}^- \Delta ko_t^-) \\ &\quad + \sum\nolimits_{z=0}^{q3} (e_{iz}^+ \Delta po_t^+ + e_{iz}^- \Delta po_t^-) + \varepsilon_{it} \end{aligned} \tag{5}$$

Equation (4) shows that oo_t^+ and oo_t^- to stand for positive and negative supply shocks. ko_t^+ and ko_t^- mean the negative and positive aggregate demand shock. po_t^+ and po_t^- represent the positive and negative market-specific demand shock. He, He, and Wen (2018) indicate previous losses and profits in investments influence investor's risk attitude that alters her investing decisions. When the different kinds of crude oil shocks create price volatilities in the stock market, the employment of NARDL takes into account the hysteresis effect. In equation (5), the price stands for the stock indexes. Δ represents the difference calculation of a variable. The superscripts (+) and (−) mean the positive and negative impact of the variable accordingly. P and q denote the necessary lag lengths of the independent variable and shock variables. The notion for long-term correlation coefficients of the shocks is the supply shock (a_{i1}), the aggregate demand shock (a_{i2}), and the market-specific shock (a_{i3}). This study uses the ADRL bounds test (PSS) for co-integration to test the long-term correlation between variables. In this PSS test, the stated null hypothesis is $a_{i1}^+ = a_{i1}^- = a_{i2}^+ = a_{i2}^- = a_{i3}^+ = a_{i3}^- = 0$. The model is considered valid when a spurious linear relationship between independent non-linear variables is resolved, thereby rejecting the null hypothesis. The Wald test is employed to examine long-term symmetric effects. The stated null hypothesis for this test is $a_{i1}^+ = a_{i1}^-$, $a_{i2}^+ = a_{i2}^-$, and $a_{i3}^+ = a_{i3}^-$. The stated coefficient for short-term symmetric effects are c_{iz}^{+}, c_{iz}^{-}, d_{iz}^{+}, d_{iz}^{-}, e_{iz}^{+} and e_{iz}^{-}. Besides, the short-term asymmetric effects of positive coefficients and negative coefficients of shock variables are tested with the Wald procedure. The stated null hypothesis is

$$\sum_{z=0}^{q} c_{iz}^{+} = \sum_{z=0}^{q} c_{iz}^{-},\ \sum_{z=0}^{q} d_{iz}^{+} = \sum_{z=0}^{q} d_{iz}^{-},\ \text{and}\ \sum_{z=0}^{q} e_{iz}^{+} = \sum_{z=0}^{q} e_{iz}^{-}.$$

4. Data

The required data samples for this study are the world crude oil output, the real economic activities index or the economic global index, the index of Ho Chi Minh stock exchange (Vn-Index), and the index of Hanoi stock exchange (HNXI). Data frequency is monthly periods from October 2011 to October 2020. The global gross crude output is obtained from the Energy Information Administration (EIA), a U.S government agency. The data is treated, following the X-13 SEATs procedure to de-trend the seasonal impacts. The Killian index is the established index for the global real economic activity in industrial commodity markets. The data is monthly and better reflects economic activities at a higher frequency than GDP (Kilian, 2009). Besides, this study wants to add to the domestic production costs of oil producers and the oil price volatilities. These import costs serve as the aim of examining the impact of oil prices on the Vietnamese stock markets. The monthly average of imported crude oil price, acquired from the Vietnam customs, is denominated in U.S Dollar. The series is then deflated with monthly U.S CPI with October 2011 as the base month, which is taken from the Federal Reserve Bank of St. Louis to get the real import price of oil. The monthly indexes for Ho Chi Minh stock exchange and Hanoi stock exchange are taken from the Thompson Eikon database. They are also deflated with monthly Vietnam CPI, which is taken from the General Statistics Office of Vietnam (GSO), to derive the real index prices.

Table 1 presents the descriptive statistics for variables. This study uses the augmented Dickey-Fuller (ADF)'s unit root test for all variables. The ADF's result shows that the percentage change of monthly crude oil output, the Killian Economic Index, and the percentage change of monthly imported crude oil price reject the null hypothesis at the 1% (O_t and P_t) and 5% (K_t) significance level. Also, the unit root test proposed by Zivot and Donald (1992) (ZA) is employed. Its result is robust to structural breaks and in line with that of the ADF unit root rest. The spurious regression issue of linear regression for SVAR can be shunned. The ADF and ZA estimates for indices of the Ho Chi Minh stock exchange and Hanoi stock exchange indicate that the value of log price indices is non-stationary while the value of price differences follows the first order of the integration process. Further, the Δln vn-index$_t$ can be seen as proxies for index returns of Ho Chi Minh stock market and Hanoi stock market whose skewness and kurtosis are below zero and larger than three, accordingly. Besides, the Jarque-Bera test (JB) provides that the value of the Vn-index series is not significant at a 5% level, which means the Vn-index's skewness and kurtosis do not match the estimates for normal distribution, and its distribution has fat tails and a high peak.

5. Results and Discussion

5.1. The Identification of the Structural Oil Price Shock

For the SVAR model, this study follows the optimal AIC and FPE (final prediction error) to set the lag length for input variables to be three. The three shock components are later estimated by applying the SVAR model with the least squares.

Table 1: Summary Statistics of Oil-Related and Stock Market Variables

Variables	Mean	Maximum	Minimum	STD	Skewness	Kurtosis	JB	ADF	ZA
O_t	0.036	1.849	−11.416	1.250	−7.172	66.704	19.000	−10.263***	−8.719***
K_t	−44.431	39.451	−159.644	39.586	−0.193	2.928	0.663**	−3.987**	−4.546
P_t	−0.227	40.675	−35.543	10.428	−0.001	6.231	46.980	−6.893***	−8.261***
ln vn-index$_t$	6.495	7.066	5.868	0.312	−0.019	1.877	5.731**	−2.781	−4.799
ln,$_t$	4.462	4.932	3.937	0.233	−0.144	2.249	2.942**	−3.206*	−3.931
Δln vn-index$_t$	0.007	0.158	−0.291	0.060	−0.964	7.637	113.500	−8.570***	−10.485***
Δln hn-index$_t$	0.006	0.147	−0.173	0.056	−0.246	3.822	4.133**	−7.297***	−9.570***

Note: O_t stands for the percentage change of monthly crude oil output; K_t denotes the global activity index; P_t means the percentage changes in the monthly real price of crude oil; ln vn-index$_t$ is the natural log of the detrended price of Vn-index; ln hn-index$_t$ is the natural log of the detrended price of Hn-index; Δln vn-index$_t$ means the returns of Vn-index; Δln hn-index$_t$ presents the returns of Hn-index.
*, **, and *** Denote the significance level of 10%, 5%, and 1% respectively.

Figure 3 shows that global supply shock changes frequently and randomly during the examination period. World crude oil output is mostly provided by OPEC members, and they control the global supply through constraining production output and price at their convenience. Therefore, crude oil price, as shown in Figure 1, fluctuates with changes in the oil market price. Besides, a cause to the price fluctuations is unsettled relationships among oil producers in the Middle East region, whose oil reserve comprises 64.5% of the world in comparison to 79.4% of OPEC's oil reserves (Organization of the Petroleum Exporting Countries, 2019). Further disputes between Iran, a large oil producer, and the US bring up concerns about the stability of oil supplies. However, the development of shale oil extraction technique pulls the crude oil price down from near 900 USD/ton to below 200 USD/ton, and the price chart has yet picked up since then. Also, an important reason is a heavy investment for oil exploration, which makes the oil production output, not in tandem with the volatility of aggregate demand.

Another note from Figure 2 and Figure 3 is dipped in charts in early 2020. This is due to the widespread COVID-19 pandemic. For the aggregate demand shock, the large changes mean the variation of the World economic environment. As the demand shock shows a great downward tendency in the COVID-19. Because the pandemic continues, the data of crude oil price and the shocks also reflect the recovery of the economy in the form of oil price, along with the V-shape revival cycle of oil demand. This is consistent with the behavior of oil price before and after the financial crisis in 2008, which is preceded by a shock of the oil market and is explained by the market fundamentals (Hamilton, 2003).

To further understand the means of oil price movements, an impulse response function is created to examine the shock components on the global oil output and aggregate demand. Although the supply and demand of the oil market are widely investigated by previous studies (Kilian, 2009), but the changes in the oil market are time-varying, which requires an empirical study for a new period. Figure 4 provides an IRF graph of the global oil output, the World real economy, and the real oil prices affected by an orthogonalized production supply shock, aggregate demand shock, and Vietnamese market demand shock, accordingly.

The world activity is heavily influenced by the aggregate demand shock and market-specific shock in the first five months but this impact lessens in the following months. The supply shock imposes milder but steadier impacts on economic activity. All the shocks have positive effects on real activity.

The oil output is affected by shock components in the short-term, noticeably in the first 4 months. However, the effects on oil production do not sustain in the long-term. The short-run variations are the results of volatilities of exogenous events such as political conflicts and climate changes rather than fundamental problems of supply and demand (Zhang et al., 2008). Also, the demand shock has stronger economic responses to the global economy than the oil supply.

The effect of supply shock on the oil price is negative, except for some adjustments in the first 4 months, a rather short-run effect; however, the effects are not significant in the

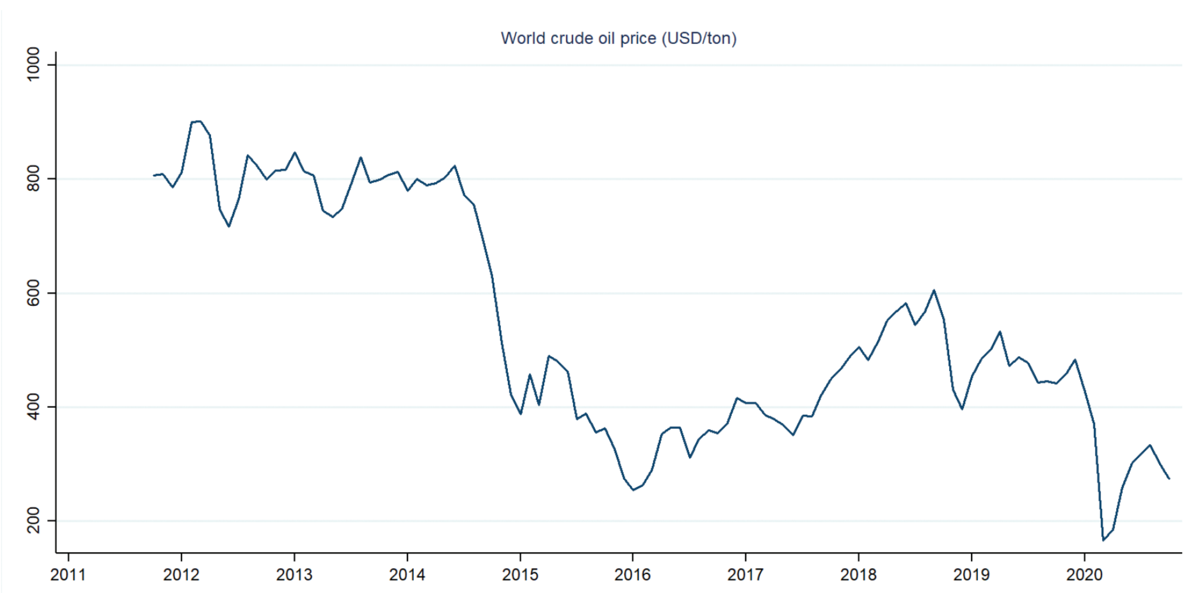

Figure 2: World Crude Oil Price (USD/ton)
Source: Author Constructed

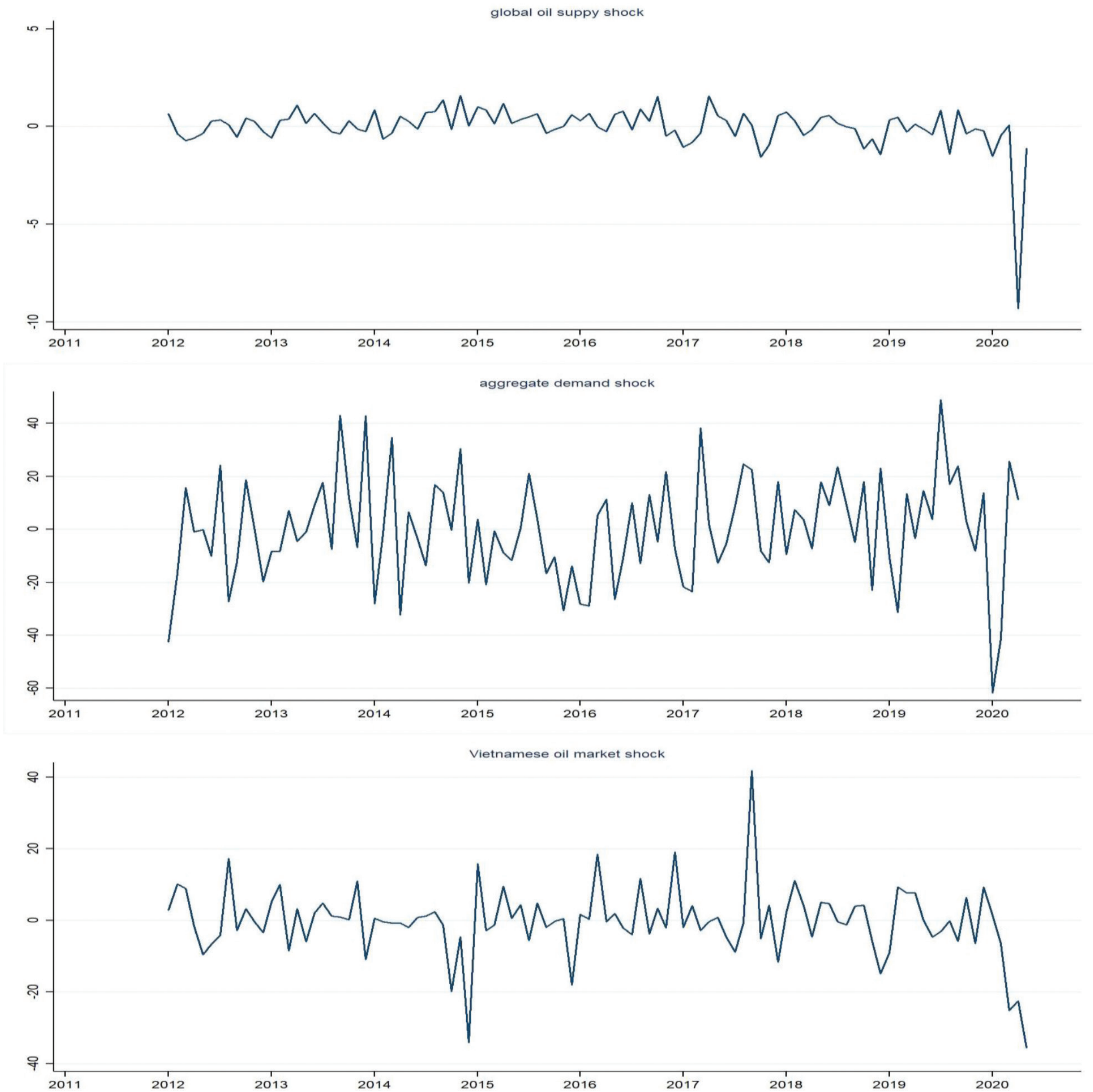

Figure 3: Structural Shock of the Oil Ma

later period. This fact is explained by the substituted capacity of output when the oil output of one area faces shortage and other regions produce more to resolve the deficiency (Kilian, 2009). Also, the oil output has not increased in Middle Eastern countries recently (James, 2009) due to competition from shale oil producers like the US, making the oil production output a weak forecasting indicator for oil price (Kilian, 2008). The aggregate demand shock has similar effects with degrees on the real oil price. The market-specific demand shock has strong positive effects in the first two months, but the effects become negligible after the sixth month. Among demand shocks, market-specific demand shocks are most effective, in which one standard deviation brings about a 5% to 10% increase in oil prices a month when the shock exits. In contrast with response intensity of the supply shock, the demand shocks, both global and market-specific shocks, have more influence on the oil price movements, which is fit with previous studies (Kilian, 2009).

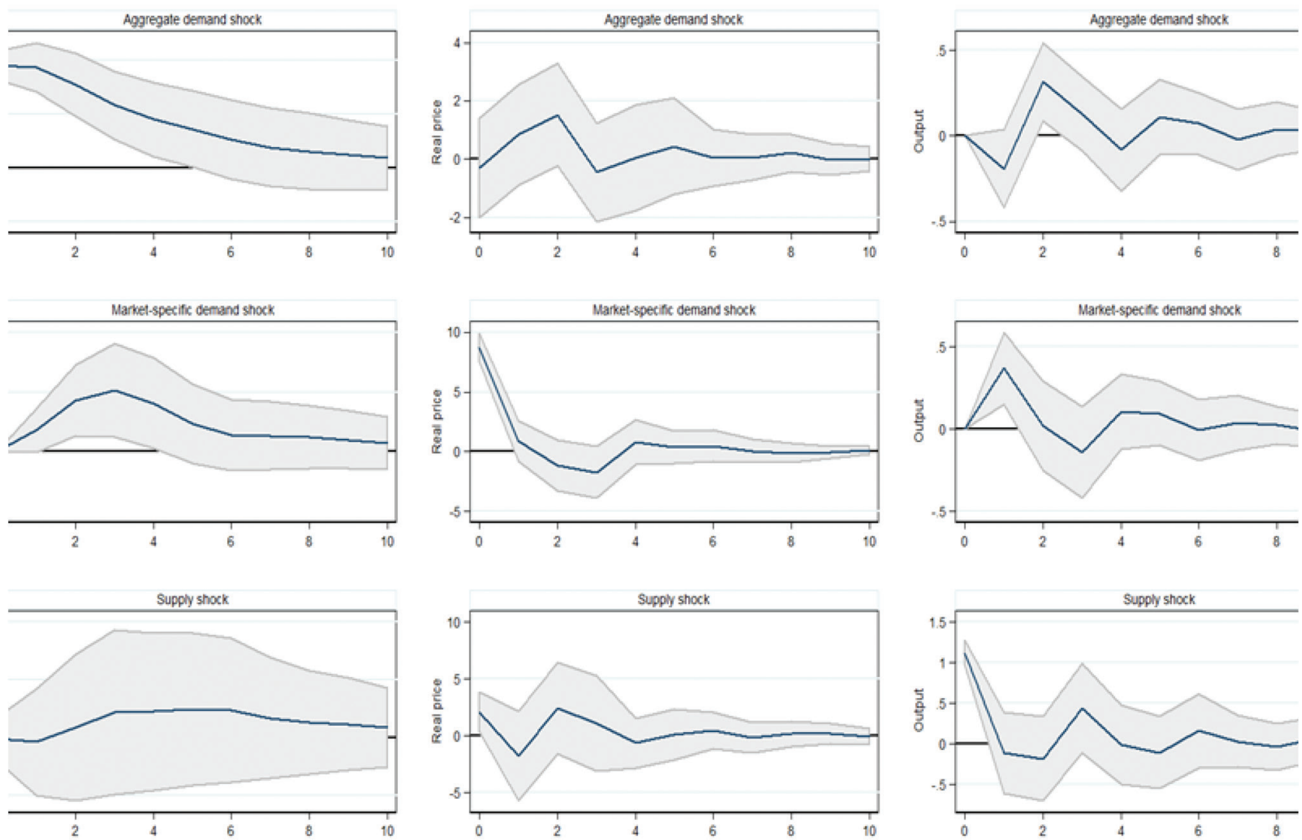

Figure 4: Impulse Response Shock of the Oil Mark

Previous studies reveal that the oil price changes show an asymmetric impact on the financial markets. However, oil price movements affect production costs, in which price increases hold down economic activities while price decrease positively affects the business environment. Specifically, adjustments in production capacity and declining consumption demands play a role in controlling the oil price changes, helping to reduce the firm's operating costs with less influencing stimulus than that of price increases. However, investors make different decisions with varied magnitudes due to their irrational basis. Table 2 provides the estimates of positive and negative supply (output) shocks, aggregate (World) demand shocks) and market-specific (Vietnamese) shocks by employing the NARDL model for the index of Ho Chi Minh stock exchange (Vn-Index) and the index of Hanoi stock exchange (HNXI). The PSS co-integration test result of the NARDL model presents that a level of co-integrating relationship exists between negative and positive types of structural oil shocks and both indexes of Vietnamese stock exchanges, indicating that the estimates of the NARDL are reliable. Further, the goodness of fit for each estimation model of HNXI and Vn-index are 0.422 and 0.400 accordingly, providing evidence that structural oil shocks can well explain Vietnam's stock market price.

Table 2 shows the estimates generated by the NARDL model. The long-run coefficients of structural shocks show that neither positive and negative structural shocks of supply shocks and market-specific demand shocks are significant. However, the positive and negative effects of aggregate demand shocks for the Vn-index model are rejected at the significance level of 5% and the positive effect of that shock is rejected at the significance level of 1%. The implied results demonstrate that the influence of structural oil shocks on Vietnamese stock prices is not identical. The above findings show that aggregate demand shocks impose the strongest impact on the Vietnamese stock market. This inference is in line with the conclusion on the significant impact of structural oil shocks on the U.S stock prices by Kilian (2009). However, it differs from the finding of the impact of structural oil shocks on the Chinese stock market by Hu et al. (2017), which provides evidence for the strong influence of the market-specific oil shock on Chinese stock markets. However, oil structural shocks have a negative relationship with stock prices in emerging economies (Basher, Haug, & Sadorsky, 2012).

Table 2: Asymmetric Impacts of Structural Oil Shocks on Vietnamese Financial Markets

Hanoi Stock Market (HNX-Index)			Ho Chi Minh Stock Market (VN-Index)		
Variable	**Coefficient**	**Standard Errors**		**Coefficient**	**Standard Errors**
Constant	0.755***	−0.250		1.309**	−0.619
$price_{(t-1)}$	−0.177***	−0.058		−0.218**	−0.100
$os^{+}_{(t-1)}$	0.031	−0.028		0.002	−0.034
$os^{-}_{(t-1)}$	0.031	−0.027		0.019	−0.034
$ks^{+}_{(t-1)}$	0.000	−0.000		0.0004	−0.000
$ks^{-}_{(t-1)}$	0.000	−0.000		0.000	−0.000
$ps^{+}_{(t-1)}$	−0.000	−0.003		0.001	−0.004
$ps^{-}_{(t-1)}$	−0.000	−0.003		−0.001	−0.004
$\Delta price_{(t-1)}$	0.142	−0.113		0.030	−0.130
$\Delta os^{+}_{(t-1)}$	−0.056**	−0.022		−0.036	−0.025
$\Delta os^{-}_{(t-2)}$	−0.038*	−0.020		−0.035	−0.022
$\Delta ks^{+}_{(t-1)}$	−0.001**	−0.001		−0.001*	−0.001
$\Delta ks^{+}_{(t-2)}$	0.000	−0.001		−0.000	−0.001
$\Delta ks^{-}_{(t-1)}$	−0.001*	−0.000		−0.000	−0.000
$\Delta ks^{-}_{(t-2)}$	0.001	−0.000		0.001***	−0.000
$\Delta ps^{+}_{(t-1)}$	−0.001	−0.002		0.000	−0.003
$\Delta ps^{+}_{(t-2)}$	0.003*	−0.002		0.005**	−0.000
$\Delta ps^{-}_{(t-1)}$	0.002	−0.002		0.004*	−0.002
$\Delta ps^{-}_{(t-2)}$	−0.002**	−0.001		−0.001	−0.001
$L_{os}^{+} = 0.094$	$L_{ks}^{+} = 0.003$*	$L_{ps}^{+} = 0.010$	$L_{os}^{+} = 0.005$	$L_{ks}^{+} = 0.003$**	$L_{ps}^{+} = 0.014$
$L_{os}^{-} = 0.150$	$L_{ks}^{-} = 0.001$	$L_{ps}^{-} = -0.009$	$L_{os}^{-} = 0.096$	$L_{ks}^{-} = -0.002$	$L_{ps}^{-} = -0.009$*
$F_{PSS} = 1.829$	Prob = 0.000		$F_{PSS} = 1.951$	Prob = 0.000	
$R^2 = 0.422$			$R^2 = 0.400$		
$F = 2.457$	$P = 0.002$		$F = 5.751$	$P = 0.001$	
$WL_{os} = 1.498$	$WL_{ks} = 1.961$	$WL_{ps} = 0.086$	$WL_{os} = 3.254$*	$WL_{ks} = 1.297$	$WL_{ps} = 2.948$*
$WS_{os} = 0.2788$	$WS_{ks} = 0.7385$	$WS_{ps} = 0.8742$	$WS_{os} = 1.372$	$WS_{ks} = 0.4471$	$WS_{ps} = 0.2549$

Note: L_{os}^{+} and L_{os}^{-} means positive and negative oil shocks, and other shocks figures are shown similarly. WL_{os} and WS_{os} are *F*-statistics for the Wald coefficient test of asymmetric effect for long and short-term output (supply) shock. Coefficient values for variables are significant at *p*-value at 0.05 or greater. *, **, and *** denote the significance level of 10%, 5%, and 1% respectively.

Compared to studies on the Chinese market, which suggest China has capital mobility control that helps its market to operate independently (Lin, Fang, & Cheng, 2014), Vietnam has weaker control on capital mobility and its economy is more dependent on FDI investments. Even though Vietnam lacks a stable legal support framework, its economy has undergone several major reforms, maintaining high and steady growth rates. Vietnam has seen strong GDP growth rates in recent years and is among the countries with one of the highest economic growth rates in Asia (The International Monetary Fund, 2019). Besides, it is among the major beneficiaries of foreign direct investment (FDI) with an average of more than 7% of GDP in 2005–2019 (World Bank, 2021). Vietnam's economy is expected to continue to grow due to its significant export growth in the Association of Southeast Asian Nations (ASEAN) countries (Viet Capital Securities, 2020) and high profitability projections.

Further, Anh and Gan (2020) also confirm that Vietnam has a stock market value well below the total market value, and firms with state ownership are linked with low stock liquidity, and market liquidity declines and remains low from 2008 financial crisis. Besides, Kilian (2009) defines the aggregate (global) demand shock as the demand shocks to all industrial commodities which have a direct effect on the economy and financial markets, which together with the oil supply shocks explains for 22% long-run variations in the U.S market returns. The impact of aggregate demand shocks on the Index of Consumer Sentiment is positive for the first couple of months and turns negative afterward (GÜNtner & Linsbauer, 2018). Coincidentally, Nguyen, Nguyen, and Nguyen (2020) find that both Brent's and WTI's oil futures price returns have a positive effect on the Vietnam market indices. This study finds evidence for the impact of aggregate oil demand shocks on the stock market, and a possible explanation is that consumer sentiment is a link in the influence path of such structural shocks. Specifically, for the index of Hanoi stock exchange (HNXI), when positive aggregate demand shock increases 1%, the HNXI increases 0.003%. For the moment, its negative aggregate demand has no significant relationship with the HNXI. For the index of Ho Chi Minh stock exchange (Vn-index), when positive aggregate demand shock increases 1%, the Vn-index rises 0.003% while the increase of negative aggregate demand shock by 1% triggers a decline of the Vn-index by 0.002%.

Relatively speaking, the Vn-index receives a larger impact and from aggregate demand shock as its coefficient is significant at the level of 5% while that of HNIX is significant at the level of 10%. The above results lead to the conclusion that the influence path is not homogenous.

In terms of the short-run coefficient figures, no shocks have a significant impact on Vietnam's market indices. The negligible impact is partly due to the problems in oil production adjustment because Vietnam is an oil producer and it can cushion the oil shortage in a short period. This explains the insignificant effects of oil structural shocks on Vietnam's stock markets. Compared to aggregate demand shock and oil-market specific shock, the supply shock has a more robust short-term effect on the stock price, whose negative and positive short-run coefficients reach 0.030 and 0.031 for HNXI, and 0.019 and 0.002 for Vn-index. Hence, a deduction can be made that no shocks have a significant impact on Vietnam's indices, but the supply shock has the strongest influence on the Vietnamese stock markets. These results are consistent with the estimation results for Vn-index.

To examine the long and short-run asymmetric effect of variables of shock, Shin et al. (2014) perform a Wald coefficient test for the NARDL model. Estimates of long-run asymmetric test present that global supply shocks and market-specific demand shocks have effects on the Vn-index at a 10% level of significance, which is understandable because large oil firms are listed on the Vn-index. This finding is logical because Vietnam had become a net oil importer since 2014 and its oil reserves and refineries can cushion the temporary global output and market-specific variations in the short-run in the short-run (Asia-Pacific Economic Cooperation, 2013).

Besides, the fast-growing economy, which is predicted to rank 19th in terms of GDP (PPP) (Centre for Economics and Business Research, 2020) demands more oil consumption which can create challenges for domestic oil refineries to provide enough supply to industries. Further, in the long term, oil price shocks send out their effects to the markets through organizational changes in economic entities and for a while. Particularly, different firms' types operating in the oil refinery, transport, manufacturing industry, so oil price fluctuations have varied impacts on firm types. Market-specific impacts on the stock markets depend greatly on how these effects counterbalance each other. According to the estimates in Table 2, the positive and negative information of aggregate demand shock impacts may be jointly canceled out in the long-run, making the aggregate demand shock's imposed effects split to an equal extent. However, the findings for markets are not homogeneous as only the Vn-index's long-run coefficients of global supply shocks and market-specific shocks have asymmetric effects on the stock market at a 10% level of significance. Therefore, the Wald test for long-term asymmetry effects shows that the Vietnamese stock market is not both mature and efficient in the long-term. In the short-run, the market fluctuations are due to the investor's behavior under the impact of inside and outside information that can generate irrational market behavior, "herd behavior" (Scharfstein & Stein, 1990).

For the asymmetric test results in the short term, no structural shocks have asymmetric effects on the Vietnamese securities market. First, the supply shock value for the Wald statistics shows the shock has no significant effects of the shock on Vietnam markets. Even though Vietnam's demand for oil is increasing, the country is an oil producer so the global supply shock is likely to affect the Vn-index in the long run. Second, the null hypothesis of the asymmetric properties of market-specific demand shock is rejected. The precautionary demand shock has no effect on Vietnam's stock market in the short-term, but the high oil demand, in the long run, can cause shock effects on the Vn-index. Kilian (2009) points out that market-specific demand shocks result from crises in oil-producing economies. According to Table 2, this unexpected factor does shape the asset pricing of Vn-index, but does not impact the hnindex. Last, but not least, the aggregate demand shock however has no asymmetric effects on either markets' indexes. The aggregate demand shocks are fundamentally fueled by real economic activities. The activity level cannot self-regulate itself even in the long-term for Vn-index. The variations of economic activity of listed firms in the short-term might not be shown in revenues and uncertainty level, but this may prompt investors to trade in the market. This investment behavior does not affect stock price in the short-run; however, trading actions cause stock price overreaction, like asymmetric effect in the long run. This finding is against that from Hu et al. (2017), which indicates that the stock price's asymmetric effect is caused by short-run tradings. Further, the corporate capital structure of listed firms, which is related to its market value, is adjusted to a greater degree in an economic crisis or boom (Cook & Tang, 2010).

6. Conclusion

This study examines the market overreaction or asymmetric effects of structural oil shocks on Vietnam's stock indexes from October 2011 to October 2020. The SVAR model is used to detect the structural shocks of the crude oil market that is decomposed into global supply (output) shock, aggregate demand shock, and the market-specific demand shock. This research also employs the NARDL model, proposed by Shin et al. (2014), to investigate the asymmetric effects of long-run and short-run coefficients of structural shocks on the index of the Ho Chi Minh stock market (Vn-index) and Hanoi stock market (HNXI). Inferences from findings are as follows.

After detecting the structural oil shocks by employing the SVAR model and examining the impulse response of such shocks, this study finds that fluctuations of the oil price are determined by aggregate demand shock and oil-market specific demand shock, with market-specific demand shock being the strongest influence while the supply shock has only short-term (first 2 months) effects on the oil price. Further, regarding the effects of structural oil shocks on Vietnam's indices, the oil supply shocks, and oil market-specific demand shocks exert negligible effects on Vietnam's stock market in the long run. However, the negative and positive aggregate demand shock imposes strong effects on the Vn-index and HNXI. The conclusion is in line with that of Kilian and Park (2009), but contradicts the results of Hu et al. (2017) for Chinese stock indices. It is attributed to the high GDP growth rate, the country's high trade openness, and the presence of foreign investors as net buyers of Vietnamese stock markets (1997–2020). This finding indicates Vietnam's stock markets operate in conformity with the global stock markets. In the short-run, the effects of lagging oil structural shocks on Vietnam's stock indices are not significant. However, the Wald coefficient tests show that the global supply shock and oil-market specific shock has an asymmetric effect on the price index of the Ho Chi Minh stock market in the long run while the short-run estimate is not significant. The positive and negative aggregate demand shock may be mutually cancelled out each other in the long run while two other shocks leave asymmetric effects on Vn-index in the long-term. This is because the domestic supply can cushion the economic boom or bust in a short period but fails to mitigate the negative effects of supply shocks and oil-market specific shock in the long term.

From the above deductions, this study proposes several policy propositions. First, market controllers have to speed up their development of the domestic oil market to help cushion the oil price movements. Besides, different measures of the asymmetric effect of oil structural shocks should be adopted to analyze the oil price changes. Second, the Vietnamese stock market is easily influenced by the aggregate demand shock due to its high trade openness and high GDP growth rate. Newly signed free trade agreements (FTA) such as the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (TPP-11) require market controllers to loosen their capital controls and capital markets while hedging risks. Third, the demand information should be better considered than the supply information. The short-horizon and long-horizon investors should pay attention to information from different investment cycles with varied oil market news. This helps reduce the risk of oil price changes and improvements for oil-included portfolio returns.

References

Abbott, P., & Tarp, F. (2012). Globalization Crises, Trade And Development in Vietnam *Journal of International Commerce, Economics and Policy, 03*(01), 1240006. https://doi.org/10.1142/s1793993312400066

Ajmi, A. N., El-montasser, G., Hammoudeh, S., & Nguyen, D. K. (2014). Oil prices and MENA stock markets: new evidence from nonlinear and asymmetric causalities during and after the crisis period. *Applied Economics, 46*(18), 2167–2177. https://doi.org/10.1080/00036846.2014.896987

Anh, D. L. T., & Gan, C. (2020). The impact of the COVID-19 lockdown on stock market performance: evidence from Vietnam. *Journal of Economic Studies*. https://doi.org/10.1108/jes-06-2020-0312

Apergis, N., & Miller, S. M. (2009). Do structural oil-market shocks affect stock prices? *Energy Economics, 31*(4), 569–575. https://doi.org/10.1016/j.eneco.2009.03.001

Asia-Pacific Economic Cooperation. (2013). *APEC Energy Demand and Supply Outlook* (APEC#213-RE-01.5). Retrieved from https://www.apec.org/Publications/2013/02/APEC-Energy-Demand-and-Supply-Outlook-5th-Edition

Basher, S. A., Haug, A. A., & Sadorsky, P. (2012). Oil prices, exchange rates and emerging stock markets. *Energy Economics, 34*(1), 227–240. https://doi.org/10.1016/j.eneco.2011.10.005

Basher, S. A., Haug, A. A., & Sadorsky, P. (2018). The impact of oil-market shocks on stock returns in major oil-exporting countries. *Journal of International Money and Finance, 86*, 264–280. https://doi.org/10.1016/j.jimonfin.2018.05.003

Bodurtha, J. N., Cho, D. C., & Senbet, L. W. (1989). Economic forces and the stock market: An international perspective. *Global Finance Journal, 1*(1), 21–46. https://doi.org/10.1016/1044-0283(89)90004-5

Centre for Economics and Business Research. (2020). *World Economic League Table 2021: A world economic league table with forecasts for 193 countries to 2035*. Retrieved from https://cebr.com/wp-content/uploads/2020/12/WELT-2021-final-23.12.pdf

Cheema, M. A., & Scrimgeour, F. (2019). Oil prices and stock market anomalies. *Energy Economics, 83*, 578–587. https://doi.org/10.1016/j.eneco.2019.08.003

Chiang, I.-H. E., Hughen, W. K., & Sagi, J. S. (2015). Estimating Oil Risk Factors Using Information from Equity and Derivatives Markets. *The Journal of Finance, 70*(2), 769–804. https://doi.org/10.1111/jofi.12222

Choudhry, T., Ul Hassan, S. S., & Papadimitriou, F. I. (2014). UK imports, third country effect and the global financial crisis: Evidence from the asymmetric ARDL method. *International Review of Financial Analysis, 32*, 199–208. https://doi.org/10.1016/j.irfa.2013.11.003

Cook, D. O., & Tang, T. (2010). Macroeconomic conditions and capital structure adjustment speed. *Journal of Corporate Finance, 16*(1), 73–87.

Ferrer, R., Shahzad, S. J. H., López, R., & Jareño, F. (2018). Time and frequency dynamics of connectedness between renewable energy stocks and crude oil prices. *Energy Economics, 76*, 1–20. https://doi.org/10.1016/j.eneco.2018.09.022

Fifield, S. G. M., Power, D. M., & Sinclair, C. D. (2002). Macroeconomic factors and share returns: an analysis using emerging market data. *International Journal of Finance & Economics, 7*(1), 51–62. https://doi.org/10.1002/ijfe.173

Gong, X., Wen, F., Xia, X. H., Huang, J., & Pan, B. (2017). Investigating the risk-return trade-off for crude oil futures using high-frequency data. *Applied Energy, 196*, 152–161. https://doi.org/10.1016/j.apenergy.2016.11.112

Gorton, G., & Rouwenhorst, K. G. (2006). Facts and Fantasies about Commodity Futures. *Financial Analysts Journal, 62*(2), 47–68. Retrieved from http://www.jstor.org/stable/4480744.

Granger, C. W. J., & Yoon, G. (2002). Hidden Cointegration. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.313831

Güntner, J. H. F., & Linsbauer, K. (2018). The Effects of Oil Supply and Demand Shocks on U.S. Consumer Sentiment. *Journal of Money, Credit and Banking, 50*(7), 1617–1644. https://doi.org/10.1111/jmcb.12512

Hamilton, J. D. (1983). Oil and the Macroeconomy since World War II. *Journal of Political Economy, 91*(2), 228–248. Retrieved from https://www.journals.uchicago.edu/doi/abs/10.1086/261140. doi:10.1086/261140

Hamilton, J. D. (2003). What is an oil shock? *Journal of Econometrics, 113*(2), 363–398. https://doi.org/10.1016/s0304-4076(02)00207-5

Haroon, O., & Rizvi, S. A. R. (2020). Flatten the Curve and Stock Market Liquidity – An Inquiry into Emerging Economies. *Emerging Markets Finance and Trade, 56*(10), 2151–2161. https://doi.org/10.1080/1540496x.2020.1784716

He, Z., Chen, J., Zhou, F., Zhang, G., & Wen, F. (2020). Oil price uncertainty and the risk-return relation in stock markets: Evidence from oil-importing and oil-exporting countries. *International Journal of Finance & Economics*. https://doi.org/10.1002/ijfe.2206

He, Z., He, L., & Wen, F. (2018). Risk Compensation and Market Returns: The Role of Investor Sentiment in the Stock Market. *Emerging Markets Finance and Trade, 55*(3), 704–718. https://doi.org/10.1080/1540496x.2018.1460724

Hedi Arouri, M. E., & Khuong Nguyen, D. (2010). Oil prices, stock markets and portfolio investment: Evidence from sector analysis in Europe over the last decade. *Energy Policy, 38*(8), 4528–4539. https://doi.org/10.1016/j.enpol.2010.04.007

Herrera, A. M., Karaki, M. B., & Rangaraju, S. K. (2019). Oil price shocks and U.S. economic activity. *Energy Policy, 129*, 89–99. https://doi.org/10.1016/j.enpol.2019.02.011

Hu, C., Liu, X., Pan, B., Chen, B., & Xia, X. (2017). Asymmetric Impact of Oil Price Shock on Stock Market in China: A Combination Analysis Based on SVAR Model and NARDL Model. *Emerging Markets Finance and Trade, 54*(8), 1693–1705. https://doi.org/10.1080/1540496x.2017.1412303

James, D. H. (2009). Causes and Consequences of the Oil Shock of 2007–08. *Brookings Papers on Economic Activity, 40*(1) (Spring), 215–283.

Kang, S. H., Kang, S.-M., & Yoon, S.-M. (2009). Forecasting volatility of crude oil markets. *Energy Economics, 31*(1), 119–125. https://doi.org/10.1016/j.eneco.2008.09.006

Kang, W., Ratti, R. A., & Yoon, K. H. (2015). The impact of oil price shocks on the stock market return and volatility relationship. *Journal of International Financial Markets, Institutions and Money, 34*, 41–54. https://doi.org/10.1016/j.intfin.2014.11.002

Kilian, L. (2008). The Economic Effects of Energy Price Shocks. *Journal of Economic Literature, 46*(4), 871–909. https://doi.org/10.1257/jel.46.4.871

Kilian, 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. https://doi.org/10.1257/aer.99.3.1053

Kilian, L., & Park, C. (2009). The Impact Of Oil Price Shocks On The U.S. Stock Market. *International Economic Review, 50*(4), 1267–1287. https://doi.org/10.1111/j.1468-2354.2009.00568.x

Lin, C.-C., Fang, C.-R., & Cheng, H.-P. (2014). The Impact of Oil Price Shocks on the Returns in China's Stock Market. *Emerging Markets Finance and Trade, 50*(5), 193–205. https://doi.org/10.2753/REE1540-496X500514

Narayan, P. K., & Narayan, S. (2010). Modelling the impact of oil prices on Vietnam's stock prices. *Applied Energy, 87*(1), 356–361. https://doi.org/10.1016/j.apenergy.2009.05.037

Nguyen, H. M., Cavoli, T., & Wilson, J. K. (2012). The Determinants of Inflation in Vietnam, 2001-09. *ASEAN Economic Bulletin, 29*(1), 1–14. https://doi.org/10.2307/41446022

Nguyen, T. N., Nguyen, D. T., & Nguyen, V. N. (2020). The Impacts of Oil Price and Exchange Rate on Vietnamese Stock Market. *Journal of Asian Finance, Economics and Business, 7*(8), 143–150. https://doi.org/10.13106/jafeb.2020.vol7.no8.143

Organization of the Petroleum Exporting Countries. (2019). OPEC Share of World Crude Oil Reserves *OPEC Annual Statistical Bulletin 2019*. 2019. Retrieved from https://www.opec.org/opec_web/en/data_graphs/330.htm

Ozturk, M. B. E., & Cavdar, S. C. (2021). The Contagion of Covid-19 Pandemic on The Volatilities of International Crude Oil Prices, Gold, Exchange Rates and Bitcoin. *Journal of Asian Finance, Economics and Business, 8*(3), 171–179. https://doi.org/10.13106/jafeb.2021.vol8.no3.0171

Papapetrou, E. (2001). Oil price shocks, stock market, economic activity and employment in Greece. *Energy Economics, 23*(5), 511–532. https://doi.org/10.1016/s0140-9883(01)00078-0

PricewaterhouseCoopers. (2021). The long view: how will the global economic order change by 2050? *The World in 2050.* Retrieved from https://www.pwc.com/gx/en/research-insights/economy/the-world-in-2050.html

Rachna, B., & Sudipa, M. (2021). The effect of non-oil diversification on stock market performance: the role of FDI and oil price in the United Arab Emirates *Journal of Asian Finance, Economics and Business, 8*(4), 1–9. https://doi.org/10.13106/jafeb.2021.vol8.no4.0001

Sadorsky, P. (1999). Oil price shocks and stock market activity. *Energy Economics, 21*(5), 449–469. https://doi.org/10.1016/S0140-9883(99)00020-1

Scharfstein, D., & Stein, J. (1990). Herd Behavior and Investment. *American Economic Review, 80*(3), 465–479.

Shin, Y., Yu, B., & Greenwood-Nimmo, M. (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. In R. C. Sickles & W. C. Horrace (Eds.), *Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications* (pp. 281–314). New York, NY: Springer New York.

Sim, N., & Zhou, H. (2015). Oil prices, US stock return, and the dependence between their quantiles. *Journal of Banking & Finance, 55*, 1–8. https://doi.org/10.1016/j.jbankfin.2015.01.013

Smyth, R., & Narayan, P. K. (2018). What do we know about oil prices and stock returns? *International Review of Financial Analysis, 57*, 148–156. https://doi.org/10.1016/j.irfa.2018.03.010

Su, C.-W., Khan, K., Tao, R., & Nicoleta-Claudia, M. (2019). Does geopolitical risk strengthen or depress oil prices and financial liquidity? Evidence from Saudi Arabia. *Energy, 187*. https://doi.org/10.1016/j.energy.2019.116003

Taghizadeh-Hesary, F., Rasoulinezhad, E., & Yoshino, N. (2019). Energy and Food Security: Linkages through Price Volatility. *Energy Policy, 128*, 796–806. https://doi.org/10.1016/j.enpol.2018.12.043

The International Monetary Fund. (2019). *IMF Annual Report 2019: Our Connected World*. Retrieved from https://www.imf.org/external/pubs/ft/ar/2019/eng/

The World Bank. (2021). *World Bank Open Data* [Time-series]. World Bank Open Data. Retrieved from: https://data.worldbank.org/

Viet Capital Securities. (2020). *Annual Report 2019: On The Front Foot For The Future*. Retrieved from Ho Chi Minh City: https://www.vcsc.com.vn/annual-reports

Vu Ngoc, N., & Dat Thanh, N. (2020). Can Crude Oil Price be a Predictor of Stock Index Return? Evidence from Vietnamese Stock Market. *Asian Economic and Financial Review, 10*(1), 13–21.

Wei, Y., Liu, J., Lai, X., & Hu, Y. (2017). Which determinant is the most informative in forecasting crude oil market volatility: Fundamental, speculation, or uncertainty? *Energy Economics, 68*, 141–150. https://doi.org/10.1016/j.eneco.2017.09.016

You, W., Guo, Y., Zhu, H., & Tang, Y. (2017). Oil price shocks, economic policy uncertainty and industry stock returns in China: Asymmetric effects with quantile regression. *Energy Economics, 68*, 1–18. https://doi.org/10.1016/j.eneco.2017.09.007

Zhang, D. (2017). Oil shocks and stock markets revisited: Measuring connectedness from a global perspective. *Energy Economics, 62*, 323-333. https://doi.org/10.1016/j.eneco.2017.01.009

Zhu, H.-M., Li, S.-F., & Yu, K. (2011). Crude oil shocks and stock markets: A panel threshold cointegration approach. *Energy Economics, 33*(5), 987–994. https://doi.org/10.1016/j.eneco.2011.07.002

Zivot, E., & Donald, W. K. A. (1992). Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis. *Journal of Business & Economic Statistics, 10*(3), 251–270. https://doi.org/10.2307/1391541