Factors Affecting Stock Price Volatility in Vietnam's Oil and Gas Industry in the Period of Pre-COVID-19 and COVID-19

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Abstract This article studies the factors affecting the stock price volatility of the oil and gas industry in Vietnam during the period of Pre-COVID-19 and COVID-19. The dataset is collected quarterly, from 2018Q1 to 2021Q4 separated into two equal periods, including crude oil price, financial factors, and macro-factors. The period Pre-COVID-19 (the disease has not yet appeared) and the period of COVID-19 start from the time when the first COVID-19 case is detected in Vietnam until the end of 2021. The results from the GMM method show that the factors affecting the stock price volatility of the oil and gas industry are different between the two periods, in which, stock price volatility in the period of Pre-COVID-19 was affected by crude oil prices, economic growth, and stock price fluctuations in the previous period. Company size and inflation rate affect the stock price volatility of the oil and gas industry during the COVID-19 period. Unlike previous studies, this study shows that a higher inflation rate during the COVID-19 period resulted in lower volatility in oil and gas stock prices. It implies that people have confidence in the Vietnamese government's strategy to combat the COVID-19 pandemic. Therefore, an increase in inflation during the COVID-19 period based on lower inflation than in the pre-pandemic period will reduce the risk of stock prices.

Keywords Stock price volatility · COVID-19 · Vietnam · Oil and gas industry

1 Introduction

Prior to the COVID-19 pandemic, studies on stock price volatility mainly explored the impact of dividend policy on stock price volatility in a number of industries such as materials and construction (Zakaria et al., 2012), manufacturing companies (Habib et al., 2012) or a group of companies on the stock market (Islam et al., 2019). These are all studies under normal economic conditions. The outbreak of the COVID-19 pandemic has affected the socioeconomic activities of most countries around the

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A. T. Nguyen et al. (eds.), *Contemporary Economic Issues in Asian Countries: Proceeding of CEIAC 2022, Volume 2*, https://doi.org/10.1007/978-981-99-0490-7_6

world. It has caused significant volatility in share prices in the world's leading stock market (Baek et al., 2020). However, studies on the impact of this pandemic on the stock market to date have mainly focused on stock returns (Phuong, 2021) but there are few studies on its impact on stock price volatility in developing markets like Vietnam.

Unexpected negative events often cause sharp fluctuations in asset prices in financial markets. Volatility is important in financial markets because it shows the level of risk or uncertainty in financial assets. Therefore, stock price volatility has always been of great interest to investors (individuals and institutions).

Under the impact of the COVID-19 pandemic, the world crude oil price has had a double impact on both the supply side and the demand side, leading to a sharp decline in oil prices in 2020 (World Bank, 2020). Vietnam's oil and gas industry is also not immune from the negative impact of this pandemic (Yen Ninh, 2021). The Vietnam National Oil and Gas Group (Petro Vietnam) and large oil and gas enterprises have been listed on the Vietnam stock market. This is an industry that plays an important role in Vietnam's economy in recent years (Phuong, 2021). However, in-depth studies on stock price volatility of Vietnam's oil and gas industry are limited. Therefore, this article will determine the factors affecting the price volatility of oil and gas stocks listed in Vietnam before the COVID-19 pandemic (Pre-COVID-19) and during the COVID-19 period (COVID-19).

The contribution of this study to the literature is in many respects. Firstly, it provides insights into the factors affecting stock price movements of oil and gas companies in Vietnam before and during the COVID-19 pandemic. Published studies in the context of COVID-19 on this topic are few and mainly focus on the leading countries of the world (Baek et al., 2020).

Second, previous studies on the impact of the COVID-19 pandemic mainly studied the short time period or the early stages of the COVID-19 pandemic in 2020 (Baek et al., 2020; Phuong, 2021) while the variant of coronavirus, Deltal, which appeared in 2021 with a fast-spreading speed, has had a negative impact on the Vietnamese economy (General Statistics Office, 2022) especially the southern provinces of Vietnam (Samuel, 2021). This article uses the period from the time Vietnam recorded its first COVID-19 patient in the first quarter of 2020 (Vndc, 2020) to the economy starting to transition into a new normal at the end of 2021 (David, 2022) for research during the COVID-19 period. For ease of comparison, the Pre-COVID-19 period also uses 2-year quarterly data (2018–2019) equivalent to the COVID-19 period. The comparison of the results of these two periods will provide empirical evidence on the changes in important factors affecting the stock prices of oil and gas companies, thereby providing useful recommendations for investors. investment and regulatory authorities.

Third, the research model using both macro-factors, oil price and financial factors in one equation is more comprehensive than previous studies (Vinh, 2014), so there may be endogeneity problems that Ngoc and Cuong's article (2016) has not been resolved. The general method of moments (GMM) is used to solve this problem and still ensure the reliable efficiency of the estimate.

Fourth, unlike previous studies (Vychytilová et al., 2019), this study shows that a higher inflation rate during the COVID-19 period results in lower stock price volatility of oil and gas companies.

This result is interesting but not too surprising when analyzing macro-factors in the two years 2020–2021. It implies that people believe in the effectiveness of government decisions to achieve the dual goal of controlling the epidemic and promoting economic growth. The COVID-19 period had a lower average inflation rate than the 2018–2019 period, so the increase in inflation rate during this period seems to be an early predictor of the recovery in aggregate demand and the prosperity of the economy.

The rest of the paper is sequenced as follows. Section 2 provides the theoretical background and empirical evidence. Section 3 is methods and data. The results and discussion are presented in Sect. 4. Finally, the conclusions and implications are presented in Sect. 5.

2 Literature Review

2.1 Theoretical Background

Markowitz's Portfolio Theory published in 1952 states that a portfolio is selected based on a comparative, risk-and-return analysis (Markowitz, 1991). According to this theory, a portfolio is considered efficient when there is the maximum return with the same level of risk, or the smallest risk with the same expected return. In fact, Markowitz's theory is not only applied to choosing an optimal portfolio (Kan & Zhou, 2007), but it is also used to find attractive stocks based on the relationship between risk and return (Phuong, 2022a).

Fama's efficient market theory (EMH) assumes that stock prices reflect all available information in the market (Fama, 1970). Besides, the "random walk" theory states that price fluctuations in the market are unpredictable (random nature). Therefore, past prices cannot predict future trends (Burton, 1973). However, in fact, studies show that the problem of information asymmetry often occurs in many stock markets, especially in developing countries. Therefore, although the information is published, it is not fully reflected in the stock price, price fluctuations generate abnormal returns (Phuong, 2022b).

Stock price volatility is the change in the price of a particular stock over a certain period of time (Robiyanto, 2017). It is a tool for measuring risk and has become one of the top concerns of securities investors (Guo, 2002). Because stock prices are unpredictable and fluctuate over time, investors (mostly risk averse) will choose a high proportion of stocks with low volatility rather than stocks with high volatility (Kinder, 2002).

2.2 Experimental Studies

Previous empirical studies on stock price volatility are usually around corporate dividend policy and have been carried out in many countries around the world such as UK, Australia, Malaysia, Bangladesh, Pakistan, and Vietnam.

Research on the Australian stock market in the period from 1972 to 1985, Allen and Rachim (1996) showed that increased size, increased income, increased leverage will increase stock price volatility; an increased payout ratio reduces stock price volatility. Allen and Rachim (1996) suggested that the positive relationship between firm size and stock price volatility is because large firms often have larger debt items of all kinds. In addition, large firms often have a negative relationship between earnings volatility and size. Allen and Rachim (1996) did not find any link between dividend policy and share price risk in the Australian stock market during this period.

Hussainey et al. (2011) pointed out that many financial indicators of the company have a significant impact on the stock price volatility of companies listed on the UK stock exchange in the period 1998–2007. Increased earnings volatility, increased long-term debt increases stock price volatility. The size of the market capitalization increases, the dividend payout ratio increases, and the dividend yield increases, reducing the volatility of shares listed in London. The regression coefficient of the asset growth variable is positive but does not significantly affect stock price movements in the UK during this period.

Using the least square regression method for construction and materials companies listed on the Malaysian stock exchange for the period 2005–2010, Zakaria et al. (2012) showed that dividend payout ratio, size positively affect stock price volatility. Financial leverage is measured by the debt-to-equity ratio, which has a negative effect on stock price volatility. Factors that do not significantly affect stock price changes of companies in the building materials industry include stock earnings, growth in market value to book value, and earnings volatility.

Studying 35 manufacturing companies listed on Bangladesh's Dhaka Stock Exchange (DSE) during 2004–2014, Habib et al. (2012) showed that the larger the size and the higher the dividend yield, the lower the price volatility of the companies. Factors including dividend payout ratio, earnings volatility and long-term debt-to-assets ratio have not significantly affected stock price volatility of manufacturing companies during this period.

Using panel data regression for 103 companies listed on the Hochiminh Stock Exchange, Vietnam in the period 2008–2012, Vinh (2014) commented on the regression results from the Fixed Effect Model (FEM). The higher the long-term debt-to-total assets ratio, the higher the asset growth, the higher the dividend payout ratio, the higher the volatility of the stock. In contrast, higher operating efficiency, higher company size, higher stock returns, lower stock volatility. However, Vinh (2014) only uses financial indicators related to the characteristics of enterprises, but has not used macro-factors in research models.

Anh and Nhi (2015) studied 165 companies listed on Vietnam stock market in the period 2009–2013 on the influence of dividend policy on stock price volatility.

The annual regression results according to the FEM model show that increasing cash dividends or increasing stock dividends will increase stock price volatility. As a result, dividend yield has a positive impact on stock price volatility. In addition, larger firms tend to have lower price volatility, while firms with a larger ratio of long-term debt to total assets have larger price fluctuations. Similar to Vinh (2014), Anh and Nhi's research (2015) also did not use macro-factors in research models.

Using data from 319 companies listed on the Malaysian Stock Exchange from 2003 to 2013, Hooi et al. (2015) studied the relationship between stock price volatility and dividend policy instruments. Hooi et al. (2015) indicated that long-term earnings and debt have a positive relationship with stock price volatility, whereas firm size has a negative relationship with stock price. Hooi et al. (2015) have not found the impact of asset growth on stock price volatility for companies listed on the Kuala Lumpur Stock Exchange.

Similar to Vinh (2014), Ngoc and Cuong (2016) use the FEM model to study the factors affecting stock price volatility on the Vietnam stock market in the period 2008–2013. The results of Ngoc and Cuong (2016) show that return on assets, stock returns, financial structure, and inflation rate have a positive relationship with the stock price volatility. GDP growth rate and firm size (ln total assets) have a negative relationship with stock price volatility. However, Ngoc and Cuong (2016) have not mentioned and dealt with the possible endogenous problem in the research model. Because when the endogenous problem is handled, it can affect the regression results.

Research in Turkey on the relationship between GDP and stock prices in the period of Q2/1989–Q2/2014, Tursoy and Faisal (2016) show stock prices and GDP are causally related in the long run. Specifically, economic growth and stock price volatility have a direct relationship with each other, economic growth has a one-way effect on stock prices in the short term.

Vychytilova et al. (2019) studied the macro-factors affecting the stock price volatility of the auto-industry. Using the quarterly Yahoo Finance Database for 39 auto-manufacturers listed on stock exchanges in 11 countries between 2000 and 2017, Vychytilová et al. (2019) pointed to higher GDP growth, higher inflation rates and a developed stock market increasing the stock price volatility of the auto-industry. Conversely, an increase in the industrial production index will reduce the price volatility of this industry's stock.

Using panel data of 200 non-financial firms in Pakistan for the period 2000–2017, Islam et al. (2019) pointed out the factors related to stock price volatility of these companies including company size, leverage, earnings volatility, asset growth, and dividend policy. Earnings volatility affects stock price volatility of non-financial companies during the crisis, dividend payout ratio impact on the price movements of these companies in the period before and after the crisis.

Hoa and Nam (2019) used financial data of non-financial companies listed on the Vietnam market in the period 2008–2015 to study the impact of stock price volatility on dividend policy and ownership structure. Research results from the GMM model show that ownership structure and stock price volatility have a positive relationship, but have not found a significant relationship between dividend policy and stock price volatility. Hoa and Nam (2019) emphasized that the role of institutional investors

(both State investors and foreign investors) has ceased to be significant after the global financial crisis. However, Hoa and Nam (2019) have not shown the relationship of macro-factors and other financial factors to stock price volatility in Vietnam.

Recently, Baek et al. (2020) studied the price movements of stocks on the US stock market in two periods. Pre-COVID-19 period from January 2, 2020, to February 23, 2020, and COVID-19 period from February 24, 2020, to April 30, 2020. Baek et al. (2020) indicated that oil and gas stocks are one of the sectors most affected by negative aggregate demand shocks. When volatility is measured according to total risks and idiosyncratic risks, oil and gas stocks are classified into the industry groups with the highest price volatility for both study periods.

Regarding the oil and gas industry in Vietnam, using the event research method, Phuong (2021) pointed out that the COVID-19 pandemic has affected investor psychology, especially in the oil and gas industry. The cumulative abnormal profit of the oil and gas industry was negative when Vietnam had the first COVID-19 case and the first outbreak in early March 2020. but the industry's cumulative abnormal profit was positive when Vietnam announced the epidemic nationwide and implemented a lockdown to limit the spread of the disease. However, so far, there has been no published research related to determining the factors affecting the stock price volatility of Vietnam's oil and gas industry in the Pre-COVID-19 period and during this pandemic. Therefore, this article will fill this gap.

3 Data and Methodology

Vietnam is mentioned as one of the few successful countries when implementing the dual strategy of both controlling the COVID-19 pandemic well and stabilizing the socioeconomy to support economic growth (Mai & Cuong, 2022). According to Vietnam's Ministry of Finance, in the first 10 months of 2021, Vietnam has spent about 4.5 billion USD (equivalent to 95.1 trillion VND), accounting for 67.92% of the total 6.67 billion USD (equivalent to 140 trillion VND expected to support) to reduce taxes, land rents, fees and charges extended to support businesses and households affected by the COVID-19 pandemic (Ministry of Finance, 2022). About 120,000 businesses and nearly 20,000 business households and individuals have received support. Under the management of the Vietnamese government, the coordination between the relevant ministries and sectors, the support and consensus of the people when strictly implementing the regulations to limit the spread of COVID-19 have made Vietnam among the few countries in the world that still maintain positive growth in the two years 2020–2021. Vietnam's gross domestic product (GDP) growth in 2020 and 2021 is 2.91% and 2.58%, respectively, while Vietnam's core inflation rate in these two years remains low at 2.31% and 0.81% (General Statistics Office, 2021, 2022). Therefore, it can be predicted that Vietnam's favorable macroeconomic background will help reduce the volatility of stock prices of listed oil and gas companies.

3.1 Model and Estimation Method

Based on previous studies, in order to determine the factors affecting stock price fluctuations in the oil and gas industry, the research model is expressed by the following function:

$$\text{SPV} = \text{F(OE; SIZE; DA; OP; CPI; GDP)} \tag{1}$$

where

Stock Price Volatility (SPV): is the movement of stock prices around the average over a period of time (Robiyanto, 2017). A stock is considered highly volatile if the price fluctuates a lot during that time period. Conversely, a stock that is less volatile has lower volatility. Calculating volatility based on a stock's high and low is said to be more efficient than calculating the standard deviation of the closing price at the end of the day (Parkinson, 1980), and this calculation has been used in many studies (Parkinson, 1980; Vinh, 2014; Hooi et al., 2015; Hoa & Nam, 2019).

$$\text{SPV} = \sqrt{\frac{H_i - L_i}{\left(\frac{H_i + L_i}{2}\right)^2}} \tag{2}$$

- H_i and L_i represent the highest and lowest prices of stock i in a quarter, respectively.

Independent variables

- Operating Efficiency (OE): is the percentage between profit after tax and equity.
- Firm size (size) is the natural logarithm of total assets.
- Debt Ratio (DA): is the ratio between total debt and total assets.
- Oil price (OP): calculated in USD/barrel
- Inflation rate (CPI): is the consumer price index in Vietnam calculated quarterly.
- Economic growth (GDP): is the growth rate of gross domestic product in Vietnam calculated quarterly.

Estimation method:

Previous studies in Vietnam related to this topic often used FEM estimation on panel data (Vinh, 2014; Anh & Nhi, 2015; Ngoc & Cuong, 2016), and the endogeneity problem has not been mentioned or processed (Ngoc & Cuong, 2016) when the model uses macro-factors. This study estimates GMM for both periods and regression according to Eq. (1) including three groups of factors: oil price, macro-factors, and financial factors of enterprises. The advantage of GMM is to overcome the problems of autocorrelation and variable variance in the research model. Besides, the GMM estimate also handles the endogeneity problem in the model to ensure that the results from the model are reliable.

3.2 Data

Research data from 2018 to 2021, including three main groups: financial data, oil price, and macro-data.

(i) Financial data is collected from quarterly financial statements published on websites of oil and gas companies listed on Vietnam stock market.
(ii) Oil price data is collected quarterly on the website: https://www.investing.com/.
(iii) Macro-data including economic growth (GDP) and inflation rate (CPI) are collected quarterly. on the website of the General Statistics Office of Vietnam https://www.gso.gov.vn/.

Vietnam discovered the first patient infected with COVID-19 in early 2020 (Vndc, 2020), after experiencing many waves of COVID-19 infection, by the end of 2021 Vietnam will transition to a new normal life (David, 2022) when vaccine coverage among the population is already high. Therefore, the dataset is divided into 2 periods. The period 2018–2019 is the time before the COVID-19 pandemic (Pre-COVID-19), and the period from 2020–2021 is the time when Vietnam is most affected by the COVID-19 pandemic (COVID-19).

4 Results and Discussion

Figure 1 shows that crude oil prices trended down from 2018Q4 and bottomed out in 2020Q1 then established an uptrend until the end of 2021. During the COVID-19 period, GDP growth had two sharp declines in the first two quarters of 2020, when Vietnam recorded the first infection and the nationwide lockdown took place at the beginning of the second quarter of 2020, and in the third quarter of 2021. showing many new variants of COVID-19 with a faster spread rate and higher mortality rate than the previous period. Similar to GDP growth, the inflation rate dropped sharply in the first half of 2020 but then fluctuated in a narrow band for the rest of the year.

4.1 Descriptive Statistics

In the period 2018–2021, there are a total of 15 companies listed in the oil and gas industry on the Vietnam stock market with quarterly data. Therefore, the dataset in Table 1 shows that there are a total of 240 firm-quarter observations (Table 1) that are evenly divided into two periods: the period before COVID-19-Pre-COVID-19 (2018–2019) and the period when the disease broke out in Vietnam-COVID-19 (2020–2021).

Except for the size and debt-to-asset ratio of oil and gas companies, the remaining factors in Table 1 all show both the economy in general and the oil and gas

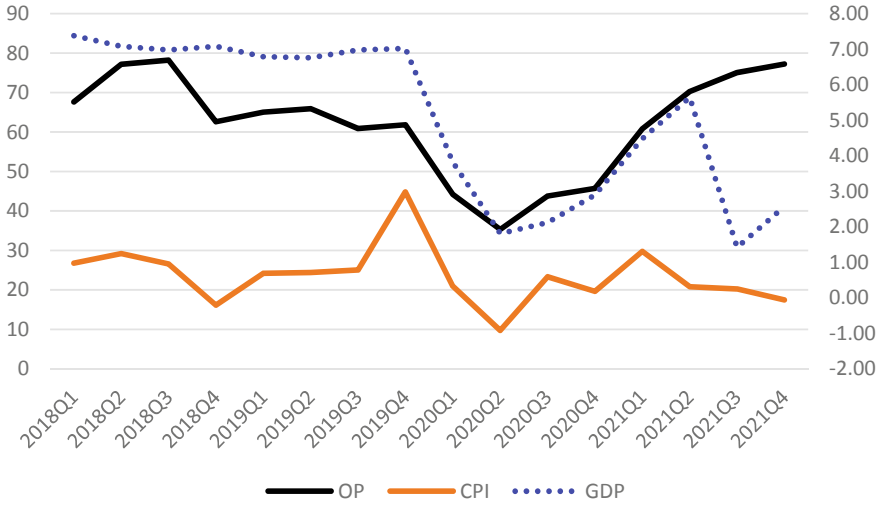

Fig. 1 Quarterly chart of oil prices, GDP, and CPI for the period 2018–2021. *Source* Author's compilation. *Notes* Left vertical axis (USD/barrel); right vertical axis (%)

Table 1 Descriptive statistical results of variables included in the research model

Variable	Obs	Mean	Std. dev	Min	Max
Pre-COVID-19					
SPV	120	31.400	18.578	1.464	103.571
l1SPV	105	32.060	18.272	1.464	103.571
roe	120	0.050	0.119	−0.484	0.293
size	120	28.974	1.856	25.010	31.850
op	120	67.400	6.316	60.880	78.230
cpi	120	1.014	0.846	−0.210	2.980
gdp	120	7.009	0.181	6.760	7.380
da	120	0.543	0.146	0.202	0.810
COVID-19					
SPV	120	45.052	22.741	15.117	145.455
l1SPV	120	41.407	20.357	6.409	103.448
roe	120	0.020	0.124	−0.515	0.237
size	120	28.932	1.945	25.250	32.000
op	120	56.543	15.306	35.310	77.213
cpi	120	0.249	0.585	−0.920	1.310
gdp	120	3.095	1.359	1.420	5.640
da	120	0.531	0.139	0.203	0.787

Source Author's calculations

Table 2 Correlation coefficient matrix between variables in the regression model

(i)\(ii)	SPV	L1SPV	roe	size	op	cpi	gdp	da
SPV	*1*	0.2515	−0.2686	−0.3636	0.0621	−0.0009	−0.0624	−0.1612
L1SPV	0.506	*1*	−0.3547	−0.2988	−0.0353	−0.2321	−0.0744	−0.09
roe	−0.313	−0.283	*1*	0.513	0.1025	0.0246	0.0005	−0.1254
size	−0.305	−0.233	0.620	*1*	0.003	−0.0022	0.0001	−0.0064
op	0.174	0.141	−0.035	0.010	*1*	0.2702	0.1929	0.0232
cpi	−0.070	−0.153	−0.060	−0.002	−0.020	*1*	0.4798	−0.0108
gdp	0.074	0.024	−0.044	0.003	0.184	0.142	*1*	0.0233
da	−0.170	−0.155	−0.179	−0.057	0.100	−0.009	0.026	*1*

Source Author's calculations
Notes (i) is Pre-COVID-19; (ii) is COVID-19

industry listed in Vietnam in particular have been strongly affected by the COVID-19 pandemic.

Comparing the statistical results in the two periods shows: The average price volatility of oil and gas stocks during the COVID-19 period was 43.48% higher (=45,052/31,400 − 1) compared to the Pre-COVID-19 period. As a result of the lockdown measures, the return on equity of the average oil and gas companies fell from 5% (Pre-COVID-19) to 2% (COVID-19); average economic growth decreased from 7% (Pre-COVID-19) to 3.09% (COVID-19), the inflation rate decreased from 1 to 0.25%. The average oil price in the period of Pre-COVID-19 from 67.4 USD/barrel to 56.5 USD/barrel, corresponding to a decrease of 16.17%.

4.2 Correlation Matrix

The correlation coefficient matrix between pairs of variables is in the range [−0.63; 0.63], showing no multicollinearity (Farrar & Glauber, 1967). Therefore, the variables are suitable for inclusion in the research model in both periods (Table 2).

4.3 Results and Discussion

The test results in Table 3 show that Mean VIF and VIF components in both periods are less than 2, so the problem of multicollinearity between variables is low. The AR(2) test shows that there is no quadratic multicollinearity problem. The Hansen test is not statistically significant, showing that the GMM estimate is consistent with the data for both study periods.

Table 3 Factors affecting stock price volatility of listed oil and gas companies in Vietnam

Variable	VIF	Pre-COVID-19	COVID-19	VIF
L1SPV	1.22	0.275***	−0.079	1.28
roe	1.79	46.896	219.228	1.52
size	1.65	−3.684	−29.328**	1.4
op	1.08	0.416***	−0.007	1.11
cpi	1.06	−0.086	−6.056**	1.45
gdp	1.06	16.456***	−0.02	1.31
da	1.11	9.024	−269.055	1.05
_cons		−21.98	1036.632**	
Mean VIF	1.28			1.3
AR(1)	0.073		0.092	
AR(2)	0.130		0.135	
Hansen test	0.979		0.163	

Note *,**,*** have significance at 10%, 5%, and 1%, respectively
Source Author's calculations

The regression results in Table 3 show that the factors affecting the stock price volatility of oil and gas companies change significantly in the two research periods. This change occurs in both macro-factors and characteristics of enterprises in the industry.

Pre-COVID-19 period:

There are three variables that significantly affect the stock price volatility of oil and gas companies during the Pre-COVID-19 period: stock price volatility in the previous quarter, oil price and economic growth.

The one period lag in stock price movements of oil and gas companies during the Pre-COVID-19 period had a positive impact on the stock price volatility of these companies in the current period. It shows that in the normal economy, the stock price volatility in the previous period plays an important role in the stock price movement of the oil and gas industry in the next period.

The variable *op* has statistical significance at 1%, showing that the change in oil price is also the cause that affects the stock price volatility of the oil and gas industry. During this period, the oil price tends to decrease, so the information about the increase in oil price will make the stock price volatility of the oil and gas industry higher. Because when oil prices increase, investors will expect more positive profits of oil and gas companies, leading to a larger difference between the highest price and the smallest price of stocks during the Pre-COVID-19 period. Besides, the difference between the highest and lowest oil prices by quarter during the Pre-COVID-19 period was about 28.5%, much lower than the 2.19 times during the COVID-19 period (Table 1).

GDP variable: GDP growth is an important factor affecting the stock price volatility of listed oil and gas companies. At 1% significance level, higher GDP growth leads to higher stock volatility. This positive correlation implies that when the economy grows, the demand for energy will increase. Earning expectations for companies in the energy sector such as the oil and gas sector will be more positive, underpinning the rise in energy sector shares. is the cause of greater price volatility than stocks of this industry. This result is similar to the study of Vychytilová et al. (2019) for the auto-industry in the period 2000–2017 but opposite to the results of Ngoc and Cuong (2016) for some companies on the Vietnam stock market.

COVID-19 period:

The factors affecting the volatility of oil and gas stock prices during the period when Vietnam was affected by the COVID-19 pandemic have completely changed compared to the period of Pre-COVID-19. All three variables that were statistically significant in the Pre-COVID-19 period were no longer statistically significant during the COVID-19 period. This result shows that the impact of the COVID-19 pandemic has changed investors' expectations about this sector's stocks. During the COVID-19 period, there were two important factors affecting the stock price volatility of the oil and gas industry, including company size and inflation rate.

Size: At the 1% significance level, the larger the firm's size, the lower the stock price volatility. In other words, the higher the asset value of oil and gas enterprises, the lower the stock price volatility during the COVID-19 period. This result can be explained by the fact that large oil and gas corporations/enterprises are held with the controlling shareholder being the State. Therefore, the negative effects on investors' psychology when the world oil price dropped sharply in the second quarter of 2020, the largest oil and gas corporations/companies in Vietnam had a smaller reduction but the oil companies gas on a smaller scale. Firm size negatively affects stock price volatility in this study, supporting the study of Hussainey et al. (2011) on the UK stock market; Habib et al. (2012) for manufacturing companies in Bangladesh; Hooi et al. (2015) listed companies in Malaysia. However, it does not support the study of Allen and Rachim (1996) in Australia; building material companies in Malaysia (Zakaria et al., 2012).

CPI: Regression results in Table 3 show that a higher inflation rate during the COVID-19 period has a greater impact on reducing oil and gas stock price volatility. This result is different from the study of Vychytilová et al. (2019) for the auto-industry. It should be noted that the Government of Vietnam has controlled commodity prices very well during this period, so the average inflation rate (means) during the COVID-19 period was 0.249 compared to 1.01 during the Pre-COVID-19 period (Table 1). Therefore, the increase in the inflation rate during the COVID-19 period shows the recovery of consumer demand in the economy when Vietnam has well-controlled the epidemic from 2020 to early 2021. It implies that the expectation of the recovery of consumer demand increasing will have the effect of reducing the price volatility of oil and gas stocks.

5 Conclusions and Implications

5.1 Conclusions

This article uses the GMM method to determine the factors affecting the stock price volatility of Vietnamese oil and gas companies in the period 2018–2021. The quarterly research results of 15 listed oil and gas companies show that the stock price volatility of these companies is affected by macro-factors and other factors in both periods. The periods are Pre-COVID-19 (2018–2019) and the period COVID-19 (2020–2021).

Pre-COVID-19 period: When oil prices are in a downtrend, a bullish reversal in oil prices has a significant effect on higher stock price volatility. Higher GDP growth in the context of a downward trend in oil prices during the Pre-COVID-19 period will stimulate higher volatility in oil and gas stock prices. Because an economy is growing, the demand for energy increases; a downward trend in energy costs (falling oil prices) will benefit the economy but increase the risks to the share price of the oil and gas industry due to increased stock price volatility.

COVID-19 period: For an economy that is slowing down and facing difficulties due to the pandemic, leading oil and gas companies will have lower stock price volatility than smaller businesses. This is because it is believed that these enterprises will have more advantages over other enterprises because they have a controlling shareholder which is the State, and they have a better cumulative profit buffer than other businesses.

An interesting result in this study is that higher inflation rates lower volatility in oil and gas stocks during COVID-19. This result comes in the context of world oil prices bottoming out in 2020Q2 and establishing an upward trend thereafter, and Vietnam's quarterly average inflation rate during this period is much lower than during the Pre-COVID-period. This result implies that investors believe in the effectiveness of the government's welfare measures in supporting essential items to the majority of people during this period. It has kept the inflation rate low. Therefore, rising inflation rate on a low inflation background is the earliest positive signal from the economy. In other words, in the condition that the economy is slowed down and disrupted by the epidemic together with low inflation rate, the signals of slight increase in inflation are considered to imply the recovery of the economy, leading to the potential for economic recovery. increase oil price, increase profit of oil and gas industry. It results in lower volatility in oil and gas stock prices in this case.

Implications.

For investors: In an economy facing difficulties due to non-financial factors such as epidemics, the selection of businesses in the portfolio plays a particularly important role. Quantitative results from this study show that in a difficult economic situation due to epidemic factors, the stocks of leading enterprises will have lower price fluctuations and are considered safer. Because they have a thicker cumulative profit cushion, their ability to dominate the market is better than the rest of the businesses.

Besides, investors also note that macro-factors and world oil prices that have a significant impact on stock price volatility of the oil and gas industry will change during the Pre-COVID-19 period compared to the period when the economy is being negatively affected by the epidemic. The understanding when comparing the factors affecting the stock price volatility of the oil and gas industry will help investors better cope with similar situations in the future.

For the operator: The successful implementation of the dual goals of controlling the epidemic, stabilizing macro-indicators such as inflation and maintaining positive economic growth in the period 2020–2021 is a success of the Government of Vietnam. This helps to reduce volatility in the price of energy stocks such as oil and gas, which helps reduce risk in the stock market. This success story of Vietnam is considered as experience in dealing with unusual situations such as epidemics for other countries to refer to.

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