Forecasting the Return of Equity Market in GCC Economy: An Application of ARIMA Model

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Abstract: Investment is nothing but looking for the best available opportunities to put your money in with minimum risks involved. To fulfil this rationale forecasting and predicting volatility is one of the most effective techniques. Our study aims to forecast the return of the equity market among countries of the GCC (Gulf Cooperation Council) using the ARIMA model. This study employs an autoregressive integrated moving average (ARIMA) and found various orders of autoregressive and moving average. This provides an insight to the investors and portfolio managers.

Keywords: GCC, Equity Market, Forecasting, ARIMA.

1. Introduction

Equity market indices work as a barometer for economic performance. Forecasting and predictions cover substantial research in the financial market and help researchers and the community to identify underlying gaps and problem-solving. We can draw inferences based on predictions which further helps in policy implications for society at large. GCC (Gulf Cooperation Council) is a group of six middle eastern countries popularly known for its capacity for crude oil and natural gas production worldwide. Emerging as one of the most promising and developing economies and a recent favorable destination for investors, GCC's geographical character of bordering the Persian Gulf established it as a promising nation connecting it to the USA and Europe as major business allies. Forecasting the equity market will suggest policy implications on how GCC's potential as a non-energy economy can be harnessed through strategic investments for sustainable economic growth. Whenever oil price sneezes entire GCC catches a cold, oil prices have always been a catalyst for the movement of the stock market across various economies, GCC has often faced regional and socio-political turmoils over decades, and Covid 19 pandemic proved to be a black swan event which affected each sector, economies, and our daily lives.

In the extant literature review, we have found various pieces of evidence for predictions and examinations of returns of GCC stock and equity indices. Further adding to the variability of studies linkages between oil price shocks and equity market has also been among favourite studies, how various economic and social crises across decades have impacted returns and performance of GCC economy crisis. (Yousaf et al., 2022; Yadav et al., 2022; Ashok et al., 2022; G.R. Irfan et al., 2022) using bivariate VAR and BEKK GARCH model to examine returns and effect of dynamic linkages among GCC share market.

(Umar et al., 2021) examines dynamic linkages between oil price shocks and

GCC, BRICS economy for the period of 2005 to July 2020 covering all major crises including the most recent one Covid 19 pandemic.

While doing a literature review, we found no use of the ARIMA application in forecasting the GCC economy. Our aim through this study is to work on this novelty and analyze the impact of the recent crisis of Covid 19 Pandemic on the equity market.

Our paper aims to forecast selected equity indices price of six GCC constituting economies using daily adjusted closing prices for the period of Dec 2019 to March 2022. For empirical purposes, major MSCI equity indexes for each country are considered. For forecasting purposes, the autoregressive integrated moving average (ARIMA) model (Box and Pierce, 1970).

Forecasting volatility is a major effective tool in the hands of investors, portfolio managers and countries to manage their portfolios through diversification and hedging for optimum risk return objectives.

This paper is structured as follows: Section 2 presents the current and similar research while section 3 explains the data and methodology to be employed in this paper. Section four provides the empirical result and discussion. In the end, policy implication and conclusion are provided.

2. Literature review:

Yadav & Gupta, (2021) investigates the future stock prices of five of the world's biggest exporting countries (China, Germany, Hong Kong, the USA, and Japan). ARIMA model is used to investigate predicting patterns and behaviour. This research compares a trend stationary ARMA (p. q) elective cycle to a unit-root trial of an ARIMA (p – 1, 1, q) with float invalid unit root measure, where the request for the time arrangement is accepted knowing via past measurable testing or applicable information. The study concludes that an investor can get a higher return by investing in Hong Kong stocks, but they must exercise caution while investing in the remaining member stocks. In Nayak et al., (2016) research for stock market trend prediction, two models were developed: one for daily forecast and the other for monthly prediction. The models are built using supervised machine learning algorithms. The model forecasts the price movement on Tn by taking into account all of the available historical data, i.e., from the beginning to Tn1, Tn2, ... Tn, where Tn denotes prediction transaction data. It derives the sentiment from social media data and news. Then uses sentiments that have been extracted with historical data to create a prediction model.

In (Akaike, 1974) the greatest likelihood technique is used to solve the identification problem. They examined stationarity and anticipated stock return using modified closing prices from January 1, 2001 to May 30, 2020, with the help of ARIMA and ADF models, respectively. The results show that the ARIMA model is accurate, has enough predictive power to anticipate future values. In this a thorough examination of the maximum likelihood estimate (MLE) leads to the definition of an estimate x, which is beneficial for this type of multiple regression analysis. The situation is ideal, the new figure is referred to as the minimal estimate. Zhu, (2020) investigates the detailed process of developing a stock price prediction model in this study. The stock price prediction algorithm was constructed using daily price data from the NYSE (New York Stock Exchange) and the NSE (Nigeria Stock

Exchange). The method of developing these predictions is the ARIMA model used for short-term stock market forecasting is also detailed in this research. The findings based on real-world data showed that the ARIMA model has a potential to offer the investors a value and also short-term forecast that could help us make an investment decision.

(Chung Roy C.P., n.d.) evaluates the pattern of variations and interruptions in China's industrial growth using a Univariate ARIMA model. Using time-series data, we can learn about the predictions of the industry. The ARIMA model is a mathematical model that calculates the probability of interruptions. It can assist in determining whether the global financial crisis is still ongoing causes what impact on China's industrial growth and the nature of the effect firms will thrive from this. This research provides with the knowledge that will help them deal with and withstand the storm of financial calamity. The ARIMA model's applications, its analyses with and without intervention have been routinely used in a variety of ways, including flexible manufacturing simulation and system scheduling in this research.

The purpose of this study is to provide an effective method for improving stock volatility predictability by combining two major predictors: oil volatility and stock market volatility(Zhifeng, n.d.). The "kitchen sink" method of market implied volatility is used, the combination strategy, which employs two predictors simultaneously, outperforms not just univariate regression models, but also multivariate regression models. Individual forecasts for oil volatility or stock market implied volatility are available, as well as a convex combination of the two. When we consider the business cycle, the improvement in predictability is equally remarkable. In addition, the reliable test based on the forecasting technique is effective across a range of lag lengths and macro information. Hagenau, (2012) presents its findings as, combination of advanced Feature Extraction methods with the feedback-based Feature Selection to improve performance. Also enhanced sentiment and classification accuracy Feature Selection has a big impact on analytics. They show that using this method can greatly improve classification accuracy, when used in conjunction with a complex feature type. This is since the method allows users to choose from a variety of options. As a result, the number of semantically meaningful traits is reduced.

Jarrett, (2011) in his paper, shows ARIMA Intervention time series analysis may be used as an analytical and forecasting tool. This study's data source is the PACAPCCER China Database, which was created by The Pacific Basin Capital Markets Research Center (PACAP) located at SINOFIN and the University of Rhode Island (USA), The China Center for Information Service Inc is a subsidiary of the China Center for Information. Peking University's Center for Economic Research (CCER) (China). The Chinese stock market price index was created using a mathematical algorithm. The ARIMA Intervention Analysis Methods produced a suitable environment for one to examine and form conclusions regarding the index's behaviour throughout time. The outcomes of the research were that China was a part in the global financial crisis, according to reports. It has an impact on both its inventory and manufacturing industry.

Kamalavalli T, n.d. (2020) utilizes

multivariate time series, linear models ARIMA/SARIMA time-series based prediction models that are unable to recognize the under dynamics situation. As a result of the findings, by implementing CNN and LSTM Neural Networks, it demonstrated better performance when compared to other models. Time-series prediction problems can be solved using networks. Various time series are examined in this work. To predict the returns for the S& P500, models are compared to neural networks. In addition, this paper shows that neural networks are well suited for time series analysis. Jupyter notebook 6.0.3 was used to conduct the research. The simulations and codes were Python 3.6.5 was used, with tensorflow 1.15.0 and keras 2.3.1 as dependencies.

The main goal of this research is to forecast emerging economy stock returns (Yadav & Khera, n.d.). For the same, the adjusted daily closing prices of eleven countries are taken into account over a five-year period. The ARIMA is a type of average which is used in this. The average (ARIMA) was used to forecast these countries' stock returns. The different ARIMA orders have been used to forecast the stock return. It was discovered that after applying the ARIMA model, the stock price increased. The return of Korea, the Philippines, and Turkey is not predictable because of their autoregressive and regressive natures. The terms that move are zero. Investing in those stocks can yield an abnormal return which is able to be predicted. Mondal et al., (2014) and Sharma et al., (2021) investigates the efficiency of the ARIMA model of fifty-six India’s equities of various sectors in their research. For the set empirical study, they chose data from the previous twenty-three months. They chose the ARIMA model because of its ease of use and widespread acceptance. In addition, they have measured the influence on forecast accuracy using various possible preceding period data. The ARIMA model was compared and parameterized using the AIC. The ARIMA model's accuracy in predicting stock prices is above 85% across all sectors, which is impressive and suggests that ARIMA has a high level of prediction accuracy.

Our goal is to use a time-series ARIMA model to estimate future stock market indices(Banerjee, 2014). For six years (2007-2012), they gathered data of the monthly closing prices of stocks of the sensex and attempted to construct a model based on them. A suitable model that would assist them in predicting the Indian equity market indices that have not been observed. In their research they exhibited the use of the ARIMA model that is focused on “Where we forecast future stock indexes with a strong performance influence on the Indian economy's performance”. Among the many models, they found ARIMA (1, 0, 1) to be the best, based on the fact that it meets all of the requirements for the excellent fit unlike the rest. In AL-shiab, (2006) research between 4/1/04 and 10/8/04, ASE general daily index was used to test the univariate ARIMA forecasting model. To determine the optimal model, many diagnostic tests were carried out describing the information. A time series was created using the ASE daily general index. The ARIMA is a mathematical model used in this. Economic forecasting based on time series can be done in five ways: Exponential smoothing methods and single-equation regression, autoregressive integrated models, simultaneous-equation regression models, vector auto-regression (VAR) and moving average models (ARIMA), examining the actual data throughput the same period. During the anticipated period, it appears that the ASE's performance has deteriorated. As a result, the forecast did not match market performance. In a nutshell, the ASE most closely resembled the EMH weak type.

We compiled a comprehensive literature review on projecting various series from December 2019 to March 2022. We have conducted research on GCC stock market forecasting during this period. Only a few research on GCC countries were found using the ARIMA model. Therefore, there is a void, which prompted us to conduct research on projecting the stock return of these economies.

3. RESEARCH METHODOLOGY

3.1 Objective

To forecast the return of the equity market among countries of the GCC

3.1 DATA:

Table 1: Description of the selected equity indices of GCC countries.

Variables	Country	Indices	Source
Tadawul All Share Index	Saudi Arabia	TASI	Bloomberg.com
DFM General Equity	UAE	DFMGI	Bloomberg.com
MSCI Qatar Equity	Qatar	MIQA00000PQA	Bloomberg.com
Kuwait Main Market 50	Kuwait	BMK50	Bloomberg.com
MSCI Oman Equity	Oman	MIOM00000POM	Bloomberg.com
Bahrain All Share Equity	Bahrain	BAX	Bloomberg.com

3.2 ECONOMETRIC MODEL:

A general modification of an ARMA model yields the ARIMA model. This model is used to forecast time series data in order to gain a further understanding of the data or to forecast values of the series (forecasting). When there is evidence of non-stationarity in the data, ARIMA models are used. ARIMA models are written as ARIMA (p, d, q), where p, d, and q are non-negative integers, p is the autoregressive model's order (number of time lags), d is the degree of differencing (the number of times the data has had past values subtracted), and q is the moving-average model's order. First step is to check the stationarity of the data by using ADF test, commonly known as ADF test. If the data is not stationary, efforts then are made by differencing the data again and again to make it stationary, but if it is stationary in the first moment, we can directly proceed to the next step of model identification (Yadav et al., 2020;. Yadav and Pandey, 2020; Yadav & Arora, 2020). From the model identification, its forecasting and diagnosis R studio software has been used.

ARIMA Model

It is fashioned as a blend of past values and error terms which is depicted in this equation

$$Y = \grave{a} + \beta 1\ Yt\text{-}1 + \beta 2\ Yt\text{-}2 + \beta 3\ Yt\text{-}3 + \beta p\ Yt\text{-}p + e1 + \theta 1\ et\text{-}1 - \theta 2\ et\text{-}2 - \theta 3\ et\text{-}3 - \theta q\ et\text{-}q$$

where Yt are the series values and et are the error terms; βi (i = 1, 2, ..., p) and θj (j = 1, 2, ..., q)

are the model parameters. p and q are integers denoting orders of auto pregressive and moving average polynomials.

4. Empirical Results and Discussions: -

Table 2: Descriptive statistics of selected equity indices of GCC

Indices	Country	Min	Max	Mean	Std Dev	Skew	Kurtosi	Adf Test	Arima Order
Tadawul All Share Inde	Saudi	-0.087	0.0683	0.0008	0.0114	-2.085	17.57	0.01	(2,0,3)
DFM General Equity	UAE	-0.087	0.0706	0.0004	0.0137	-1.117	10.882	0.01	(3,0,3)
MSCI Qatar	Qatar	-0.139	0.043	0.0005	0.012	-3.456	40.525	0.01	(0,0,0)
BKP Kuwait Premier Market	Kuwait	-0.116	0.0614	0.0005	0.0128	-3.49	31.6	0.01	(0,0,1)
MSCI Oman Equity	Oman	-0.125	0.043	0.0007	0.0115	-3.153	32.877	0.01	(1,2,1)
Bahrain All Share Equi	Bahrain	-0.06	0.0342	0.0004	0.0067	-1.959	17.528	0.01	(0,1,2)

From Table 2. The minimum return of each stock indices of GCC is negative while the maximum value is positive and significant. The highest volatility is observed in the case of UAE whereas the lowest volatility is observed in the case of Bahrain. The daily return series exhibits negative skewness for all series, which indicates that there exists asymmetry volatility. Further, we notice that the majority of returns are leptokurtic, Qatar reflects the highest Kurtosis whereas UAE carries the lowest kurtosis rate. Skewness and kurtosis signify the rejection of normality in distribution. Referring to the Augmented Dickey-Fuller (ADF), it found that the series is stationary as its p-value is less than 0.05. Therefore, the volatility can be captured in these series. Figures 1 and 2, display the graphical inspection of raw series and log return series respectively. On this note, it can infer that each raw series of GCC equity indices has the presence of a stochastic trend. To remove this trend, it is converted into log difference which is shown in figure 2. It signifies that there is a presence of volatility clustering. Volatility clustering refers to the tendency of high changes to be followed by high changes and low changes followed by low changes (Sharma et al., 2020). Further, the estimated model for Saudi is ARIMA (2, 0, 3) in which AR comes out to be two which explains that stock returns of Saudi can be forecasted based on the previous two days. I stand as 0 which shows stationarity of natural log returns series at level. MA comes out to be three which represents that the stock returns of Saudi are affected by the error term of the previous three days. The estimated model for UAE is ARIMA (3, 0, 3) in which AR comes out to be three which explains that stock returns of UAE can be forecasted based on the previous three days. I stand as 0 which shows stationarity of natural log returns series at level. MA comes out to be three which represents that the stock returns of UAE are affected by the error term of the previous three days.

The predicted model for Qatar is ARIMA (0, 0, 0) in which AR comes out to be 0 which explains that the stock returns of Qatar cannot be forecasted based on previous days. I stand as 0 which shows stationarity of natural log returns series at level. MA also comes out to be 0 which represents that the stock return of Qatar is not affected by error terms of previous days. While the model for Kuwait is calculated at (0, 0, 1) in which AR comes out to be 0 which explains that stock returns of Kuwait cannot be forecasted based on previous days. I stand as 0 which shows stationarity of natural log returns series at level. MA comes out to be one that represents that the stock returns of Kuwait are affected by the error term of the previous day.

ARIMA orders for Oman and Bahrain respectively are (1,2,1) and (0,1,2).

Figure 1: Time series plot of raw series 1) Saudi Arabia 2) UAE 3) Qatar 4) Kuwait 5) Oman 6) Bahrain.

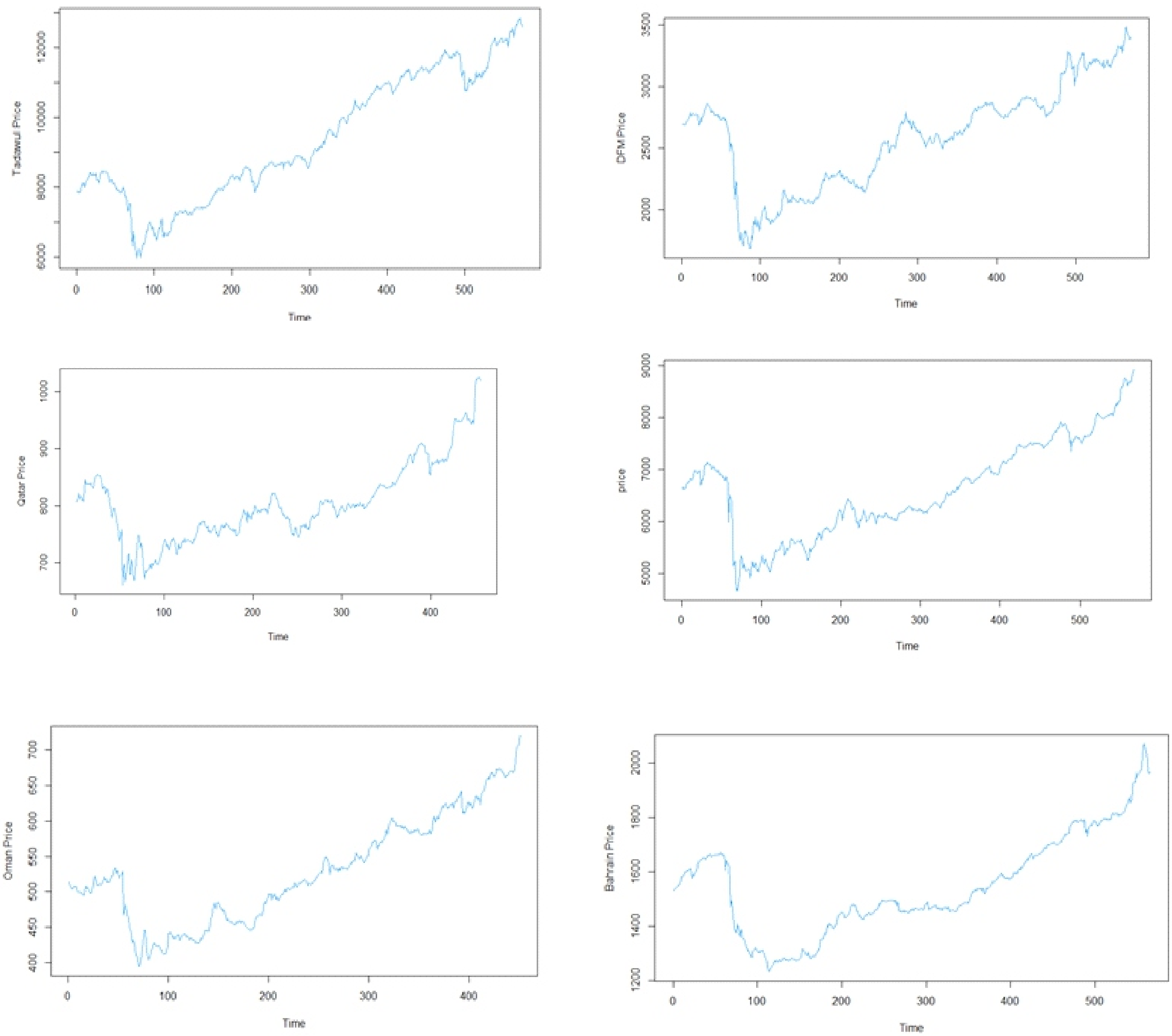
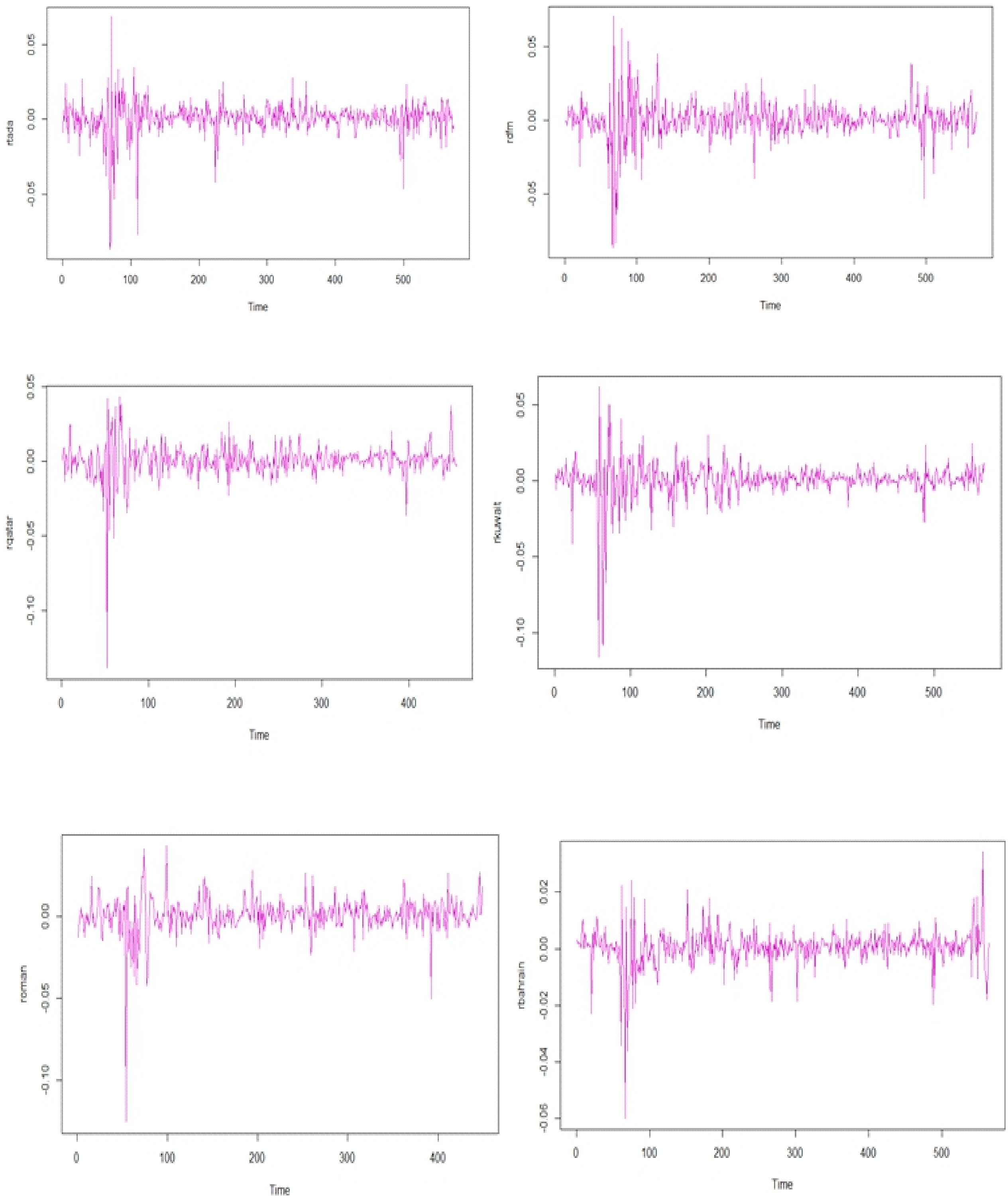


Figure 2: Time series plot of log return of constituent series 1) Saudi Arabia 2) UAE 3) Qatar 4) Kuwait 5) Oman 6) Bahrain.



4.1 Diagnostic robustness checking of the model:

For autocorrelation in a time series the Ljung-Box test to validate hypotheses is used. The null value, The H0 hypothesis states that the residuals are distributed randomly. The alternative hypothesis is that the residuals are serially correlated and not independently distributed. The Ljung–Box test (named after Greta M. Ljung and George E. P. Box) is a statistical test that determines whether any of a collection of time series autocorrelations are different from zero. It is a portmanteau test since it evaluates "overall" randomness based on a lot of lags rather than assessing randomness at each individual lag. In this we see p-value of all the indices are much smaller than .05 that is the significance level, thus we can reject the null hypothesis, indicating the time series does contain an autocorrelation.

Figure 3: Shows autocorrelation of 1) Saudi Arabia 2) UAE 3) Qatar 4) Kuwait 5) Oman 6) Bahrain.

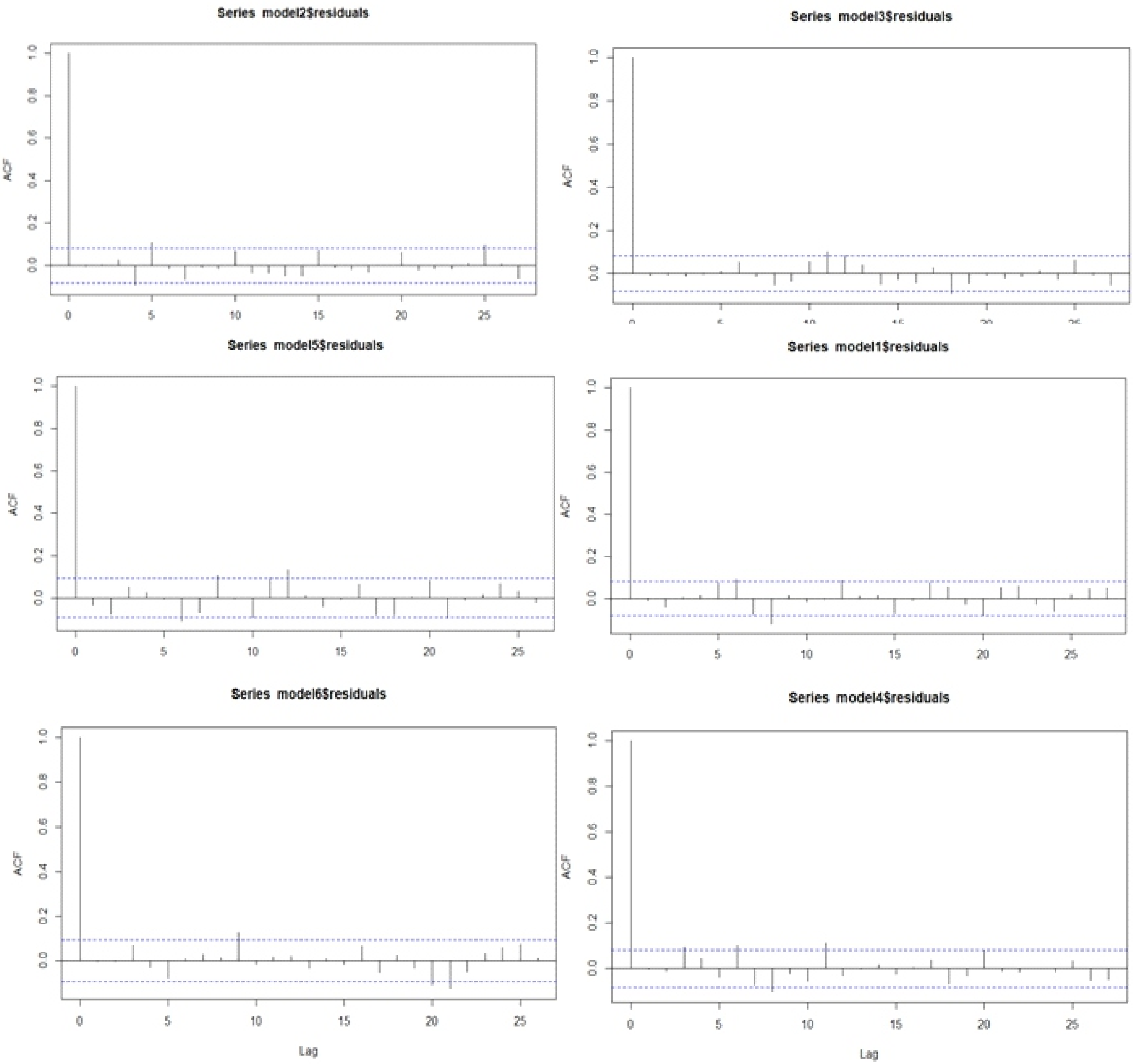
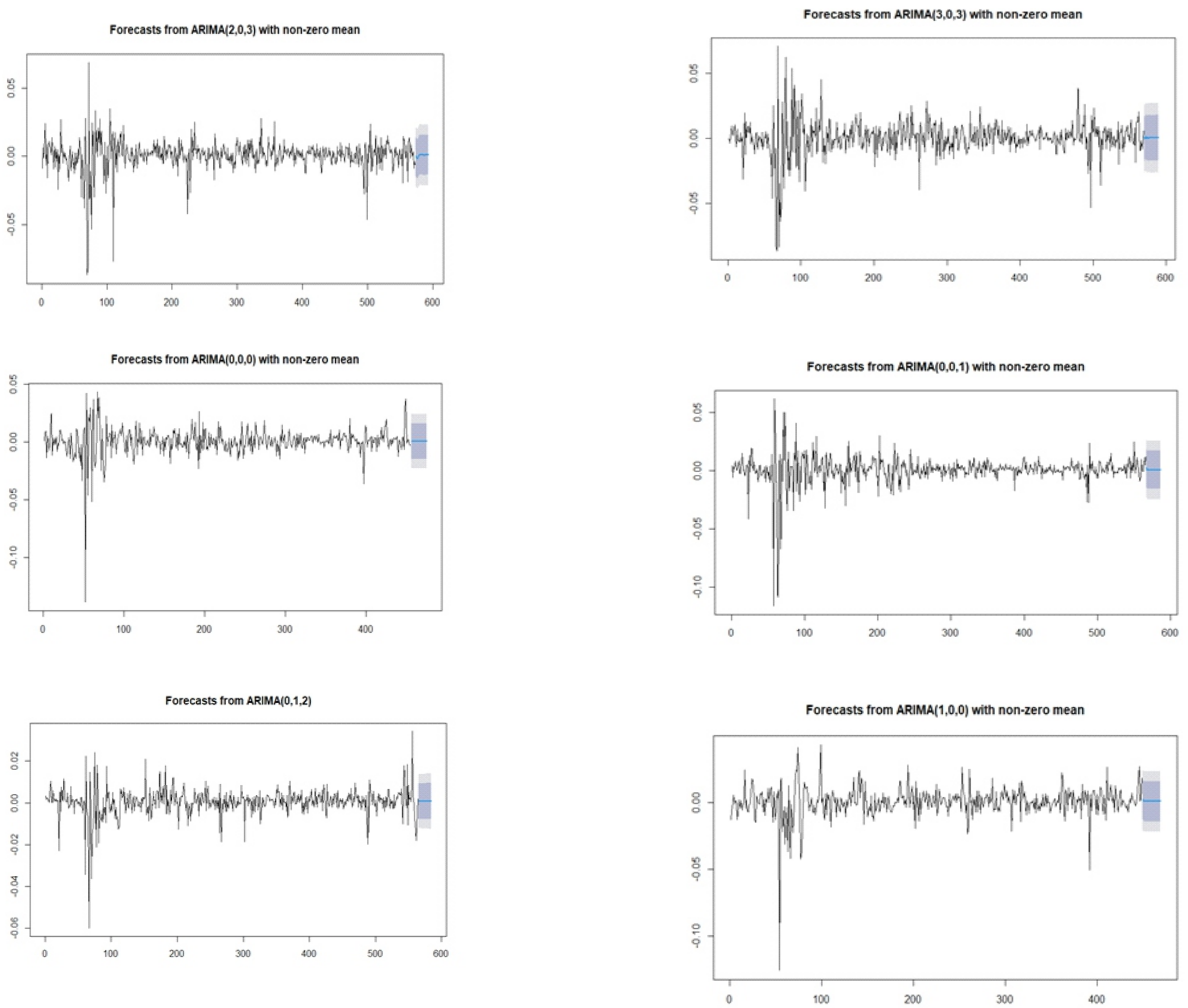


Table 3: Result of L jung-Box test

Country	Indices	X- squared	DF	P- Value
Saudi Arabia	Tadawul All Share Index (TASI)	34.071	10	0.00018
UAE	DFM General Equity	12.417	10	0.2581
Qatar	MSCI Qatar Equity	132.85	10	< 2.2e-16
Kuwait	BKP Kuwait Premier Market	19.004	10	0.04021
Oman	MSCI Oman Equity	74.442	10	6.11E-12
Bahrain	Bahrain All Share Equity	27.376	10	0.00227

Figure 4: Shows forecasted plots of 1) Saudi Arabia 2) UAE 3) Qatar 4) Kuwait 5) Oman 6) Bahrain.



5. Conclusion and Policy Implications

Equity market of any country is a platform for investors' savings and investment targets. Results of the ARIMA model have an effective level of predictability which means ARIMA is one of the best suited models to predict volatility. P value of coefficient of AR (Auto Regressive) and MA (Moving Average) of all constituent series is significant (less than 5 percent).

Further adding to the scope of study different groups of economies like BRICS, ASEAN, OPEC can be considered, neural network model can be used to forecast in addition to ARIMA model.

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