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The Determinants and Forecasting of Electricity Consumption in Pakistan

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ABSTRACT

The current study examined the determinants of electricity consumption and also intends to forecast the electricity consumption in Pakistan. The study has used time series data analysis, applied Johansen Cointegration Test, error correction mechanisms and regression for examining determinants and autoregressive integrated moving average model is used for forecasting. The study has used times series secondary annual data on different variables for the period ranging from 1970 to 2018. The results of the study showed that gross domestic product and population have positive impact on electricity consumption. Whereas, National output (GDP) is statistically significant in the determination of total electricity consumption. The results also indicated that increase in the real economic activities has increases the total electricity consumption. Furthermore, the results of electricity consumption model also suggest that electricity price have negative impact on total electricity consumption. As electricity demand is inelastic to electricity price and income, it indicates that fewer substitutes of electricity are available in the market. Hence electricity is essential component of energy for economy. The results of the current study can be useful for the policymakers and government regulatory bodies relating to electricity.

Keywords: Determinants, Electricity Consumptions, ARIMA, Pakistan
JEL Classifications: G2, M53, Q4

1. INTRODUCTION

Energy plays a significant role in economic growth of the any country. According to classical economists the labor and capital are the main factor in the process of production while ignored the role of energy in economic growth. However, neoclassical economists strained on increase in productions due to increase in labor, capital, and technology (Stern, 2004), and modern studies recommends that energy plays key role in the economic growth of developing nations (IEA, 2005). Nevertheless, energy uses increase the employment opportunity to expand the economic activities and to fulfill the necessities of agricultural, industrial, transportation and commercial sectors. Thus, energy sector has a significant contribution to the economic growth of a country (Odalaru, 2009).

In Pakistan, the total energy demand was covered by 86% from domestic energy supply in 1980s however, the remaining 14% of the energy was imported from abroad, but according to SBP (2006) this gap extended to 47% till 2000. In 2010, this gap between energy demand and energy supply expanded which affected different sector of the economy. This short fall also affected foreign market and propagated to trade balance because of increase in prices of oil. Similarly, according to PEPCO (2009) and Economic Survey of Pakistan (2010), there are 8-10 h of load-shedding in urban areas in Pakistan while 12-16 h in rural areas it's because

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of shortage of electricity. The current shortfall of energy not only increase the trade balance but also affected other macro-economic variables like Balance of payments, budget deficit, employment level, exchange rate, reserves of foreign exchange, economic growth, and living standard of the people (Asif, 2011).

The electricity share in total energy mix during 2009-10 was 15.6% and its demand has increased up to 5.2% annually from 2001-02 to 2009-10. The share of gas in total energy consumption is 43.9% during 2009-10. Available natural gas reserve has been 26.62 trillion cubic feet. The transport and household showed increasing demand for gas by 14.3% and 0.75% respectively. Coal share in the energy mix is 11% during 2009-10. Pakistan has 185 billion tons coal reserves out of which only 175 billion tones are estimated in Thar, the energy share is considerable and important for policy making regarding energy sector (Economic Survey of Pakistan, 2010-11).

Pakistan has had high potential to produce electricity, but unable to installed power producing plants because of lack of any integrated and alarming management and planning to satisfy future needs. As a result, the shortfall reached to an average of 5000MW, and this shortfall further increased to 7000MW last July, 2014. The existed gap was broadened and resulted in 12-16 h of load-shedding in the country. That is why the power sector of the country has faced a large amount of serious issues. And the addition of new power generation added to the system in past few years which proved helpful to reduce the tense situation of power shortfall in Pakistan since 2018. The most recent figures about installed electricity generation capacity in 2020 reached to 37402 MW and the total demand of the residential and industrial sectors are about to 25000 MW, on the other hand the transmission and distribution volume is caught up at about 22000 MW. The difference in demand and supply is about 3000 MW at peak time. However, the total demand of the country is too low than the country's installed capacity of 37402 MW in 2020.

Forecasting of energy demand is very crucial for the future growth and development of a country. While correct energy demand forecasting is made by the researchers, planners and government, it will help to handle energy crises effectively. Particularly for country like Pakistan, accurate forecasting is very essential because in Pakistan the gap between energy demand and supply is widening day by day. According to official forecasting made by National Transmission and Dispatch Company Limited (NTDC) from 2009-10 to 2019-20, the total electricity consumption in 2019-20 will be 35048 MW as compared to 17847 MW in 2009-10 respectively (NTDC, 2009-10). The cause of high demand for electricity consumption is due to rapid increase in consumers of electricity. In 2010 the total domestic consumers were 0.172 billion, whereas in 2020 it will be 0.209 billion (NTDC, 2008). The gap between total demand and supply of electricity will be -13651 MW in 2020, while it was -3338 MW in 2008 (IPP, 2008).

Pakistan faces a lot of challenges ranging from poverty, low economic growth, political instability and terrorism to energy crisis. The most important of all these challenges is the energy crisis as it is roots cause of many other problems like poverty, unemployment, slow economic growth and low living standard of the masses.

2. LITERATURE REVIEW

Wahid et al., (2016) provided the forecasting of coal consumption in Pakistan. They used annual time series data for the period of 1972-2015, by using Johansson co-integration technique. Different economic and social factors were investigated to forecast their objective. The consumption of Coal was found dependent on GDP per Capita, Production of cement industry and coal's Import. ARIMA is used to take forecast of the future trend in Pakistan for the period of 2016-2030.

Alberinia et al. (2011) estimated the static and dynamic gas and electricity demand models in U.S. They established greater response of energy demand to energy prices and the demand of electricity and gas were inelastic with respect to energy price. They found no proof in favor of difference in elasticity of gas and electricity for heating purpose. It further indicated that income elasticity of household for gas and electricity was less than price elasticity. The study recommended that price and income elasticity have immense importance for energy policy makers and for forecasting energy demand. Furthermore, the study suggested that policies should be more focused on energy prices.

Kankal et al. (2011) forecasted electricity consumption in Turkey. Different multiple regression models were estimated in which different socio economic variables were used i.e. population, GDP, export, import and employment. The results illustrated that imports, exports (due to world economic crises and fluctuation) and employment have statistically insignificant effect on electricity consumption. The Artificial Neural Network model was applied to forecast electricity consumption and their results were tally with official forecasts which were over estimated. The study concluded that correct forecasts will more important for efficiently execute energy polices to obtain maximum outcomes.

Shuvra (2011) conducted study on electricity demand in Bangladesh and observed that for economic development of a country, sufficient availability of energy is necessary. The study focused on to enhance capacity of energy by effective investment. The study assessed the impact of different variables such as GDP, price of electricity, population and time trend as a proxy of technology on electricity demand. Auto regressive econometric technique was used to foresee electricity demand. The result of forecast presented that Bangladesh demand for electricity was increasing rapidly.

Bianco et al. (2010) forecasted non housing electricity consumption of Romania. Price and elasticity of demand for electricity were inelastic for both short-run and as will in the long-run, further the coefficient of income and price were statistically insignificant. In the second part of the study nonresidential electricity demand forecasted up to 2020 by using the Trigonometric Grey and A Holt-Winter exponential smoothing models. Results of the both models almost gave equal results, with less than 5% mean deviation. This deviation was committed due to time horizon in the study.

Chaudhary (2010) estimated the demand for electricity in Pakistan. The price and income elasticity of electricity demand for the entire economy, across different firms, and for different sectors of the economy are calculated. Results indicated that income has significantly and positive effects on electricity demand while the coefficient of price has significantly and negatively related to demand for electricity.

Babatunde and Shuaibu (2009) used ARDL approach to estimate electricity demand. Results of the study showed that per capita income, price of substitute and specially population have foremost effect on electricity demand. Price has statistically insignificant effect on electricity demand, while its direction was contradict with economic theory. Moreover the price of substitute has significant effect on electricity demand but also their direction was against theory. The residential demand for electricity has price and income inelastic. Further the results of the model were stable and suitable for forecasting and policy purpose. Bianco et al. (2009) assessed the consumption of electricity and investigated the impact of a few economic variables on electricity demand. The multiple regression models are assessed to examine the long term consumption of electricity. The reading focused on the evaluation of price, GDP, and per capita income elasticity of imported and domestic electricity usage. Inelasticity was found both in imported electricity demand and domestic with respect to short run price elasticity, whereas the long run elasticity was also found not elastic. Contrary to this the forecast that nationally circulated was lower than the assessed forecast of electricity consumption.

Hsiao et al. (2009) estimated effect of the national income, number of users of electricty, GDP and CPI on the electricity consumption in Taiwan. They used linear and nonlinear statistical models. Both methods concluded that electricity consumption was frequently influenced by population and national income, whereas GDP has least effect on electricity consumption. The ANN method was used for forecasting electricity consumption, it provides significant results and showed increasing trend in electricity consumption.

Khan et al. (2008) studied the demand for energy in Pakistan. The results showed that the coal and electricity have elastic demand to income and inelastic demand to price. In short run the gas demand responded negatively to price and positively to real income, furthermore prices have insignificant effect on coal and electricity demand. Moreover, the absolute elasticity of real income and prices for gas demand are more than coal and electricity demand in the short run. Different components of energy have different elasticity, which have crucial for policy makers to boost revenue generation.

Erdogdu (2007) evaluated that in early 2000s Turkey commenced a lot of modification in the form of privatization and liberalization in the electricity market. The rationale behind this reform was rapidly increasing electricity demand and eventually energy crises. This paper estimated and forecast electricity demand by using regression and ARIMA models. The results of the study indicated that electricity demand were inelastic to income and price, which indicate economic regulation in the electricity market, moreover the official forecast projected high demand of electricity then estimated forecast obtain from ARIMA model. Mohamed et al. (2005) used Harvey and logistic models to forecast electricity consumption. The Harvey model forecasted high electricity consumption then the Logistic model, while the projection results of Harvey Logistic model were in between the other two models. The forecasting of Harvey model was more appropriate, while Logistic model gave best forecast of non-domestic electricity consumption. But overall the Harvey model was best to forecast the total electricity consumption. The forecast obtained from all three models were found more accurate then national forecast. At last the study concluded that in New Zealand the total electricity consumption including domestic and non-domestic sectors will be increasing more in future.

Nasra et al. (2000) estimated influencing determinants of electricity consumption in of Lebanon. In different period of time, the study investigated the impact of GDP, gross imports and temperature on electricity consumption. The GDP have positive and significant impact on electricity consumption, while temperature and total imports have negative effect on electricity consumption. All determinants of electricity consumption were statistically significant. The study established the existence of long run relationship between variables under consideration. Finally the ECM technique was applied for short run analysis.

3. DATA AND ESTIMATION TECHNIQUES

3.1. Theoretical Framework

To evaluate the determinants of electricity consumption, the theoretically frame work for models are consumption function and Fisher and Kaysen (1962) model, which indicates that in long run consumption depend on income as well as prices, weather and population etc.

Energy demand is derived demand; transpire from the requirement of economic activities as factor input. Thus economic agents use energy consumption as factor input in the production process as it supplement in household utility and cost of production of firms. Energy consumption required to meet certain human needs to obtain utility, such as heat, lighting, transport, power, business, industrialization and public services etc. Energy demand shows how much quantity of energy purchased at specified price within constrained of income and how effected demand by change in price and income, which is unsatisfied side of demand. Where energy consumption take place after decision is complete to buy, as it express the measured satisfied demand, nevertheless the demand and consumption of energy are used as swapping.

3.2. Data collection and sources

In this study, times series secondary annual data on different variables in favor of empirical analysis for the period ranging from 1970 to 2018 has been used. The data required for the study is obtained from various sources. The data for total electricity consumption, GDP, population, maximum temperature area taken from Economic Survey of Pakistan various issues. The numerical data of price per unit of electricity is taken from WAPDA and Pakistan Energy Year Book (2017) respectively.

3.3. Selection of variables

3.3.1. Gross domestic product

It is the sum of sale value of all final commodities produced inside the geographical boundary of our country in one year. It is used in this study as proxy of income of the nation. According to economic theory other things remaining same an increase in income leads to higher demand and vice versa. As for increase in GDP concerned which in turn uplifts the standard of living of the masses, it ultimate increase consumption of the overall energy.

3.3.2. Price of electricity

It is important determinants of electricity demand. Usually demand respond to price negatively i.e. other things remaining same, any decrease in price will lead to increase in electricity consumption and vice versa. In Pakistan prices of energy set administratively, that ultimately help in enhancing revenue generation. Price of electricity is represented by "SPE."

3.3.3. Population

It is important demographic factor which effect electricity demand positively. With growing the total population the energy requirement in different forms will increase in all sectors of economy. It is denoted by "POP" in this study.

3.3.4. Weather factors

Electricity demand depend on seasonal variation. In winter for heating purposes the demand for electricity is high, while in summer the demand of electricity is also high. Temperature is denoted by "TEMP".

3.3.5. Quantum index of manufacturing industries

It presents the overall production index of manufacturing industries in Pakistan. Along with increase in manufacturing units the demand for electricity will enhance. Quantum index of manufacturing industries represent by "QIM".

3.4. Econometric Modeling for Electricity Consumption

In light of the above arguments the multiple regression models are estimated to assess the determinants of components of electricity consumption in Pakistan.

For econometric modeling of energy demand the following studies provide base i.e. Filippini and Pachauri (2004), Geem (2011), Kankal et al. (2011), Khan and Qayyum (2008), Shurva (2011) and Ali et al. (2019). They expressed energy especially electricity demand as double and single log linear function of explanatory variables.

$$LnTEC = b_0 + b_1 LnGDP + b_2 LnPOP + b_3 LnSPE + b_4 LnTEMP + b_5 LnQIM + U_t$$

Where, TEC represent Total Electricity Energy Consumptions (Ghw), GDP stands for Gross Domestic Product (Rs.bn), POP shows Population (in billions), SPE indicate Average Sale of Electricity (Paisa), TEMP represent Temperature in Degree Celsius, and QIM shows Quantum of Manufacturing Index (100 nu). However, b_0 is the intercept and b_i coefficients while U_t is Error term which includes the effect of all those variables which are not included in the model.

3.5. Autoregressive Integrated Moving Average Model (ARIMA)

The ARIMA model permits every variable to explain by its lagged or previous values and error term. For application of ARIMA model it is necessary that time series data must have stationary at level or becomes too stationary at first or more differencing order. Annual time series data from 1972 to 2018 is used and data is not change to logarithms form.

4. EMPIRICAL RESULTS

4.1. Results of ADF test

The Table 1 shows the results of Augmented Dickey Fuller test. The ADF statistic for all variables (LGDP, LPOP, LTEC, LTEMP, LSPE, LQIM) are statistically insignificant at 5% level. It means that the given variables are non-stationary. At first difference null hypothesis are rejected. Thus all variables are becoming statistically significant at 5% level of significance, which implies that variables are stationarity at first difference. Hence the above variables are integrated of order 1(1).

4.2. Co-integration Test for Total Electricity Consumption

The results of Johansen co integration test for TEC are given in Table 2. The trace statistics confirm three co-integrating vectors and the maximum Eigen value also confirm 2 co-integrating vectors at 5% significance level.

Thus the results of the data confirm the existence of long-run relationship between total electricity consumption, GDP, population, sale price of electricity, temperature and no of manufacturing industries.

4.3. Multiple Regression Models Estimation

Usually time series data have non stationarity problem, in such case using OLS models on non-stationary data gives spurious or not reliable results (Granger and Newbold, 1974). If variables of the study are stationary at same difference and co integrated after applying suitable tests, then results obtained from OLS are not spurious. Therefore the results obtained from OLS are consistent.

4.4. Estimation of Determinants of Total Electricity Consumption

The results of regression are given in Table 3. The results indicate that GDP has positive impact on electricity consumption and according to economic theory. The coefficient of GDP shows that 1 percent increment in GDP will enhance electricity consumption by 0.296 percent which indicates inelastic demand of electricity to income. The coefficient of GDP is statistically significant. The sign of the variable is in conformity with Ali et al. (2019), Alberinia (2011), Babatunde and Shuaibu, Chaudhary (2010), Erdogdu (2007), Faris (2012), Halvorsen (1975), Kankal et al (2011), Khan et al (2008), Shurva (2011) and Vita et al (2006).

Table 1: Augmented dickey fuller test for unit root

Variables	Level		First difference		Conclusion
	Statistic value	Critical value at 5%	Statistic value	Critical value at 5%	
LTEC	−1.0387	−3.032	−4.0727*	−3.032	1(1)
LGDP	−0.899	−3.042	−5.381*	−3.042	1(1)
LPOP	−2.159	−3.0447	−9.037*	−3.0447	1(1)
LSPE	−2.003	−3.0447	−5.005*	−3.0447	1(1)
LTEMP	−1.970	−3.002	−4.054*	−3.002	1(1)
LQIM	−2.016	−3.015	−5.034*	−3.015	1(1)

*Denotes rejection of null hypothesis at 5% level of significance

Table 2: Results of Johansen Co Integration test for total electricity consumption

Null hypothesis	Alternative hypothesis	Trace statistics	5 % critical value	Max-Eigen statistics	5% critical value
R = 0	R ≥ 1	1119.24*	101.56	61.80*	42.05
R ≤ 1	R ≥ 2	98.24*	70.18	49.49*	42.78
R ≤ 2	R ≥ 3	49.94*	48.05	38.64	30.83
R ≤ 3	R ≥ 4	30.30	35.707	12.61	19.36
R ≤ 4	R ≥ 5	10.89	16.701	9.076	13.966

*Represent rejection of null hypothesis at 5% level. Critical values of Trace and Eigen are taken from Mackinnon-Haug-Michelis (1999)

Table 3: Determinants of total electricity consumption

Dependent variable LTEC			
Variable	Coefficient	T-statistic	Prob.
Constant	6.07	1.051	0.425
LGDP	0.296	3.792	0.002
LPOP	0.691	2.688	0.023
LSPE	−0.08	-1.904	0.108
LTEMP	0.471	0.598	0.346
LQIM	0.28	2.838	0.013
R^2= 0.8879	AdjR^2= 0.865		
F-Stat=31.53	Prob(F-stat)= 0.000		D.W = 2.17

Population (pop) directly affects electricity consumption. The implication of the result shows that 1 % increase in population will bring 0.691 % increase in electricity consumption. The sign of pop confirms with theoretical expectation and dominant effect on total electricity consumption in Pakistan and their effect is statistically significant. The sign of the variable agrees with the study of Babatunde and Shuaibu, Fillippini and Pachauri (2004) and Kankal et al (2011).

The price elasticity is −0.08, which shows negative effect of price of electricity on total electricity consumption. This indicates that if the price of electricity is add by 1%, electricity consumption will decrease by -0.08 %. Further the result shows inelastic demand with response to price. The coefficient of price of electricity is statistically insignificant at 5%, due to the reasons that electricity is supplied under government owned companies and profit making is not primary objective. Moreover there is no close substitute and no large private producers of electricity. Also price of electricity is not determined by market forces. Hence consumers are coercing to consume electricity irrespective of their price. Therefore price is not dominant factor of electricity consumption in Pakistan. The result is validating with Babatunde and Shuaibu (2009), Biancao (2010), Fillippini and Pachauri (2004), Halvorsen (1975), Khan et al (2008), Shurva (2011) and Vita et al (2006).

The value of coefficient of maximum temperature (TEMP) is 0.471, indicates positive relationship between maximum temperature and electricity consumption. This means that 1 percent increase in temperature would lead to 0.471 percent increase in electricity consumption. This variable is in line with economic theory but statistically insignificant at 5 percent level. Maximum temperature is statistically insignificant determinant of total electricity consumption, because electricity has many uses and electricity is demanded more in maximum and minimum temperature as well. Therefore electricity is consumed more irrespective of high temperature. Also, coefficient of numbers of manufacturing units (QIM) is positive and valid with theoretical expectation. In other words, 1 percent increase in QIM will increase electricity consumption by 0.28 percent. The result indicates that QIM is statistically significant at 5 percent level.

The results imply that GDP, population and number of industrial units are crucial determinants of electricity consumption.

The adjusted R^2 is 0.8879 hence the fit is good. The value of F-statistic 31.53 indicates that overall model is statistically significant at 5 % level of significance. The Durbin-Watson statistic value is 2.17, which indicates there is no serious autocorrelation problem.

4.5. ECM Results for Total Electricity Consumption

The results of ECM are given in Table 4 are shown that the variables have no strong relation in short-run analysis; further the results indicate the effect of lags value of all variables on total electricity consumption were insignificant. The coefficient of error correction term is negative and has statistically significant at 5 per cent level, which proof long-run equilibrium among variables of interest are stable. In case of any short run shock there will be a convergence to long run equilibrium, while equilibrium will be restored on the basis of short run dynamics. The speed of convergence is almost 29 %.

4.6. Graphic Representation of CUSUM Tests

While analyzing the stability of the multiple regression coefficients, both the cumulative sum of squares and the cumulative sum are used. A graphical representation of CUSUM and CUSUMsq are given below in Figures 1 and 2 respectively. The plots of these

Figure 1: Plot of cumulative sum of squares

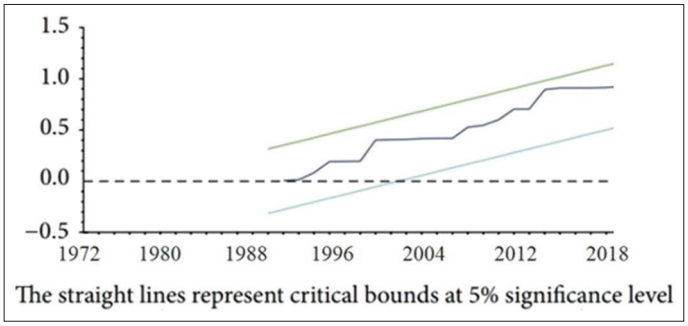

Figure 2: Plot of cumulative sum of recursive

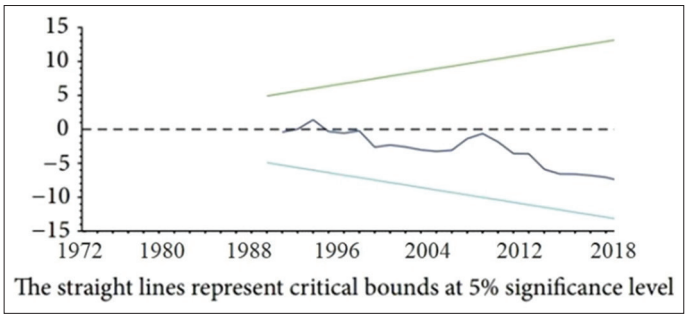

Table 4: ECM results for total electricity consumption

Dependent variable D(LTEC)			
Variable	**Coefficient**	**T-statistic**	**Prob.**
Constant	0.051	1.782	0.084
D(LTEC-1)	0.487	1.866	0.070
D(LGDP)	0.361	1.224	0.274
D(LGDP-1)	−0.380	−1.096	0.301
D(LPOP)	0.406	2.570	0.031
D(LSPE)	−0.115	−0.692	0.464
D(LSPE-1)	−0.128	−0.713	0.541
D(LTEMP)	−0.305	−0.736	0.458
D(LQIM)	0.158	0.770	0.402
ECT(-1)	−0.290	−2.542	0.020
R^2= 0.350263		AdjR^2= 0.170468	
F-Stat = 6.211		Prob(F-stat)= 0.004	
Durbin-Watson = 2.145			

statistics stay within the critical boundaries. Given figures show that both the plots are within the acceptance bound, which show that model coefficients are stable.

4.7. Forecasting of Total Electricity Consumption

The forecasted values of total electricity consumption from 2019 to 2030 by using ARIMA model are given in Table 5. Total electricity consumption for the year 2019 to 2030 will be 101170 and 1387939 Gwh respectively and the rest of the forecasted year values could be visited in table given above. Average electricity consumption in Pakistan from 2019 to 2030 showed an increasing trend. Furthermore forecast results are within acceptable bound at 95% of confidence interval. The estimated forecasts are low from official forecasts of electricity consumption conducted by NTDC (2008). The NTDC forecast given for the year 2012, 2014, 2016, 2018, and 2020 are 74340 Gwh, 86138 Gwh, 98789 Gwh, 112954 Gwh and 128121 Gwh correspondingly, it is over estimated. Our estimated value for

Table 5: Forecasting of total electricity consumption from 2019 to 2030

Projected Years	Forecasted Electricity consumption (Gwh)	Lower 95% confidence interval	Upper 95% confidence interval
2019	101170	45307	157032
2020	104904	40137	169670
2021	107792	33633	181951
2022	111622	27715	195529
2023	114611	20509	208713
2024	118537	13911	223164
2025	121627	6061	237193
2026	125103	565.571	249641
2027	128512	-5981.4	263006
2028	131921	-12528	276372
2029	135330	-19075	289737
2030	138739	-25622	303103

year 2020 is 104904 Gwh is lower than the estimated value of NTDC, while the existed electricity consumption is 106,928 Gwh in 2020 which is nearest to our estimated value in case of Pakistan. The mentioned ground proves that our forecasted value is more nearest (accurate than NTDC furcated value) to the value existed in 2020. Hence the estimated forecasts are real and match with ground reality.

5. CONCLUDING REMARKS

5.1. Findings

Following are the important findings of the study.

The regression results indicate that GDP, POP, TEMP and QIM have positive outcome while price has negative effect on electricity consumption and further sign of the coefficient are in line with theory. There is an inelastic reaction of price and income to the consumption of electricity when in turn the elasticity of price and GDP are −0.08 and 0.296. There is a significant level when the QIM, GDP and POP are at 5% and significance can also be observed when the coefficient of the price of electricity is at 10% level. But statistically the insignificant level at 5% can also be observed in terms of temperature.

The study forecasted the electricity consumption in Pakistan from 2019 to 2030 by using ARIMA model. According to the ARIMA forecasted results, there is increasing trend in electricity consumption in Pakistan. It is also found that economic, demographic and metrological variables have least effect on electricity consumption, because in energy sector there is government control monopoly due to this market imperfection, government intervention and no rival in market, hence the energy sector shows less response to socio economic variations.

5.2. Conclusion

According to the results of the study, Gross Domestic Product and population have positive impact on electricity consumption. Whereas, GDP is statistical significant determinant of total electricity consumption, it indicates that real economic activities rouse the total electricity consumption.

The results of electricity consumption model suggest that electricity price have negative impact on total electricity consumption. Furthermore electricity have inelastic demand to electricity price and income, it indicates that fewer substitutes of electricity are available in the market. Hence electricity is essential component of energy for economy.

5.3. Policy Recommendations

This fact cannot be ignored that Pakistan is rich in various natural resources such as the passageways of natural gas, coal, oil and extended water resources. But in Pakistan, resources availability is not an issue. The more important issue is underutilization and exploitation of available resources, insecurity, mismanagement, ill-planning and no inducement to attract FDI and MNCS to energy sector of Pakistan. For the last two decades Pakistan faces severe energy crises. Increase in energy demand further manifolds the crises. The main factors responsible for the increase in crises is economic growth, industrialization, increased per capita energy consumption, enhance agriculture productivity, growth in services, urbanization, modernization, increased per capita income and providing electricity to Rural areas (NBP, 2008).

The results of study demonstrate that price and income elasticity of electricity consumption are inelastic also rapid increasing demand of energy and prevailing energy crises require economic deregulation and modification in the energy market in the form of privatization and liberalization. Due to entrance of private sector along with public ownership strong competition will start and as outcome minimize the production cost, diminish shortage and ultimate increase revenue generation. Further, economic growth will escalate and fiscal burden will decrease.

In 2002 Alternative Energy Development Board (AEDB) of Pakistan set short term goal that 700 MW windmill electricity will add by 2007 and long term goal of AEDB that almost 9700 electricity will be added from renewable sources by 2030. Another objective of AEDB to provide renewable energy to 7874 far-flung villages of Balochistan and Sindh provinces of Pakistan. But AEDB does not seem to be successful in achievements of these targets. A comprehensive short and long term projects should be initiated to generate electricity from solar and wind through participation of private sector.

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