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FORECASTING PAKISTAN'S EXPORTS TO SAARC: AN APPLICATION OF UNIVIRIATE ARIMA MODEL

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ABSTRACT

This study made an attempt to forecast the Pakistan's exports to SAARC for a few coming years. Box and Jenkins (1976) methodology of univiriate ARIMA model has been selected as an appropriate econometrics model. This study found ARIMA (1,1,4) as most appropriate model among other ARIMA models to forecast Pakistan's exports to SAARC. Present study rejected null hypothesis and it has been concluded that in a few coming years, exports from Pakistan to SAARC region will be increased. Pakistan's exports to SAARC will increase in coming years on an average of 27630 Million Rupee per year. So, the government of Pakistan should invest into those sectors in which Pakistan has export potential to the SAARC countries.

Keywords: ARIMA Model, Box-Jenkins Methodology, SAARC, Pakistan, Exports, Forecasting

INTRODUCTION

International trade is most important engine for economic growth and exports are its essential parts (Ali & Talukder, 2009). Exports have strong a relationship and positive impact on economic growth (Alam, 2011). The theory of Comparative Advantage and Customs Union provides basis for the formation of regional organization (Ruffin, 2002). According to Customs Union theory regional blocks are hope for the improvement of trade and economy welfare. So, the purpose of present is forecast Pakistan's exports to SAARC at regional level for a few coming years.

South Asian Association of Regional Cooperation (SAARC)

SAARC was found in December 1985 by seven countries namely; Pakistan, India, Sri Lanka, Bhutan, Nepal, Bangladesh and Maldives. Afghanistan joined the SAARC later on in 2007 (Jabeen, Mazhar, & Goraya, 2010). In SAARC, Pakistan is second largest nation after India. Agriculture, industry and services sectors of Pakistan contribute in Gross Domestic Product (GDP) 21.8 %, 23.6 % and 54.6 % respectively. During the period of 1988-2010, Pakistan's exports to SAARC increased from 3,737 to 51,151 million Rupees on an average of 17,124 Million rupee per annual.

Problem Statement

Various researcher, exporters, producers and farmers have much interested to study the economic integration information as well as related to the Pakistan's exports to SAARC. As in the selected empirical literature review, no clue was found on this topic. So, to provide an updated estimation about the forecasting of Pakistan's exports to SAARC over the next few years, a study is needed because its future trends have much more importance.

Significance of Study

This study could prove helpful to understand the future trends of Pakistan's exports to SAARC. The forecast values for a few coming years will also lead to the policy makers towards the improvement of exports relations with selected SAARC countries. Finally, the importance of present study may lead Pakistan's economy towards growth, development and also improvement of the country balance of payment.

Research Objectives

The objectives of present research are mention as bellow;

- To suggest appropriate ARIMA model for the generation of forecasting Pakistan's exports to SAARC
- To generate forecasts of Pakistan's exports to SAARC by using appropriate ARIMA models.

The remaining paper structure is as follows. Section 2 provides the literature review. Data and methodology is built in section 3. Section 4 reports the data analysis, results and discussion. The last section contains conclusions, recommendations and future work.

LITERATURE REVIEW

Various studies have been conducted to formulate the forecasting models, especially by using the Box-Jenkins ARIMA methodology. This section presents literature review, especially with respect to Box-Jenkins ARIMA methodology.

Naz (2012) used ARIMA model methodology to dates exports in Pakistan. Ayyub, Bilal and Ahmad (2011) worked out on the forecasting of price and production of Pakistani meat by using ARIMA. Badmus and Ariyo (2011) used this model to forecast the production and area of maize from Nigerian. Adamsa, Akano and Asemota (2011) also used this model to forecast generation of electricity power from Nigeria. They concluded ARIMA (3,2,1) as a best model. Sankar (2011) used the same methodology to generate forecast export of fish product from Tamilnadu. This study included some measures in model selection criteria as ACF, PACF, BIC, residuals estimated and Box-Ljund Q statistic. ARIMA (0,1,2) model selected as appropriate model..

Wankhade, Mahalle, Gajbhiye, & Bodade (2010) made a study to forecast the production of Pigeon pea with the help of ARIMA model. Albayrak (2010) also applied same model to forecast the production and consumption of primary energy in Turkey. Kumar & Gupta (2010) developed this model for the aim to forecast export of industrial goods. Emang, Shitan, Ghani, & Noor (2010) used this model to forecast chipboard and moulding export demand in Malaysia. Their study included some measures such as: MAPE, RMSE and MAE for selection of appropriate model. Rahman (2010) built this model to forecast the production of rice in Bangladesh. Some measures being MAPE, MSE, MAE, RMSE and R2 were included in model selection criteria.

According to Zakria & Muhammad (2009) the ARIMA (1, 2, 0) model has a best model to forecast the Pakistan population by using the Box Jenkins methodology. This model was also used by the Sher & Ahmad (2008) to forecast wheat production in Pakistan. Khan et al. (2008) made an attempt to forecast the production of mango from Pakistan and their study concluded ARIMA (1,1,1) as an appropriate model. Ediger and Akar (2007) used this model to forecast total primary energy demand.

Mustafa and Ahmad (2006) applied ARIMA model to forecast the export of oranges from the Pakistan. Ahmad, Mustafa, & Mehdi (2006) used same model to forecast export of mango from Pakistan. Bokhari & Feridun (2006) used ARIMA and VAR models to forecast inflation of Pakistan and concluded that ARIMA model is appropriate as compared to VAR

model. Their study used some test as best model selection; their selection model criteria included ACF, PACF, AIC, SIC, SSR, MSE, RMSE but they mainly focused on MSE and RMSE to select best model. Ghafoor and Hanif (2005) used same model to examine the Pakistan trade pattern and concluded that imports and exports from Pakistan will increase.

DATA AND METHODOLOGY

Collection of data

Annual time series data for the period of 1975 to 2009 was used to forecast the Pakistan's exports to SAARC. The data on Pakistan's exports to SAARC were taken from the Economy Survey of Pakistan 2009-10. This variable has been measured by taking nature logarithm of value of Pakistan's export to SAARC million rupees in term of nation currency of Pakistan.

Hypothesis

Following is main hypothesis of present study:

H_1: There is an increasing trend in forecast values of Pakistan's exports to SAARC

H_0: There is no an increasing trend in forecast values of Pakistan's exports to SAARC

Statistical Techniques

Box and Jenkins (1976) methodology of univiriate ARIMA has been used to forecasting Pakistan's exports to SAARC for a few coming years. Detaisls on this methodology are as follow:

This methodology was considered most flexible method and also used by a numbers of researchers for forecasting with time series data. According to Google Scholar on February, 14, 2012, the book written by Box and Jenkins (1976) has been cited by 11,245 studies. According to the Box and Jenkins (1976), a non-seasonal ARIMA model denoted by ARIMA (p,d,q).This model is a combination of Auto Regressive (AR) and Moving Average (MA) with an order of integration or differencing (d). Where p is order of autocorrelation and q is order of moving averaging.

ARIMA in general form is as follow:

$$\Delta Z = C + (\varnothing \Delta Z + \cdots + \varnothing \Delta Z - a + \cdots + a + a$$

Where 'C' is a constant and Δ denote difference operator like

$$\Delta Z = Z - Z$$

$$\Delta Z = \Delta Z - \Delta Z$$

Zt-1 … Zt-p are values (lags) of past series values and $\varnothing$ is the coefficient to be estimated by auto-regressive model.

The auto-regressive model of order 'p' denoted by AR (P) is as follow (2)

$$Z = + \varnothing Z + \varnothing Z + \cdots + \varnothing Z + a$$

Where, a random variable with zero mean and constant variance is denoted by a_t.

In the moving average (MA) model, Φ is denoting to coefficient. So, the Moving Average Model is of order 'q' or MA (q) which can be written as:

$$Z = a - a - a - \cdots - a$$

Box and Jenkins (1976) ARIMA methodology consist these four steps model identification, model estimation, diagnostic checking, and forecasts respectively (Ahmad, Mustafa, & Mehdi, 2006; Gujarati, 2003).

Diagnostic Checks

Box and Jenkins ARIMA methodology include a step of checking the model adequacy and accuracy by both residual and parameter analysis (Burhan, Khalid, &

Mubashir, 2006). For this purpose, the following are some main diagnostic checks which have been used for estimated ARIMA models. Diagnostic checks includes Investigation of Unit Root, Line Graph, Histogram-Normality test and Jarque-Bera statisticCorrelogram.

In present study, Augmented Dickey Fuller (1981) test has been used to find unit root in the time series data of variable under consideration. Various studies used this test to check the unit root in time series data (Shafaqat, 2012a; Mehmood, Ahmad, Ahmad, & Bokhari, 2012; Naz, 2012; Afzal, 2012, Rehman, 2012; Javed, 2012). For the identification of data stationarity, line graph shows graphical behaviour of the observation at level, first difference and so on (Gaynor & Kirkpatrick, 1994). Correlogram showed the plots of Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF) against the lag length. To judge significance of error terms individually, two standard error bands $\pm 2/\sqrt{T}$ are used in Correlogram (Gujarati, 2003). This statistic was developed by Jarque & Bera (1987) and it is used for checking normality of error terms and is based on the Kurtosis and Skewness having normal form of distribution approximately equal to zero (Park, 2008).

Model Selection Criteria

In the time series research, selection of appropriate models is an art. Different researches mentioned different criteria for the selection of model. There are not any hard and fast rules for the selection of appropriate model in time series studies. A model with minimum values of RMSE, MAPE, MSE, MAE, AIC, BIC, Q-statistics and with high R-square, Stationary R-square considered an appropriate model for forecasting. The model selection criteria includes Akaike Information criterion and Schwarz's Bayesian Information criterion, Mean squared error (MSE), Root Mean squared error (RMSE), Mean absolute error (MAE) and Minimum Absolute Percentage Error (MAPE).

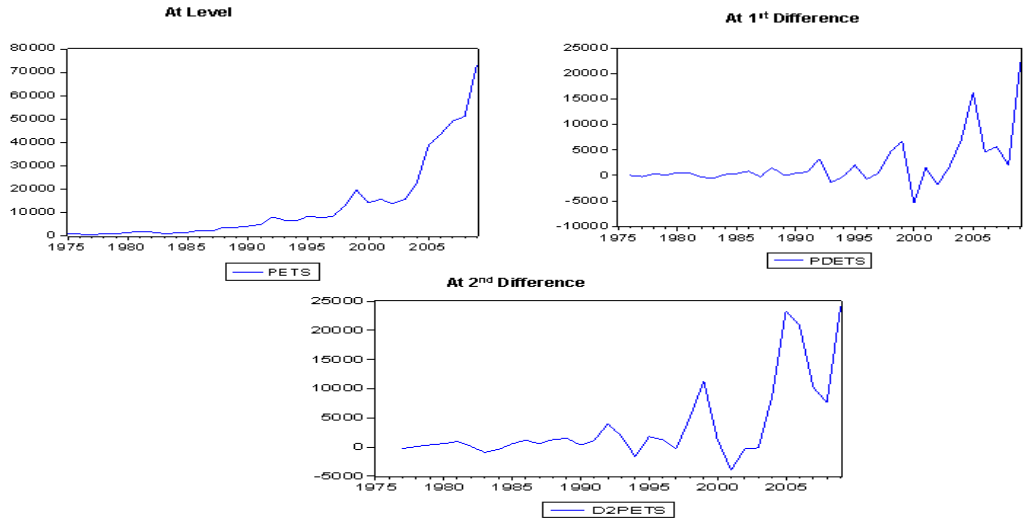
RESULTS AND DISCUSSIONS

For the data stationarity requirement these tests apply such as: Dickey- Fuller, Augmented Dickey-Fuller test and Sequence Plots. The Order of Auto Regressive (AR) and order Moving Average were selected from Correlograms by keep in mind behaviour of Auto Correlation Function (ACF) and Partial Auto Correlation Function (PACF). ADF test has been applied on original values of time series data of Pakistan's exports to SAARC.

TABLE 1
ADF Test on Original Data

Test	Durbin-Watson Stat.	Decision	ADF Test			
			ADF values	Critical Values at		
				1%	5%	10%
ADF at level	2.239	Data Non-Stationary	-1.437	-2.653	-1.953	-1.609
ADF at 1st difference	2.029	Data Non-Stationary	1.275	-2.660	-1.955	-1.609
ADF at 2nd difference	2.251	Data Non-Stationary	3.591	-2.660	-1.955	-1.609

FIGURE 1
Line Graphs of Original Data at Level, 1st and 2nd Difference



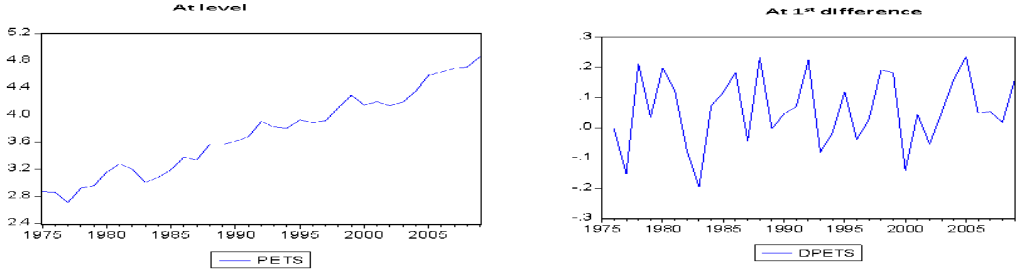
Results from Table 1 showed the non-stationarity at level for time series data of PETS. Test of ADF indicated that the calculated values of ADF are greater than the critical values at 1%, 5% and 10% at level, at first difference and at second difference. Further the values of Durbin-Watson test also greater than two showed that time series data have problem of autocorrelation.

Figure 1 also indicates the trend of time series data at level, first difference and second difference. It's clear from figure 4.1 that time series data have upward trend which shows non-stationary of data. Therefore, logarithm transformation is necessary for the achievement of stationarity requirement of time series data.

TABLE 2
DF and ADF Test on Log Values of PETS

Test	Durbin-Watson Stat	Decision	ADF Test			
			ADF values	Critical Values at		
				1%	5%	10%
DF at level	1.811	Data Non-Stationary	0.911	-2.634	-1.951	-1.610
DF at 1st difference	1.949	Data became Stationary	-6.061	-2.626	-1.951	-1.610
ADF at level		Data Non-Stationary	2.911	-2.634	-1.610	-1.610
ADF at 1st difference	1.936	Data became Stationary	-4.859	-2.626	-1.951	-1.610

FIGURE 2
Line Graphs of Log PETS at Level and 1st Difference



Results from Table 2 showed the non-stationarity at level for time series data of PETS but series achieved stationarity at first difference. Test of DF and ADF indicated that calculated values of ADF are greater than the critical values at 1%, 5% and 10% at level. Further, the values of Durbin-Watson test also greater than two at level, which showed that time series data have problem of autocorrelation. But at first difference test of DF and ADF indicates that calculated values of DF and ADF test are less than the critical values at 1%, 5% and 10% at level. Its means, time series data have achieve stationarity after taking difference of log values. Figure 2 also includes line graphs of log values. The trend of time series data at first difference shows that time series data does not contain problem of non-stationarity.

FIGURE 3
Correlogram at Level

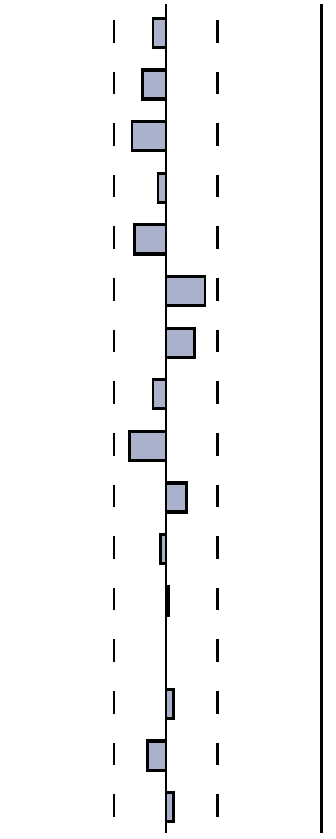
Date: 01/09/12 Time: 11:44
Sample: 1975 2009
Included observations: 35

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.810	0.810	24.980	0.000
		2	0.647	-0.025	41.412	0.000
		3	0.501	-0.046	51.573	0.000
		4	0.419	0.093	58.890	0.000
		5	0.334	-0.048	63.711	0.000
		6	0.271	0.009	67.000	0.000
		7	0.233	0.050	69.518	0.000
		8	0.182	-0.065	71.112	0.000
		9	0.115	-0.074	71.774	0.000
		10	0.072	0.031	72.046	0.000
		11	0.035	-0.031	72.114	0.000
		12	0.020	0.021	72.136	0.000
		13	-0.000	-0.013	72.136	0.000
		14	-0.004	0.012	72.137	0.000
		15	-0.014	-0.014	72.149	0.000
		16	-0.016	0.012	72.167	0.000

Correlogram in Figure 3 indicates that there is only one significance spike for Partial Auto Correlation Function (PACF) at lag one and various significance spikes exist in case of Auto Correlation Function (ACF). Results from Correlogram at level will be suitable for the model having AR (1). Furthermore, there are many significance ACF which indicates that MA(1), MA(2), MA(3) etc. will be appropriate for best select model but problem of variance of non-stationary exist at level. So, above decision about selections of order of AR and MA may lead to misrepresentation of model.

FIGURE 4
Correlogram at 1st Difference

Date: 01/09/12 Time: 11:45
Sample: 1975 2009
Included observations: 34



	Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
1			-0.084	-0.084	0.2601	0.610
2			-0.159	-0.167	1.2255	0.542
3			-0.229	-0.267	3.2889	0.349
4			-0.044	-0.144	3.3667	0.498
5			-0.215	-0.377	5.3126	0.379
6			0.258	0.057	8.2323	0.222
7			0.196	0.094	9.9766	0.190
8			-0.089	-0.143	10.346	0.242
9			-0.244	-0.220	13.252	0.152
10			0.140	0.089	14.257	0.162
11			-0.027	-0.003	14.295	0.217
12			0.013	-0.033	14.304	0.282
13			-0.008	-0.133	14.307	0.353
14			0.046	-0.073	14.436	0.418
15			-0.123	0.002	15.418	0.422
16			0.043	-0.008	15.544	0.485

Correlogram in Figure 4 indicate that after taking the first difference of log values of Pakistan's exports in SAARC region, time series data has no problem of non stationary variance. There is not any significance spike for both ACF's and PACF's. Present research work has included basic six possible ARIMA models which depend on the value of (p, d, q). models such as: { (0,1,2), (0,1,3), (1,1,1), (1,1,2), (1,1,3) and (1,1,4).

TABLE 3
Initial Estimates of Parameters of ARIMA Models

Model	Parameters	Estimate	S.E.	t-ratio	P-value
ARIMA (0,1,2)	C	3.759424	0.123926	30.3361	0.0000
	MA1	1.084564	0.090514	11.98231	0.0000
	MA2	0.756316	0.124718	6.06422	0.0000
ARIMA (0,1,3)	C	3.801072	0.1544	24.61839	0.0000
	MA1	1.715971	0.189638	9.048676	0.0000
	MA2	1.358941	0.276712	4.911026	0.0000
	MA3	0.303401	0.1589	1.909388	0.0655
ARIMA (1,1,1)	C	312.2656	46874.12	0.006662	0.9947
	AR1	0.999809	0.028995	34.48227	0.0000
	MA1	-0.22628	0.179786	-1.25858	0.2176
ARIMA (1,1,2)	C	21.38741	59.43332	0.359856	0.7215
	AR1	0.996638	0.011437	87.1397	0.0000
	MA1	-0.48722	0.179504	-2.71424	0.0109
	MA2	-0.42403	0.190518	-2.22568	0.0337
ARIMA (1,1,3)	C	24.62426	100.4798	0.245067	0.8081
	AR1	0.997137	0.013889	71.79586	0.0000
	MA1	-0.33984	0.194833	-1.74426	0.0917
	MA2	-0.36821	0.199406	-1.84656	0.075
	MA3	-0.20291	0.186509	-1.08791	0.2856
ARIMA (1,1,4)	C	136.2037	1286.27	0.10589	0.9164
	AR1	0.99956	0.004272	233.9848	**0.0000**
	MA1	-0.43929	0.106284	-4.13317	**0.0003**
	MA2	-1.02434	0.070147	-14.6027	**0.0000**
	MA3	-0.44228	0.054348	-8.13798	**0.0000**
	MA4	0.934418	0.108343	8.624638	**0.0000**

TABLE 4
Comparative Results of Different ARIMA Models

Model	Sta. R^2	R^2	MSE	RMS-E	MA-PE	MAE	AIC	BIC	Q-statistics
ARIMA(0,1,2)	0.189	0.830	0.061	0.247	2.36	0.0835	0.3132	-0.346	20.590
ARIMA(0,1,3)	0.226	0.893	0.038	0.196	2.41	0.0866	-0.187	-0.009	21.765
ARIMA(1,1,1)	0.191	0.962	0.012	0.112	2.39	0.0854	-1.327	-1.192	24.159
ARIMA(1,1,2)	0.210	0.830	0.009	0.099	2.38	0.0852	-1.515	-1.335	21.244
ARIMA(1,1,3)	0.291	0.972	0.009	0.096	2.39	0.0853	-1.508	-1.283	13.522
ARIMA(1,1,4)	0.282	0.984	0.005	0.071	2.34	0.0833	-2.050	-1.781	16.539

Note. Here; MSE stands for Mean Square Error,
RMSE stands for Root Mean Square Error,
MAPE stands for Mean Absolute Percentage Error,
MAE stands for Mean Absolute Error,
AIC stands for Akaike Information Criteria and
BIC stands for Bayesian Information Criteria

Table 3 shows the initial estimate of parameters of different six ARIMA models. This study observed ARIMA (1,1,4) as an optimal and appropriate model to forecast the Pakistan export in SAARC region. The selected model also approximately fulfils the basic criteria of model selection such as: minimum value of RMSE, MAPE, MSE,, BIC and AIC, and with high correlation of R-square and Stationary R-square which mentioned in Table 4.

TABLE 5
Optimal Model for Forecasting Pakistan's Exports to SAARC

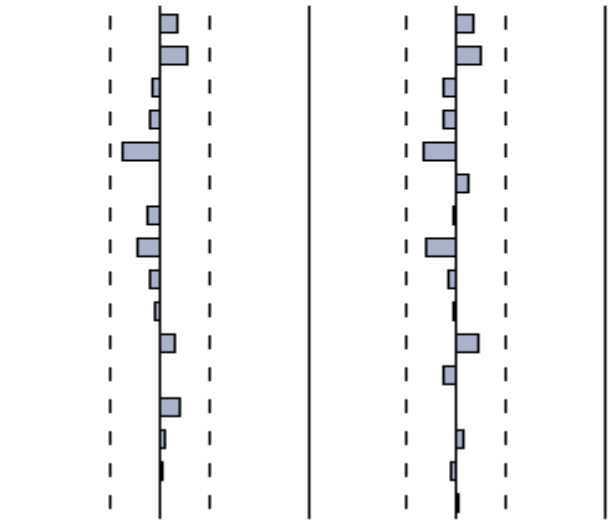
Model	Parameters	Estimate	S.E.	t-ratio	P-value
ARIMA (1,1,4)	C	136.2037	1286.27	0.10589	0.9164
	AR1	0.99956	0.004272	233.9848	0.0000
	MA1	-0.43929	0.106284	-4.13317	0.0003
	MA2	-1.02434	0.070147	-14.6027	0.0000
	MA3	-0.44228	0.054348	-8.13798	0.0000
	MA4	0.934418	0.108343	8.624638	0.0000

Equation of appropriate ARIMA model is as follow:

$$\Delta = 0.066169 + 0.999 + 0.439 + 1.024 + 0.442 - 0.934 +$$

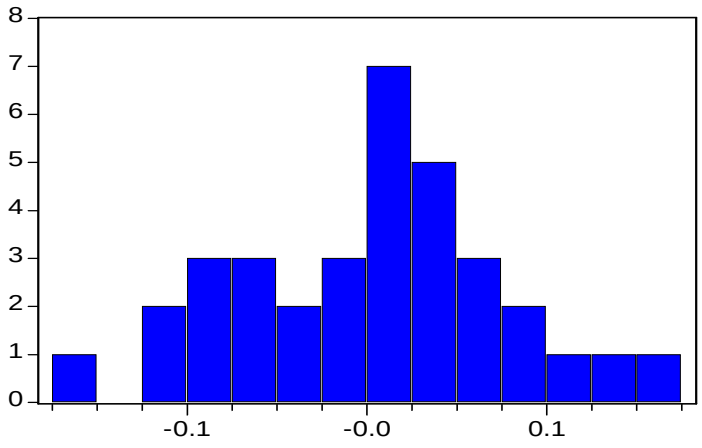
FIGURE 5
Correlogram of Residuals test on selected Model

Date: 01/09/12 Time: 11:49
Sample: 1976 2009
Included observations: 34
Q-statistic probabilities adjusted for 5 ARMA term(s)



Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.119	0.119	0.5222	
		2	0.183	0.171	1.7962	
		3	-0.043	-0.085	1.8681	
		4	-0.070	-0.092	2.0677	
		5	-0.257	-0.230	4.8624	
		6	0.003	0.084	4.8626	0.027
		7	-0.092	-0.019	5.2485	0.072
		8	-0.148	-0.198	6.2794	0.099
		9	-0.065	-0.054	6.4852	0.166
		10	-0.035	-0.022	6.5469	0.257
		11	0.104	0.158	7.1181	0.310
		12	-0.007	-0.091	7.1209	0.416
		13	0.134	0.007	8.1630	0.418
		14	0.040	0.043	8.2602	0.508
		15	0.013	-0.026	8.2717	0.602
		16	-0.007	0.022	8.2754	0.688

FIGURE 6
Histogram- Normality Test of selected Model



Series: Residuals
Sample 1976 2009
Observations 34

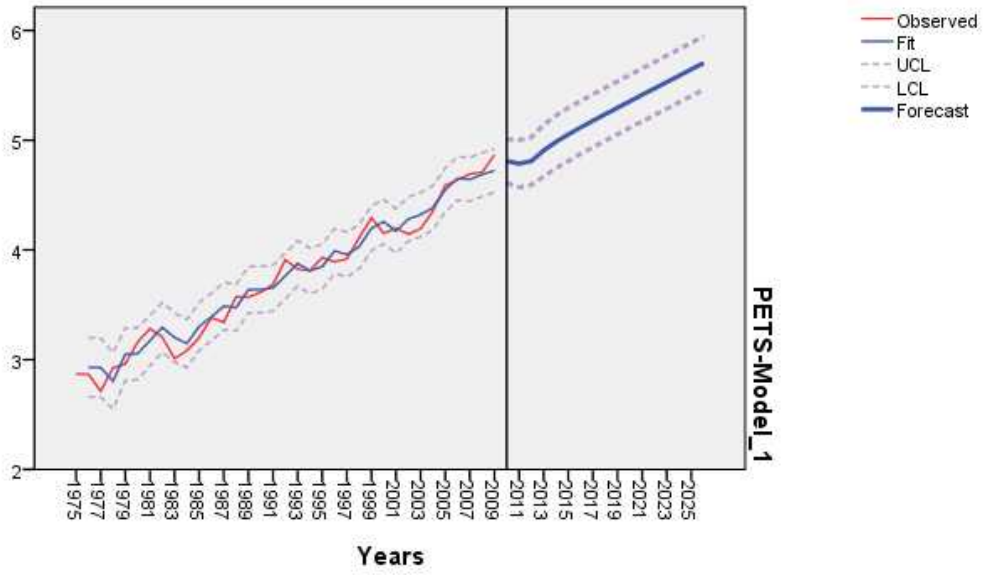
Mean	0.003067
Median	0.012764
Maximum	0.165272
Minimum	-0.155009
Std. Dev.	0.073783
Skewness	0.003849
Kurtosis	2.594419
Jarque-Bera	0.233120
Probability	0.889977

ARIMA (1,1,4) model has been used to forecast the values of Pakistan's export in SAARC region. Table 5 shows that all parameters of selected model are significant and this model fulfils the criteria of best model selection as compared to other models. The forecast values of Pakistan export in SAARC region for a few coming years from 2009-10 to 2024-25 mentioned in the Table 6.

TABLE 6
Forecasted Values of Pakistan's Exports to SAARC

Sr. No.	Year	Forecasts in Million Rupee	95 % LCL	95% UCL
1	2009-10	64446.6	40813.14	101788.8
2	2010-11	61108.27	37196.32	100392.2
3	2011-12	64476.28	39075.09	106365.3
4	2012-13	80612.06	46784.29	138899.3
5	2013-14	96516.15	55462.57	167919.1
6	2014-15	112979.6	64803.73	197015.3
7	2015-16	130767.6	74972.16	228086.7
8	2016-17	150452.7	86258.12	262421.9
9	2017-18	172544.1	98946.4	300953.9
10	2018-19	197605.9	113292.2	344667.2
11	2019-20	226151.8	129628.4	394457.3
12	2020-21	258642.6	148251.8	451232.1
13	2021-22	295801.2	169511.8	516059.8
14	2022-23	338220.6	193776	590201.1
15	2023-24	386634	221564.4	674838.7
16	2024-25	442079.1	253279.5	771791.5

FIGURE 7
Behavior of Forecasted Values



The forecast indicates that in the year of 2025, the export from Pakistan to SAARC region will be 442,079 million rupee with lower and upper class limit of 253,279 and 771,791 million rupee respectively.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

Present study made an attempt to forecast the Pakistan's exports to SAARC for a few coming years. Box and Jenkins (1976) methodology of univiriate ARIMA model has been selected as an appropriate econometrics model. This study found ARIMA (1,1,4) as most appropriate model among other ARIMA models to forecast Pakistan's exports to SAARC. Present study rejected null hypothesis and it has been concluded that in a few coming years, exports from Pakistan to SAARC region will be increased. The forecast indicate that in the year 2025 the value of Pakistan's exports to SAARC will be 442079 Million Rupee which is 368605 Million Rupee more than the value of Pakistan's exports to SAARC in 2009. Pakistan's exports to SAARC will increase in coming years on an average of 27630 Million Rupee per year.

Recommendations

The government needs to employ various measures to raise exports and economic growth. The government should develop a conscious policy to attract domestic and foreign investment, which will be beneficial to improving productivity, encouraging capacity building, recovering quality and competitiveness in term of cost. The government should focus on encouraging SAARC member countries investment, especially Indian investment in Pakistan. The government of Pakistan should invest into those sectors in which Pakistan has export potential to the SAARC countries. The government of Pakistan should also arrange seminars and workshops on the importance of regional integration.

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