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The Relationship Between Oil Price Fluctuations, Power Sector Returns, and COVID-19: Evidence from Pakistan

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Abstract

Oil prices have become more volatile as a result of global economic contraction and control measures. Before and during the COVID-19 crisis, this study examines the relationship between oil price swings and daily stock returns in the power sector. The impact is investigated using a panel Vector Autoregressive (VAR) model. Granger causality tests are used to see if oil prices are effective in predicting returns. The dynamic impact of supply shocks is studied using Impulse Response Functions (IRFs). From January 2011 to May 2021, the study used daily data from all listed power sector enterprises on the Pakistan stock exchange. To investigate the differences in reactions between the Pre-COVID and COVID eras, the sample was separated into two groups. Oil shocks are inversely associated with daily firm stock returns. The conclusions are further supported by the lack of impact of stock prices on oil prices. The relationship, however, deteriorates during the COVID pandemic. We could not uncover any evidence of a significant relationship. In developing countries that rely on oil imports, the study sheds light on the utility of oil price shocks in daily stock return predictions.

Keywords: Daily Stock Returns, Oil Prices, Power Sector, COVID-19, Panel VAR

JEL Classification Code: G15, G12, G20, E17

1. Introduction

During the COVID-19 period, oil price volatility was particularly high, and global negative trends have caused concern in the power sector (Rao, 2021). The presence of crude oil has been defined as an essential commodity that focuses on demand and supply variations to predict market prices and has been identified as the main factor in modern development that can affect the country's financial markets and the real economy (Huang et al., 2018). Global warming, environmental and energy security in exporting countries, and their political instability are all factors that influence this variation (Alam et al., 2020; Habiba & Zhang, 2020; Ozturk & Cavdar, 2021). This fluctuation in oil prices is a significant concern for the oil-exporting countries, because of their exposure (Alshihab & AlShammari, 2020; Echchabi & Azouzi, 2017). Oil importing developing countries which lack infrastructure, capacity shortage, losses in transmission and distribution, governance issues, and circular debts issues are equally susceptible to such volatilities (Ullah et al., 2017). According to Khan et al. (2019), the presence of oil prices has been stated as an essential factor for the economy, and their variations can also influence in a negative way to the stock markets.

According to the equity valuation theory, stock prices are determined by the discounted values of future cash flows and their sum (Hashmi et al., 2021). However, research demonstrates that exogenous shocks affect stock market outcomes. According to Moya-Martnez et al. (2014), fluctuations in oil prices could affect stock returns in developed economies in the event of a spike in these prices, which could influence production costs and finally result in a quick change in cash flows. According to Sedighi et al. (2019), Oil fluctuations are a significant component that might induce differences in the stock market by causing fast highs and lows in its pricing. The investigation of oil

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fluctuations on stock returns or financial markets has gained momentum in the recent past (Nazif Çatık et al., 2020).

There have been different studies on sector returns in the context of a developed country (Nazif Çatık et al. 2020). However, there is still a dearth of empirical evidence in the context of developing countries, especially in the COVID-19 period. The study aims to investigate how price shocks impact power sector stock returns in countries that are oil importers with heavy dependency on oil for power generations.

Pakistan is an exceptional case study for this phenomenon because its power sector relies heavily on oil. According to Waheed et al. (2018), as an oil importer, oil price shocks may significantly impact the development of the power sector and the country's progress. The increase in oil prices has been noted as a key source of misery in developing countries, as it has resulted in lower economic growth, power sector development, and electrical supply shortages (Yasmeen et al., 2019). Despite significant development since its inception, Pakistan's power sector continues to struggle to enhance its financial output due to a lack of infrastructure and electricity shortages (Tiep et al., 2021). The power sector has a problem with increasing circular debt and supply-demand imbalances, which impedes their performance and slows economic growth (Qazi & Jahanzaib, 2018). Another key issue between different companies has been cash flow, which has hampered the power sector's ability to function properly. As a result of the difficulty, payments to oil companies are delayed, resulting in a shortage of oil for the power industry (Zameer & Wang, 2018). Stagflation has also come from oil price shocks (Atiq & Farhan, 2018). According to Waheed et al. (2018), the continuous increase and pushes in oil prices create a hindering factor in financial earning, due to which investors were found less interested in stocks that reduce the stock returns in Pakistan.

The power sector crises, generation, and distribution concerns have been the focus of previous research in Pakistan, but there is a paucity of literature on sectoral stock returns (Qazi & Jahanzaib, 2018). Furthermore, because of the simultaneous worldwide supply and demand shocks, the COVID-19 crisis has been described as a distinct crisis from the 2008 crisis (Mohammad, 2021; Mohammad, Muhammad, & Muhammad, 2021). The following questions are addressed in this research: What are the returns on an oil-dependent country's electricity sector, and how did the connection change during the COVID-19 pandemic? To test this phenomenon, we use panel vector autoregressive regression. For both periods of expansion and recession, the relationship's direction is established. The study uses daily data of all listed power sector firms in the Pakistan stock exchange from January 2017 to May 2021.

2. Literature Review

Studies on the macroeconomic effects of oil shocks extend back to (Hamilton, 1983), which documented a spike in oil prices in the United States before postwar recessions. The recessions followed a similar pattern (Hamilton, 2011). Moreover, oil price shocks appear to have a negative impact on economic development and macroeconomic indicators around the world (Cunado & Pérez de Gracia, 2003; Engemann et al., 2011; Hamilton, 2003, 2011).

The literature on oil price shocks includes evidence of their impact on trade balances, exchange rates, inflation, etc. Evidence on oil price and daily returns have mixed findings. Economic policy coupled with exogenous shocks influence stock returns (Kang & Ratti, 2013). Some studies suggest a negative impact of oil price increase on stock returns and that they can be used for predicting stock returns (Driesprong et al., 2008; Jones & Kaul, 1996). Others, however, find an insignificant relationship between the two (Chen et al., 1986). This relationship may be sector-specific (Lee et al., 2012).

Using VECM, Cunado and de Gracia (2014) discovered that it was inversely related. This association has also been investigated in other studies (Bouri et al., 2016; Ciner, 2001; Jones & Kaul, 1996; Kaul & Seyhun, 1990; Kilian & Park, 2009; Lee et al., 2012; Shabbir et al., 2020). The majority of research into the link has focused on how stock indices respond to shocks, with some focusing on the influence of supply shocks on stock indices.

Responses to shocks vary between nations and have diverse effects on real stock returns, according to consensus (Jones & Kaul, 1996; Rao, 2021). The type of the oil shock may have a distinct influence on stock returns (Park & Ratti, 2008).

In their analysis of US data, Kilian and Park (2009) found no indication of oil supply shocks affecting monthly returns. Ongsakulvasu and Liammukda (2020) find a positive risk and return relationship for EU SA and US oil markets. Similarly, Güntner (2014) finds comparable results. Oil prices have an impact on the oil and energy sector but have no effect on the stock market. Also, when a country's markets and economy are heavily reliant on oil income, it can have a tremendously detrimental impact. As a result, this relationship could have an impact on a variety of macroeconomic indicators, including stock market activity. According to Jalil et al. (2009), oil prices should not be utilized to predict stock returns.

Anyalechi et al. (2019) investigated the same and found that the relationship was unaffected by time horizons. According to Alamgir and Amin (2021), an increase or decrease in oil prices has been recognized as a significant factor affecting stock market returns, and both short-run and long-run models have identified the same result. However, because corporations may be adopting emerging renewable technologies instead of crude oil, this association is minor, indicating that it may not affect stock prices.

The function of oil price is critical in importing countries since it can have a negative impact on growth, but Masood et al. (2019) found that oil has no impact on returns in the G7 countries. Furthermore, economics literature has mostly focused on addressing this issue, as it is critical for policy and investment decisions (Bhuyan et al., 2021). However, because of the complexities of the connection, it should be approached with prudence (Hedi Arouri et al., 2011).

According to Bhuyan et al. (2021), the oil-stock nexus has a major impact on each other since a decrease in oil prices can lower stock market returns. There is a significant relationship between these two parameters, and it varies by country, as oil-producing countries may profit from this knowledge for better investment and risk management (Bouri et al., 2016). According to Hamilton (2003), an increase in oil price is more essential than a fall in the oil price since an increase could disrupt consumer or corporate expenditure in the equities markets. However, according to Zahran (2019), oil price declines are more effective than price increases.

The availability of oil has been described as a critical aspect for energy and as a country's greatest requirement, therefore its pricing can impact the country's performance. Depending on the rationale for the changes, oil prices may have a different impact on returns (Shabbir et al., 2020). Najaf and Najaf (2016) come to identical conclusions. Oil price variations have been identified as critical in altering stock markets in both the short and long run and can aid in the development of national economies. Oil price variations can add to asset price risk at the industry level (Elyasiani et al., 2011). Studies suggest variability in responses across industries and also based on the price specifications. In analyzing G7 economies, Lee et al. (2012), find a significant impact on sectoral indices.

According to Waheed et al. (2018), the continual rise and push in oil prices create a stumbling block in financial earnings, as investors have become less interested in stocks, lowering stock returns in Pakistan. Although there is a growing body of work on this topic, no effective results have been found in terms of oil prices on stock markets. Moreover, there is a scarcity of studies on industry or sectoral responses to oil shocks, particularly in oil-dependent developing countries, even less so during COVID-19.

3. Methodology

The study has used the following econometric model to achieve the research purpose based on the model lag selection criterion. The model has the following form:

$$\text{DailyReturn}_{i,t} = \alpha_0 + \sum_{j=1}^{m} \alpha_{1,j} \text{DailyReturn}_{i,t-j} + \sum_{j=1}^{m} \alpha_{2,j} \text{OilPrice}_{i,t-j} + \tau_i + \mu_{it} \quad (1)$$

$$\text{OilPrice}_{i,t} = \beta_0 + \sum_{j=1}^{m} \beta_{1,j} \text{OilPrice}_{i,t-j} + \sum_{j=1}^{m} \beta_{2,j} \text{DailyReturn}_{i,t-j} + \eta_i + \nu_{it} \quad (2)$$

In the model, *i* refers to the firm and *t* refers to the time period. "*m*" is the lag number and are individual fixed effects. The daily return represents the daily returns using the opening and closing prices of firms and oil price refers to the daily oil price. In the condensed form the model can be viewed as

$$Y_t = G_1 Y_{t-1} + e_t \quad (3)$$

Where $Y_t = \begin{pmatrix} y_{1t} \\ y_{2t} \end{pmatrix}$, $G_1 = \begin{pmatrix} g_{11} & g_{12} \\ g_{21} & g_{22} \end{pmatrix}$, and $e_t = \begin{pmatrix} e_{1t} \\ e_{2t} \end{pmatrix}$

In the model, the method which has been used is Panel vector autoregression (VAR), whereas Y_t donates for the Oil Price and Daily Stock Return and G_1 is the unitary matrix and whereas Y_{t-1} belongs to the previous value of Oil Price and Daily Stock Return and e_t is the error or residual term.

Daily data has been compiled from January 3rd, 2017 to April 26th, 2021 on daily basis for all the power sector firms listed on the Pakistan Stock Exchange, with a total of 16890 daily observations. The stock market return data has been gathered from Pakistan Stock Exchange (PSX) database, while oil prices data have been compiled from the online database of West Texas Intermediate. Daily stock returns are calculated using the opening price minus closing price divided by the opening price.

To see the impact of COVID-19 on the relationship, the sample is divided into a pre-COVID-19 and COVID-19 period. During the COVID-19 period, the model selection criteria are revised, and 3 lags are used since the panel VAR becomes unstable at lag 1. Figure 1 reports the average daily returns.

3.1. Preliminary Diagnostics

Model selection criteria for the complete sample, pre-COVID period, and COVID-19 period are listed in Table 1a, 1b, and 1c. For the complete and pre-COVID period sample, since most of the criteria have the lowest value in Lag 1, the study estimates the panel VAR using the GMM technique at lag 1. For the COVID-19 sample 3 lags are used for estimating the panel var. The VAR stability diagnostic results are reported in the Appendix as A1 A2 and A3.

4. Results

The relationship between stock market returns and oil prices has gathered a lot of public attention because oil prices have shown exceptional volatility which has eventually increased the uncertainty of the financial markets as well as the whole economy. Table 2 shows the result of panel vector autoregression (VAR) analysis based on GMM estimation of the complete sample.

Oil prices have a negative and significant coefficient, although the influence is minimal. The study uses dollar prices for oil, and the results show that an increase in the currency causes stock returns to fall by 0.1 percent. This adds to the body of evidence pointing to a negative association between Pakistani power and energy companies. According to Waheed et al. (2018), the continual rise and push in oil prices create a stumbling block in financial earnings, as investors have become less interested in stocks, lowering stock returns in Pakistan. This may be one factor that explains our results. This is finding is consistent with the other global findings (Driesprong et al., 2008; Jones & Kaul, 1996). The results suggest the absence of reverse causality. To confirm these results a panel granger causality test is carried out. Table 3 reports the findings.

Oil prices have no causal association with stock market returns, as seen in the table above, implying that changes in oil prices may not contribute to changes in stock market returns in Pakistan's power and energy industry. Stock market returns, on the other hand, have a one-way causal link with oil prices, implying that a change in stock market returns in Pakistan's power and energy sector causes a change in oil prices.

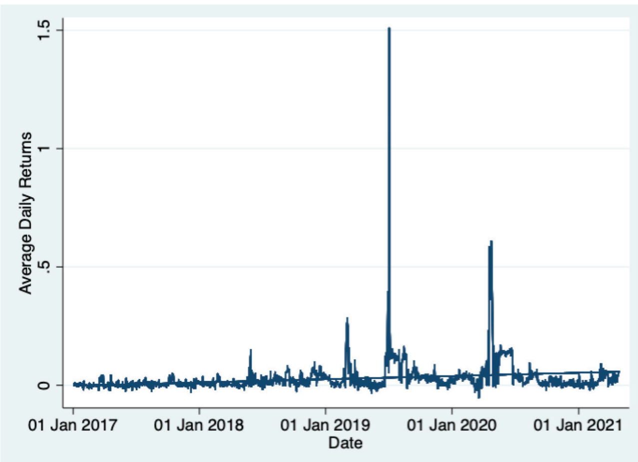

Figure 1: Average Daily Returns in the Power Sector Over Time

Table 1a: Running Panel VAR Lag Order Selection on Estimation Sample (Complete Sample)

Lag	CD	J	J *p*-value	MBIC	MAIC	MQIC
1	0.901	48.43	0	–92.202	16.43	–21.124
2	0.962	22.81	0.029	–82.664	–1.19	–29.355
3	0.94	8.229	0.411	–62.087	–7.771	–26.548

Table 1b: Running Panel VAR Lag Order Selection on Estimation (Pre-COVID Sample)

Lag	CD	J	J *p*-value	MBIC	MAIC	MQIC
1	0.947	25.175	0.067	–109.584	–6.825	–43.013
2	0.945	11.865	0.457	–89.204	–12.135	–39.276
3	0.778	4.839	0.775	–62.54	–11.161	–29.255

Table 1c: Running Panel VAR Lag Order Selection on Estimation (COVID Sample)

Lag	CD	J	J *p*-value	MBIC	MAIC	MQIC
1	0.921	88.844	0.000	–32.666	56.844	23.967
2	0.985	20.575	0.057	–70.558	–3.425	–28.083
3	0.96	4.569	0.803	–56.186	–11.431	–27.87

Table 2: Panel VAR GMM Estimation - Complete Sample

	Coef.	Std.Err.	z	*P* > *z*	95%Conf.	Interval
Oil Prices						
L1. Oil Prices	0.765***	0.012	62.33	0.000	0.741	0.789
L1. Stock Return	0.318	0.286	1.11	0.265	–0.241	0.878
Stock Return						
L1. Oil Prices	–0.001*	0.001	–1.86	0.063	–0.002	0.000
L1. Stock Return	0.445*	0.237	1.87	0.061	–0.02	0.91

Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.001.

Table 3: Granger Causality - Complete Sample

Equation/Excluded	Chi²	df	Prob. > Chi²
Oil Prices			
Stock Return	1.242	1	0.265
ALL	1.242	1	0.265
Stock Return			
Oil Prices	3.452	1	0.063
ALL	3.452	1	0.063

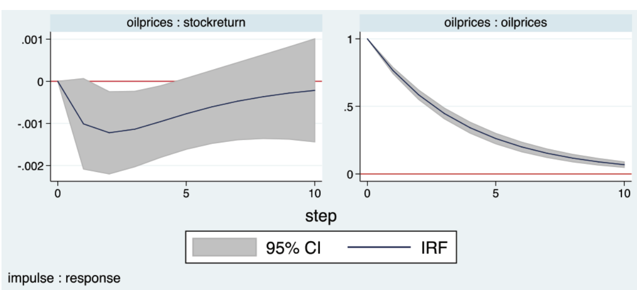

Figure 2: All Sample Impulse Response Function

The impulse response is depicted in Figure 2. In response to negative oil price shocks, daily stock returns fall with a one-day lag and mean reversion occurs within ten days. The pre-COVID sample is used to see if there is any variation in the responsiveness of daily stock returns to oil prices. The results reveal that daily returns have a similar negative sensitivity to oil price shocks as expected by the entire sample. The reaction of daily stock returns to oil price is larger if only the pre-COVID times are studied rather than the entire sample. Table 4 summarises the findings.

The pre-COVID sample also supports the earlier findings of unidirectional causation running from oil prices to daily stock returns (Table 5).

Splitting the sample into two parts causes that for the pre-COVID period the response was larger and with a delayed reaction of a day after the shock (Figure 3).

When there is economic volatility, such as booms and busts, nonlinearities in the reaction develop. External events or financial crises, such as wars or geopolitical tensions, can produce volatility by altering the behavior of stock returns or oil prices (Ajmi et al., 2014; Smyth & Narayan, 2018). According to Zhang (2017), the link is not stable. Oil is the most influential commodity of all commodities since it significantly impacts financial markets. Several studies have examined the relationship (Kayalar et al., 2017).

Table 4: Panel Vector Autoregression GMM Estimation–Pre-COVID Sample

	Coef.	Std.Err.	z	*P* > *z*	95%Conf.	Interval
Oil Prices						
L1. Oil Prices	0.348***	0.034	10.23	0.00	0.281	0.414
L1. Stock Return	–0.121	0.335	–0.36	0.718	–0.778	0.536
Stock Return						
L1. Oil Prices	–0.003***	0.001	–3.68	0.00	–0.004	–0.001
L1. Stock Return	0.122	0.122	1	0.32	–0.118	0.362

Note: *p-value < 0.1; **p-value < 0.05; ***p-value < 0.001.

Table 5: Granger Causality–Pre-COVID Sample

Equation/Excluded	Chi²	df	Prob. > Chi²
Oil Prices			
Stock Return	0.13	3	0.718
ALL	0.13	3	0.718
Stock Return			
Oil Prices	13.557	1	0.000
ALL	13.557	1	0.000

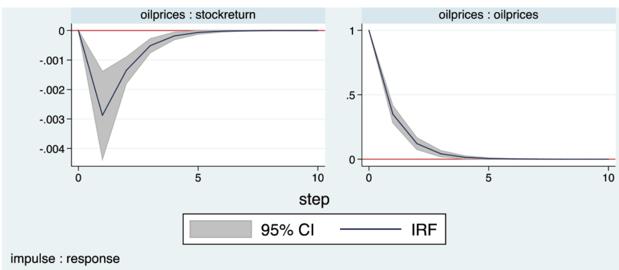

Figure 3: Pre-COVID Sample Impulse Response Function

According to Degiannakis et al. (2018), projections of oil price volatility and prices can be used to predict stock returns. Furthermore, Kaul and Seyhun (1990) found a negative and significant relationship between stock returns and oil price volatility.

The COVID period relationship between oil prices and daily stock returns is presented in Table 6. According to the lag selection criterion, the panel VAR becomes stable when using the COVID period's daily returns and three lags. We discover that there is no positive relationship within this time span. This shows that oil price volatility in forecasting may be less effective during recessions.

Table 7 shows that granger causality estimates yield unimpressive results in terms of causality. (Apergis & Miller, 2009; Güntner, 2014; Kilian & Park, 2009; Rao, 2021). In addition, no indication of oil price shocks affecting monthly or daily stock returns has been found in any of these investigations.

During the COVID period, the impulse response function and oil price shocks were found to impact future oil prices but not on the daily stock returns of the firms (Figure 4). Oil prices have been discovered to be autoregressive.

Table 6: Panel Vector Autoregression GMM Estimation–During-COVID Sample

	Coef.	Std.Err.	*z*	*P* > *z*	95%Conf.	Interval
Oil Prices						
L1. Oil Prices	0.937***	0.021	44.83	0.000	0.896	0.978
L2. Oil Prices	–0.052	0.032	–1.63	0.104	–0.115	0.011
L3. Oil Prices	–0.025***	0.004	–6.39	0.000	–0.033	–0.017
L1. Stock Return	–2.521*	1.32	–1.91	0.056	–5.108	0.066
L2. Stock Return	1.045	1.402	0.75	0.456	–1.703	3.793
L3. Stock Return	2.085	1.57	1.33	0.184	–0.993	5.162
Stock Return						
L1. Oil Prices	–0.0002	0.0002	–0.88	0.378	–0.001	0.000
L2. Oil Prices	0.0001	0.0002	0.4	0.69	0.000	0.001
L3. Oil Prices	–0.0000	0.00007	–1.02	0.31	0.000	0.000
L1. Stock Return	0.402***	0.045	8.94	0.000	0.313	0.49
L2. Stock Return	0.417**	0.09	4.65	0.000	0.241	0.593
L3. Stock Return	0.105	0.09	1.17	0.241	–0.071	0.281

Note: **p*-value < 0.1; ***p*-value < 0.05; ****p*-value < 0.001.

Table 7: Granger Causality

Equation/Excluded	Chi^2	df	Prob. > Chi^2
Oil Prices			
Stock Return	3.791	3	0.285
ALL	3.791	3	0.285
Stock Return			
Oil Prices	1.951	3	0.583
ALL	1.951	3	0.583

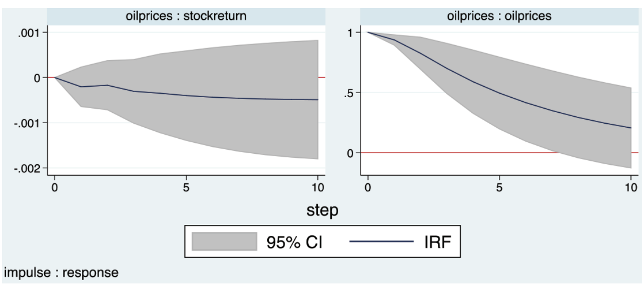

Figure 4: COVID Sample Impulse Response Function

5. Conclusion

Oil prices have been attributed to economic development in oil-importing countries, and price volatility adds to the uncertainty. Using Pakistani power sector firms, the study aimed to clarify the contradictory evidence on the relationship between exogenous price shocks and stock market returns.

The study's findings revealed that oil price shocks have a detrimental impact on daily stock returns for Pakistani power and energy companies. As a result, oil price shocks would boost the predictive power of stock return forecasting models. Surprisingly, the association did not hold during the COVID period, according to the study. Because forced shutdowns resulted in both demand and supply-side shocks, the COVID-19 global pandemic was a catastrophe unlike any other. In addition, expectations for earnings are lower because of the recession, which could be one reason for the lack of influence on stock prices. During the 2008 financial crisis, other studies discovered a similar effect (Hedi Arouri et al., 2011; Uzo-Peters et al., 2018).

An understanding of asymmetric association can help managers and investors make better investment decisions when selecting profit-generating stocks. Our findings show that using oil price shocks as a predictor of daily returns in the power sector during recessionary periods should be done with caution.

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Appendix

Table A1: Eigenvalue Stability Condition–(Complete Sample)

Eigenvalue		
Real	**Imaginary**	**Modulus**
0.764	0	0.764
0.446	0	0.446

All the eigenvalues lie inside the unit circle. pVAR satisfies stability conditions.

Table A2: Eigenvalue Stability Condition–(Pre-COVID Sample)

Eigenvalue		
Real	**Imaginary**	**Modulus**
0.349	0	0.349
0.12	0	0.12

All the eigenvalues lie inside the unit circle. pVAR satisfies stability conditions.

Table A3: Eigenvalue Stability Condition–(COVID Sample)

Eigenvalue		
Real	**Imaginary**	**Modulus**
0.9531429	0	0.9531429
0.8412001	0	0.8412001
–0.2795554	–0.1843291	0.3348559
–0.2795554	0.1843291	0.3348559
0.2245475	0	0.2245475
–0.1213615	0	0.1213615

All the eigenvalues lie inside the unit circle. pVAR satisfies stability conditions.