Efficiency Test of Forecasts: an illustration for Carbon Emission

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ARTICLE DETAILS	ABSTRACT
History *Revised format: May 2020* *Available Online: June 2020*	World Economies are facing numerous challenges concurrently. Among them one of most pertinent is global warming. Almost all the countries are victims of climate changes. Therefore, several economic mechanisms in environmental policy have been adopted to combat the distasteful impacts of climate change. The implication of environmental policies for clean energy environment in a country can be accessed via several channels. Forecast analysis is one of them, it reveals the forthcoming arrangement. The direction of the forecast trend discloses the current as well as potential outlook, indicating the intensity of policy brunt. The study evaluated the forecast and their accuracy to ensure the performance of forecast. Carbon emission in Gulf countries and their forecast are used as a case study. ARIMA model is used to obtain the forecast. Afterward, to evaluate the forecast performance, the study utilized the different efficiency criterion defined by Nordhaus (1987). By following the several efficiency test study found consistent and efficient forecasts. These performance tests ascertain the reliability and accuracy of the trend followed by forecasts. Accurate Forecasts direct better policy formation and management decision with buoyancy. Moreover, earlier policy resolution becomes more lucid.
Keywords *Forecasting, Consistent forecasts, efficient forecasts, ARIMA modeling, Carbon Emission forecasts*	
JEL Classification *Q53, Q54, Z38, C13, C18*	

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1. Introduction

The world economy is growing rapidly demanding a higher level of growth and industrialization. Consequently, every country has the challenge of creating a balance in Triple Bottom Line of Economic, Social and Environmental Sustainability, irrespective to the level of development of the country. It could be right to state that economies are developing at the cost of environment. Economic development and Energy utilization are assumed to be interconnected positively in accusation of large amounts of CO2 emissions, causing threats to the ecosystem.

Since the 1990s, many international agencies and organizations in the different part of the world have been attempting to reduce the adverse impacts on environmental degradation. However, despite several agreements in this

respect including Kyoto Protocol, United Nations Framework Convention on Climate Change and many others, it is still a burning issue of the world and CO_2 ability of natural sink is being influencing by the human-related activities and industrialization (Nordhaus, 2010).

The majority of studies for the past two decades have been intensively focusing on CO_2 emission in reference to find the natural relationship between economic growth and energy use for example ; Riti et al. (2017); Chaudhary and Bisai (2018) ; Bildirici (2017); Zhang et al. (2017b); Robaina-Alves et al. (2016); Han et al. (2018); Song et al. (2018a); Zhao et al. (2017); Alam et al. (2016); Antonakakis et al. (2017); Bekhet et al. (2017); He et al. (2017); Chiu (2017); Zhao et al. 2017) and many others found the interconnection. In general, these studies concluded that CO_2 emissions and economic growth are correlated; therefore a reduction in emissions may not be a desirable outcome.

Further procession of the researcher explored the relationship between carbon emission and economic development in several directions. For instance, Azam (2016) examined the relationship between environmental degradation due to CO2 emissions and economic growth from 1990 to 2011. Friedl and Getzner (2003) explored the link between economic development and CO_2 emissions. Whereas, Zhang and Da (2015) decomposed the carbon emissions and carbon emission intensity in reference to industrial fabrication and energy sources in China. Whereas Fan et al., (2006), used manufacturing and services outcome as a percentage of GDP to evaluate energy intensity .

In the similar fashion, another trend that is explored by Narayan and Smyth (2005), Bartleet and Gounder (2010), Shahbaz et al. (2011), Chandran et al. (2010), Yoo and Kwak (2010), Wolde-Rufael (2006), is the relationship of carbon emission with economic growth and electricity consumption.

Adding to existed literature, Sharma (2011) examined the determinants of CO_2 emissions for 69 countries between the period 1985 and 2005 by using a dynamic panel data for CO_2 emissions, trade openness, urbanization, GDP and energy-consumption. Similarly, the link between CO_2 emissions, energy use, gross fixed capital, GDP, and the labor is examined by Soytas et al. (2007). Correspondingly, Halicioglu (2008) analyzed the dynamic relationships between CO_2 emissions, trade, energy use and income in the context of Turkey. Whereas, Jayanthakumaran et al., (2012), applied Bounds Test approach to make comparative analysis of CO_2 emissions, energy-consumption, trade and income in China and India between the periods of 1971 and 2007 .

A range of the earlier studies also investigated the correlation among CO_2 emissions, economic growth, and population of a specific country such as about China (Yang et al., 2015), 124 countries (Dutt, 2009), Turkey (Akbostancı et al., 2009), 126 countries (Borghesi, 1999), 42 countries (Ravallion et al., 2000), Netherlands, West Germany, UK, and USA (De Bruyn, 1997), 30 developing and developed countries (Panayotou, 1993), 11 OECD countries (Cole, 2004), Malaysia (Vincent, 1997), 44 countries (Eicher and Begun, 2012), Louisiana (Paudel et al., 2005), 25 Countries in Central and Eastern Europe (Archibald et al., 2009), 97 countries (Lee et al., 2010), 146 countries (Caviglia-Harris et al., 2009). In addition, many other researchers used population and energy variables to account for energy generation and consumption (Marques and Fuinhas, 2011; Shafiei and Salim, 2014; Bloch et al., 2012) .

Recently, Mardani et al., (2018), categorized nine different directions for research on CO_2 emissions; together with CO_2 emission and economic growth, CO_2 emissions, economic growth and electricity consumption, CO_2 emissions, economic growth and renewable energy, CO_2 emissions, economic growth and population, CO_2 emissions, economic growth and financial investment, CO_2 emissions, economic growth and tourism economic, CO_2 emissions, economic growth and energy intensity, CO_2 emissions, economic growth and energy-consumption and finally CO_2 emissions and economic growth with other indicators.

There is plenty of literature that has analyzed the CO_2 emission, its determinants, and directions. Nevertheless, there are only a few studies that give thought to forecast CO_2 emission. Expectations and forecasts play a fundamental role in several areas of economics. The importance of forecasting is noticeable in decision making and policy designing for the future plan of individuals as well as government. When we talk about the significance of forecasts and expectations, the accuracy and inquiry about forecast adequacy become of prime importance. Forecast reliability and impartiality become a matter of heightened importance.The measurement of forecasting efficiency has been a matter

of tremendous apprehension that was investigated and explored over the last few decades. The present study contributed to this line of research. In this study, the concept of "forecast efficiency," introduced by Nordhaus(1987) is applied.

The present study endeavor to plug the literature gap in reference to CO_2 emission Forecast. Forecast reliability is checked by applying several criterions. A sample of Gulf countries is taken as a case study to develop forecasts and further to analyze the forecasts efficiency by applying several measures.

2. Theoretical Background of Forecast Efficiency

Forecasting is an art that is intricate as well as a subtle part of the analysis. Traditionally, the efficiency of the economic forecast was measured by the comparison of Root Mean Square Errors (RMSE). A forecast having lower RMSE was considered as the best among the others forecast having a high RMSE. Clement et al. (1993) and Armstrong et al. (1995) made a criticism on the RMSE, and mention that RMSE is not a good benchmark. According to Yin-Wong et al. (1997), forecast accuracy was standing on examining the mean, variance and serial correlation properties of the forecast errors. The issues of integration and cointegration of forecast errors were hardly ever addressed. After the rejection of conventional tools of analyzing the forecast efficiency the cointegration approach named consistency was introduced. The technique was used by Liu et al. (1992) and Aggerwal et al. (1995) to assess the impartiality and integration vis a vis cointegration characteristics of macroeconomic data and their respective forecast. Consistency or Efficiency standard is defined by different researchers in different ways. In a CBO Report (1999), efficiency designates the extent to which a particular forecast could have been improved by using additional information that was at the forecaster's disposal when the forecast are made. Nordhaus (1987), defined the efficiency of forecasts into categories; weakly and strongly efficient.

Many Researchers contributed to rationality testing of forecasts such as Carlson (1977), Figlewski et al. (1981), Friedman (1980), Gramlich (1983), Mullineaux (1978), Pearce (1979) ,Pesando (1975), Hafer et al. (1985), McNees (1986), Pearce (1987) and Zarnowitz (1984, 1985, 1993),however they placed great weight on minimum mean square error (MSE) and did not incorporate accuracy analysis convincingly in their test of rationality. There are few studies about the rationality of IMF and OECD forecasts like Holden et al. (1987), Ash et al. (1990, 1998), Artis (1996), Pons (1999, 2000, 2001), Kreinin (2000), Oller et al. (2000) and Batchelor (2001). A Doctrine of rationality was defined by Lee (1991) that expectations are said to be rational if they fully incorporate all of the information available to the agents at the time the forecast is made. On the whole, there are several tests to measure the performance of forecast. The performance of forecasts can be tested in the following three heads

- Consistent Forecast
- Efficient Forecast
- Rational Forecast

2.1 Consistent Forecast

Consistent forecast states that the, observed series and their relevant forecast series are integrated of the same order and they are cointegrated. To test the existence of unit root, the spirit of Dickey and fuller (1979, 1981) is usually used. According to them a series Yt is said to be stationary, if Yt follows AR (1) process. If the observed variable and their forecast are of same level of integration, say I (1). Then the first condition for consistency is met.

2.2 Efficient Forecast

We test the efficient forecasts hypothesis following the Nordhaus (1987), Keane *et al*. (1990) and Bonham *et al.* (1995).

2.2.1 Weak Efficiency

A forecast is weakly efficient if it minimizes $E\left\{\left(u_t^2\right)|J_t\right\}$, where "$J_t$" is the set of all past forecasts. U_t^2 is the square of forecast error at time *t*. In order to test weak efficiency of forecasts obtained from any techniques, estimate the following regression.

$$U_t{}^2 = \alpha_o + \sum_{i=1}^{k} \alpha_i P^e{}_{t-i} + \varepsilon_t$$

Selection of k depends upon the significance under t-statistics. Only significant lags of expected forecasts are included and then test the weak efficiency hypothesis. Under this kind of efficiency norm, a forecast is said to be weak efficient if we are unable to reject the null that all the coefficients are simultaneously zero.

2.2.2 Strong Efficiency

A forecast is strongly efficient if $E\{(u_t{}^2)|I_t\}$ is minimized, where "I_t" is all information available at time t. As we have no information set in our study so we regress the following equation, to test the strong efficiency for the forecasts obtained from ARIMA processes.

$$U_t{}^2 = \alpha_o + \sum_{j=1}^{n} \alpha_j P^o{}_{t-i} + \varepsilon_t$$

" $P^o{}_t$ " is the observed value of variable at time t. A forecast fails to pass the strong efficiency hypothesis if "α_0" and "α_j" are significantly different from zero.

2.3 Rational Forecast

In order to analyze the rationality of forecast Bonhan *et al*. (1991) define a hierarchy of rationality tests starts from 'weak rationality' to 'strict rationality' the level of hierarchy define as follows;

❖ Weak rationality means the forecast must be unbiased and meet the tests of weak information efficiency.

❖ Sufficient rationality means The forecast must be weakly rational and must pass a more demanding test of sufficient orthogonality, namely, that the forecast errors not be correlated with any variable in the information set available at the time of prediction

❖ Strong rationality states the forecast must be sufficiently rational and pass tests of conditional efficiency. Conditional efficiency requires a comparison of forecasts[1].

❖ Strict Rationality, a forecast is strictly rational if it passes tests of strong rationality in a variety of sub periods.

In present study we exclude the test of Rationality due to the nature of data taken that was Univariate.

3. Data Source and Analysis

In order to test the forecast and their performance, we collected forecast for the series of CO_2 emissions (kg per 2010 US\$ of GDP) of Gulf Countries namely, United Arab Emirates (UAE), Bahrain, Saudi Arabia, Qatar, Oman, Kuwait. Carbon dioxide emissions are those stemming from the burning of fossil fuels, manufacturing of cement, and carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.

All the data is taken from World Bank Database (WDI). Data are taken on annual basis from the year 1965 to 2018, maximum available on the World Bank database website. Time series chart (Fig-1) and Descriptive statistics (Table-1) of the data shows main features and trend of the data over time period considered for the sample of countries taken in the study.

Table-I
Descriptive Statistics of Data

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[1] Emanating from the classic study by Bates *et al*. (1969) a long literature on forecast combination summarized by Clemen (1989), Diebold *et al*. (1996) and Timmermann (2005) has found evidence that combined forecasts tend to produce better out-of-sample performance than individual forecasting models.

Descriptive Statistics

	N	Range	Minimum	Maximum	Variance
BHR	35	.642275725	.890699988	1.5329757130	.030
QAT	15	.557069807	.548336249	1.1054060560	.036
KWT	23	.339790007	.480904950	.8206949570	.007
SAU	47	.650301110	.331305725	.9816068350	.045
OMN	50	.915580325	.017473077	.9330534020	.068
UAE	40	.358662779	.240343976	.5990067550	.008

Table-I explains the characteristics of time series data of CO_2 emission in metric ton of GDP. It is evident from values in Table-I that BHR (Bahrain) and QAT (QATAR) are emitting CO_2 higher as compared to other Gulf Countries. The minimum of CO_2 is emitted by UAE.
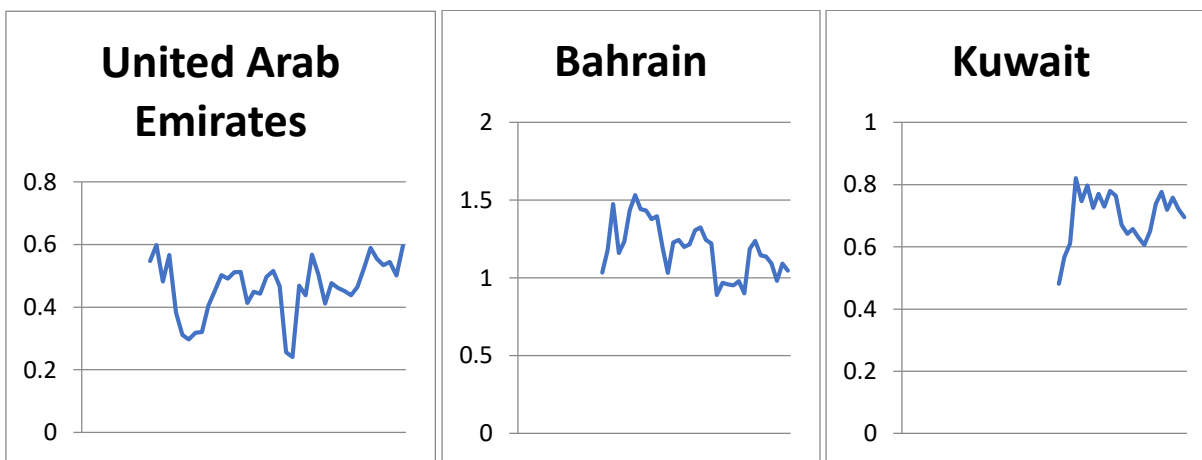

Fig-I-Trend Charts of the Data

The trend chart for all the Gulf countries are taken separately to visualize the trend of CO_2 emission. United Arab Emirates (UAE) trend of CO_2 emission is constant over the time and it is fluctuated around the mean between 0.4-0.6.The fluctuations are not volatile and trend is also constant at the end of the series and increasing slightly. The trend chart for Bahrain shows a decreasing trend in the quantity of CO_2 emitted over the period of time analyzed. Bahrain emitted maximum of CO_2 in 1980's but later on it got control over it. Ultimately at the end of the series it is showing a decreasing tendency. Kuwait is also showing the same trend as it is seen in Bahrain and at the end of the series it is drifting downward.
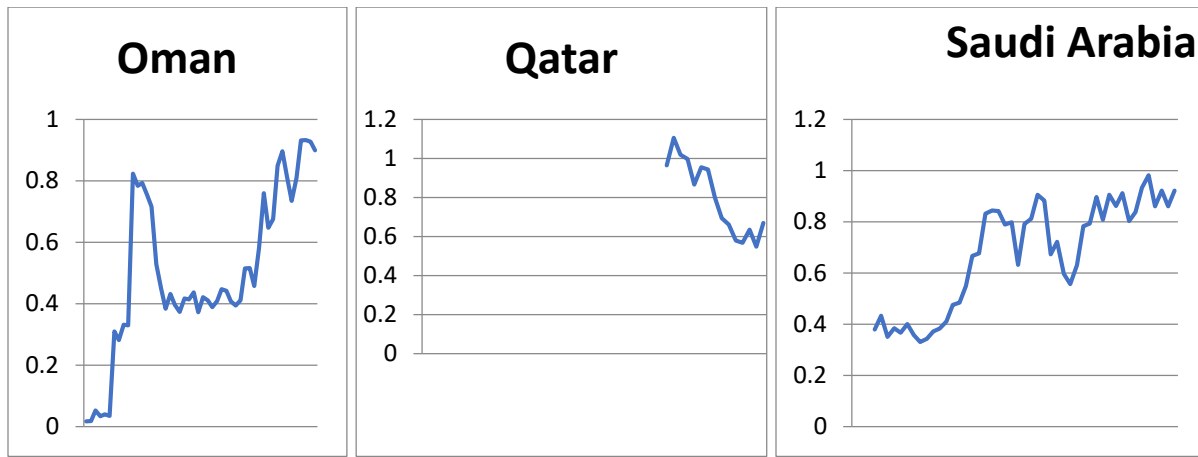
Time trend for the Oman and Saudi Arabia are depicting the similar anecdote. The trend is increasing over the period of analysis. Though at the early years the emission was more as compared to the end years in the series yet on average the CO_2 emission is decreased. Qatar is showing a decreasing trend over the whole time period.

4. Discussions

Data collected over time tend to exhibit trends, seasonal patterns and so forth observations in different time periods are related to one another or auto correlated. Autocorrelation exists when successive observations over time are related. ARIMA (autoregressive integrated moving average) models are a class of linear models that are capable of representing stationary as well as non stationary time series. ARIMA models make use of the information in the series itself to generate forecasts. These models rely on the autocorrelation pattern in the data. ARIMA models provide another approach to time series forecasting by describing the autocorrelations in the data. We used an iterative model building strategy that consists of selecting an initial model (model identification), estimating the model coefficients (parameter estimation) and analyzing the residuals (model checking), if necessary, the initial model is modified and the process is repeated until the residuals indicate no further modification is necessary .

Table -II
Specification of ARIMA Models for CO_2 Emission Forecast

UAE	**ARIMA (1,0,0)**
Bahrain	ARIMA (1,0,0)
Kuwait	ARIMA (1,0,0)
Oman	ARIMA (4,1,0)
Qatar	ARIMA (0,1,0)
Saudi Arabia	ARIMA (0,1,0)

In our data series Table II Presents the model selection, UAE is ARIMA(1,0,0),Bahrain is ARIMA(1,0,0),Kuwait (1,0,0), Oman is ARIMA(4.1.0) ,Qatar is ARIMA(0,1,0,) and Saudi Arabia is ARIMA(0,1,0) .We have taken the first difference and log to make series stationary where it was required.

Table III
Univariate Models

	UAE	Qatar	Bahrain	Kuwait	Oman	SaudiA
Constant	0.471	-0.021	1.170	0.680	0	0.019
T. Value	(16.305)***	-(0.842)	(18.469)***	(18.469)***		(1.109)
Difference	None	1	None	None	1	1
Natural-Log	None	None	None	None	Yes	Yes
Transformation						
AR(1)	0.613	0	0.674	0.689	AR(4)= 0.656	0
T. Value	(4.649)***	0	(5.281)***	(4.515)***	(6.355)***	0
MA(1)	0	0	0	0	0	0
T. Value	0	0	0	0	0	0
R-squared	0.358	0.75	0.452	0.248	0.619	0.84

*** Significant at 1% level of Significant ** Significant at 5 % level of Significant * Significant at 10% level of Significant

Table III demonstrates the result for Univariate model selection. Based on these result the model are selected for forecasting.

Table -IV

Forecast Statistics of Univariate Time Series Models

	UAE	Bahrain	Qatar	Kuwait	Oman	Saudi Arabia
Included observations	40	35	15	23	50	47
Root Mean SQ Error	0.074	0.130	0.094	0.073	0.157	0.83
Mean Absolute Error	0.056	0.100	0.074	0.050	0.082	.062
Mean Absolute Error	13.698	8.609	9.617	7.428	17.158	9.392
Normalized BIC	-5.035	-3.877	-4.55	-4.949	-3.622	-4.894

Table-IV illustrates forecasts Statistics, Root Mean Squared Error (RMSE), Mean Absolute error (MAE), Mean Absolute percentage errors (MAPE), In every case forecast error is defined as the forecast value minus the actual value, lesser will be the error better will be the forecasts. We get best forecast from our data series applying ARIMA as it is evident from statistics above.

4.1 Forecasts
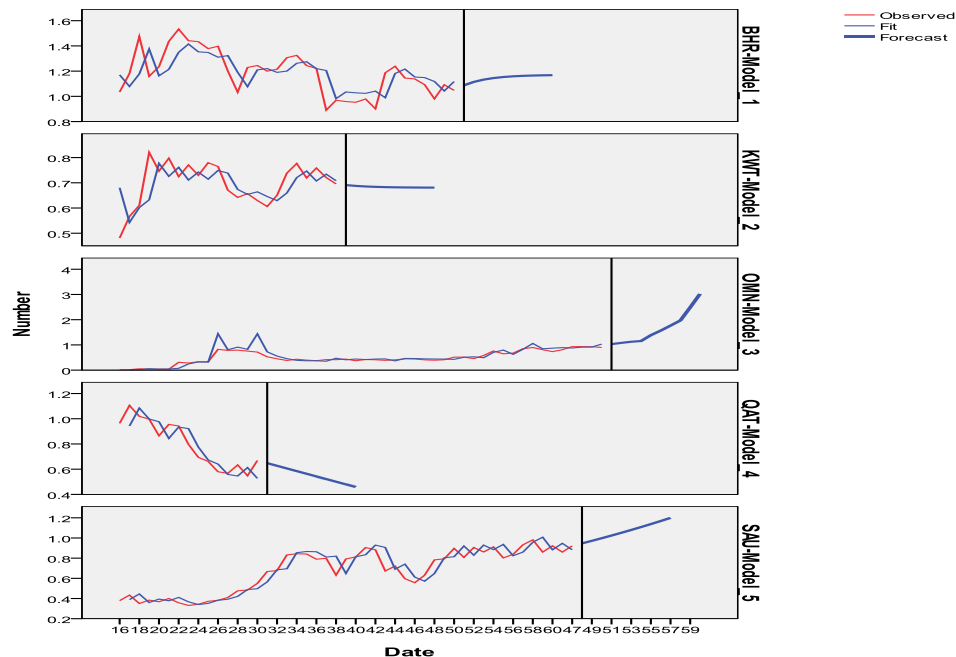

Figure given above is obtained from forecast obtained from model defined for each country.
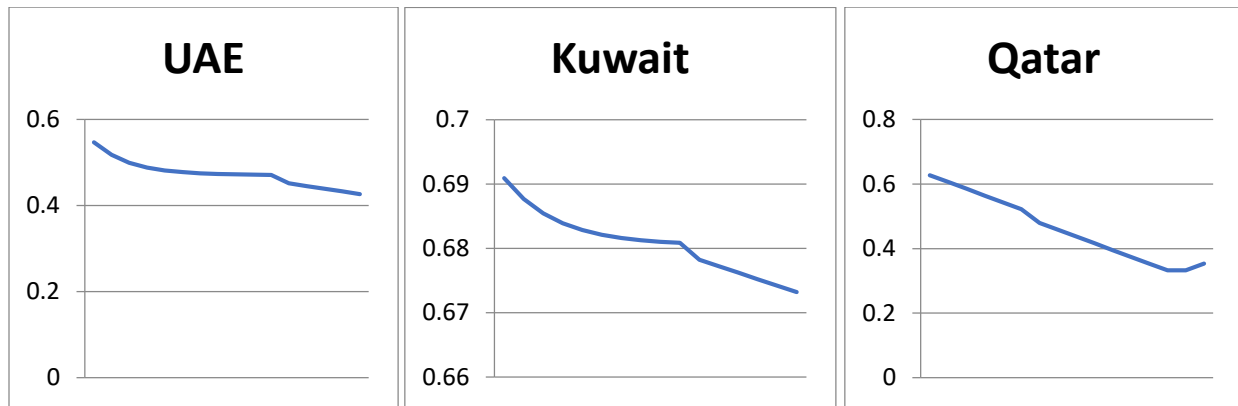
Table-V
Point Forecasts

Year	UAE	Kuwait	Qatar	SaudiA	Oman	Bahrain

2019	0.547003	0.69093	0.626878	0.971712	1.12521	1.087419
2020	0.517436	0.687681	0.605836	0.997613	1.153185	1.114457
2021	0.499318	0.685444	0.584795	1.024204	1.38516	1.132679
2022	0.488216	0.683903	0.563753	1.051504	1.566379	1.144959
2023	0.481414	0.682841	0.542712	1.079531	1.765624	1.153235
2024	0.477245	0.68211	0.52167	1.108305	1.96928	1.158812
2025	0.474691	0.681606	0.479588	1.137847	2.488843	1.162571
2026	0.473126	0.68126	0.458546	1.168176	3.023408	1.165104
2027	0.472167	0.681021	0.437505	1.199313	2.884918	1.166811
2028	0.47158	0.680856	0.416463	1.224204	3.11618	1.167962
2029	0.47122	0.678237	0.395422	1.25264	3.347442	1.189131
2030	0.451363	0.677232	0.37438	1.281077	3.578705	1.197082
2031	0.445175	0.676227	0.353339	1.309513	3.809967	1.205033
2032	0.438987	0.675222	0.332297	1.337949	4.04123	1.212984
2033	0.432799	0.674217	0.332297	1.366385	4.272492	1.220935
2034	0.426611	0.673212	0.353339	1.394822	4.503755	1.228886

Point forecast for each country is given in Table-V. To analyze the trend of forecast we present the forecast line chart.

UAE

Kuwait

Qatar

Saudi Arabia

Oman

Bahrain

The forecasted value for the subsequent 15 years is given in Table-V. On average the forecasted values for UAE, Kuwait and Qatar are showing a decreasing inclination illustrating that initiative taken to control CO_2 emission in these countries is executed successfully.
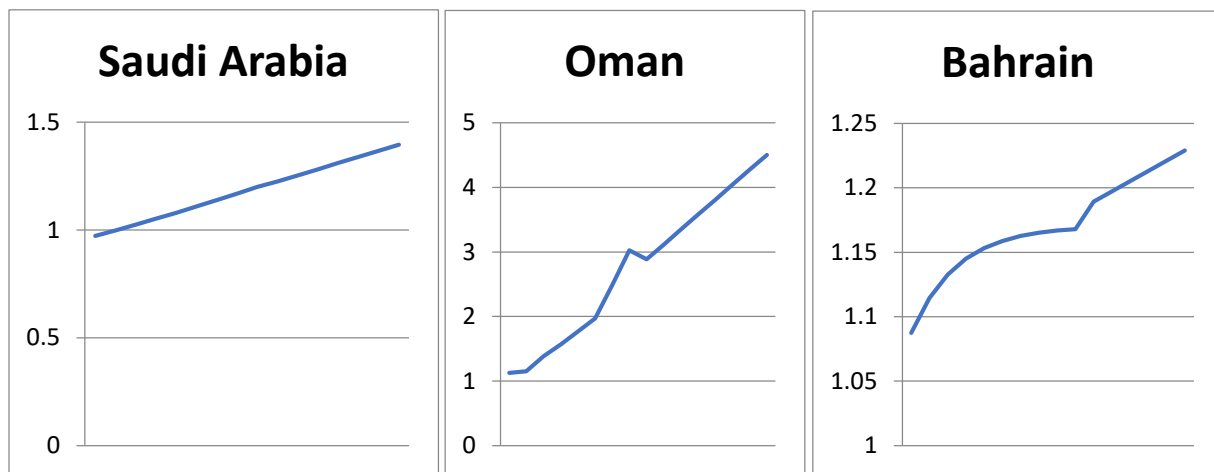
The forecasted values for Saudi Arabia, Oman and Bahrain are depicting increasing trend that is pointing towards the several reservations. It may indicate that development/GDP in these countries will increase that may increase the emission afterward, similarly it may also stipulate the inconsequential concern of these countries towards environmental friendly activities.

We cannot conclude anything with confidence as our forecasts might be misleading however on average it specifies the direction of trend. To increase the precision and accuracy of these forecasts we apply several techniques developed to analyze the forecast efficiency. Our efficiency test provides verification for forecasted fallout. Successive section is on the test of forecasts efficiency

5. Efficiency Test of Forecasts

We discussed several test in section.2 .Following them we check the consistency condition of our forecasts first that states, observed and expected series of any variables should be the same order of integration. To test the unit root the traditional test were applied. The results of unit root tests of observed Y_t and Expected F_t data series are given in Table-VI.

Table-VI
Unit Root Tests of Y_t and F_t Series

CO_2	Y_T	P-	T-value	P-	F_t	P-	T-value	P-value	Result

Series	Level	value	1stDiffere	value	Level	Value	1stDifferen		Yt & Ft
Bahrai	-2.49	0.12	-6.53	0.00**	-1.93	0.31	-1.930	0.06	I(1)
Kuwait	-3.42	0.02	-5.169	0.00**	-3.02	0.04	2.34	0.00**	I(0)
Oman	-1.64	0.45	-7.008	0.00**	- 0.47	0.53	-7.01	0.00**	I(1)
Qatar	-0.95	0.78	-4.708	0.03**	-0.97	0.74	-6.52	0.00**	I(1)
SaudiA	-1.43	0.59	-8.22	0.00**	-1.27	0.63	-6.82	0.00**	I(1)
UAE	-2.89	0.04	-6.65	0.00**	-3.3	0.01	-7.67	0.00**	I(0)

** Significant at 1% level of significance.   Original series (Y_t) and their relevant forecasts (F_t).

It is obvious from the results given in Table-VI that the four series included in this study have unit root at level form. Series of UAE and Kuwait are stationary at level at 5% level of significance. Following the general practice of considering the level of significant at 5%, we conclude that four series are I (1) and two are I (0). Then in order to satisfy the conditions of consistency the forecasts series must be of the same order of integration. The results of unit root test for the forecast series are also given in Table-VII that shows the same order of integration as of the observed series for all variables. We can infer that forecasts series obtained in this study have same order of integration as of their original series. Hence first condition of consistency is met.

For consistency the second condition is that the observed series must be co integrated with their respective forecast. In this study we find the evidence on co integration between observed and forecasted series by following the Engle-Granger. In our analysis the forecasts and observed series of Kuwait and UAE were stationary therefore test was not applicable for these two, whereas for all other four data series that were stationary at level I(1),the forecasts were qualified for consistency test. This means that there exists a long-run relationship between both series. Now there is a need to check the stability of the long run relationship that is to determine whether or not this relationship is stable in the long run. For a stable long run relationship the feedback effects obtained from the error correction mechanism (ECM) should be negative. Table-VII shows that all the feedback effects are negative, implying that all the consistent relationships between observed and forecasted series are stable in the long run. Thus disequilibrium between observed and expected series in any period is eliminated in the subsequent period. In short, we can say that we found four out of six forecasted series consistent and having a stable consistent long-run relationship with their relevant observed series.

Table-VII
Feedback Effects of Forecasts

UAE	**NA**
Bahrain	-0.871999
Kuwait	NA
Oman	-1.120881
Qatar	-1.615521
Saudi Arabia	-1.095771

Results of Efficiency Tests of Forecast

In the debate of efficiency we presented the weak efficiency and strong efficiency following the concept represented by Nordhaus (1987). A forecast is weakly efficient if it minimizes $E\{(u_t^2)|J_t\}$, where J_t is the set of all past forecasts.

We regress the Square Forecast error on past Forecast (the maximum lag length is chosen on the basis of significant t-statistics, in case if neither any lag nor first lag was significant , only first lag is used).The weak efficiency hypothesis that no past forecast explains the square forecast error is tested. The null should be accepted in order to be weakly efficient forecasts. Table-VIII represents the results of weak efficiency of forecasts obtained from equation (a.1).

$$U_t^2 = \alpha_o + \sum_{i=1}^{k} \alpha_i P^e_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots(a.1)$$

Ho: All the coefficients are zero

Table -VIII
Weak Efficiency Forecasts Test (ARIMA Models)

CO₂ Ser	α_0	T Val	α_1	T Val	α_2	Tval	Conclusion
Bahrain	0.025	0.560	-0.002	0.160	0.033	0.631	Coefficients=0, H0=accepted. Weakly efficient.
Kuwait	0.067	0.948	-0.03	0.956	0.028	0.843	===============
Oman	0.300	0.604	-.415	-0.876	0.091	0.143	===============

Qatar	0.010	0.975	-.087	-0.269	0.033	0.963	================
SaudiA	0.004	0.411	-.0106	0.307	-0.09	0.121	================
UAE	-.012	-.826	.0155	0.452	0.021	0.625	================

According to the weak efficient condition, our all forecasts were efficient. These results are seems to be coherent with the Nordhaus (1987). Strong efficiency test is based on equation (a.2)

$$U_t^2 = \alpha_o + \sum_{j=1}^{n} \alpha_j P^o_{t-i} + \varepsilon_t \ \ldots\ldots \ \text{(a.2)}$$

Table -IX
Strong Efficiency Forecasts Test (ARIMA Models)

CO_2Serie	α_0	T Val	α_1	T	α_2	T	Conclusion
Bahrain	0.025	0.560	-0.026	-0.060	0.033	0.631	Coefficients=0,H0= accept Strongly Efficient
Kuwait	0.009	-.482	0.3522	2.549	0.410	1.11	=================
Oman	0.300	0.604	-0.415	-0.876	0.091	0.143	=================
Qatar	0.010	0.958	-0.008	-0.269	0.033	0.963	=================
SaudiA	0.004	0.411	-0.010	-0.307	-.009	-.021	=================
UAE	-0.04	-.527	0.0089	0.416	0.011	0.562	=================

Our forecasts are weakly as well as strongly efficient. That indicates our forecasts are reliable and can be use for policy formation or in decision making. Forecasts test has increased the level of confidence for further utilization of results. The summary of our results is given in Table-X.

6. Summary of the Results
Table X summaries the result taken to determine the accuracy of forecast obtained for Carbon emission series of Gulf Countries.

Table-X
Result summaries for Efficiency criterion of Forecast

		Forecast	4.1	4.2	4.3
Countries	UAE	*ARIMA* *(1,0,0)*	0	1	1
	Bahrain	*(1,0,0)*	1	1	1
	Kuwait	*(1,0,0)*	0	1	1
	Oman	*(4,1,0)*	1	1	1
	Qatar	*(0,1,0)*	1	1	1
	Saudi Arabia	*(0,1,0)*	1	1	1

1 for met the test, 0 otherwise NA, no justification of test.
4.1 Consistency Test
4.2 Weak Efficiency Test
4.3 Strong Efficiency Test

7. Conclusion

Forecasting is a statistical technique and process of prediction that provides relevant and reliable information about future based on available past and present information. It is not a magic tool that can reduce the complications and uncertainties however; it can be used as a watchful gizmo. Organization can modify their important decision in the light of forecasting results that leads towards sound planning. It gives confidence for making important decisions and basis for making planning premises. Moreover, it keeps policy makers active and vigilant to mug the challenges of future. Forecasting can only estimate, guarantee about future outlay is not promising. Therefore, short-term forecasts are considered more accurate and reliable as compared to long-term. Forecasting is based on certain assumptions and past measures, if assumptions get wrong and history not replicate itself, forecasting will be fruitless. Hence, to reduce the shortcomings of forecasting several tests has been developed to enhance the efficiency and accuracy. The present study applied the efficiency test of forecast on carbon emission of gulf countries for illustration. The purpose was to provide a tool of analysis for accurate forecasts in future research. Moreover; it also provides the direction for future planning with more confidence keeping in view the weaknesses of forecasting.

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