Volume and Issues Obtainable at Center for Sustainability Research and Consultancy

Journal of Business and Social Review in Emerging Economies

ISSN: 2519-089X (E): 2519-0326

Volume 6: Issue 2 June 2020

Journal homepage: www.publishing.globalcsrc.org/jbsee

Relationship of Energy Consumption and Economic Growth in Pakistan

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ARTICLE DETAILS

History

Revised format: May 2020

Available Online: June 2020

Keywords

Energy Consumption, Economic growth, Co-integration, Pakistan

JEL Classification

M20, M21

ABSTRACT

The paper analyzed the fundamental relationship among the uses of energy, uses of electricity and gas, total consumption of oil, and economic development of Pakistan. This analysis used time series data for the sample span of 1972-2017, retrieved from economic survey of Pakistan (ESP, 2018). Vector Auto Regressive (VAR) model is used for analyzing the causal link amongst the variables. Before estimating VAR, Augmented Dickey Fuller (ADF) and breusch-Godfrey serial correlation LM tests are applied for confirming a stationarity characteristic of every variable, initial with intercept and then, with interrupt along with the linear deterministic trend. The Schwartz Information Criterion (AIC) is applied for the selection of optimal lag. Johansen Co-integration analysis is adopted for identifying long run association. Result of the VAR model reveals that 1% increase in consumption of natural gas accelerates economic growth by 1.5%.Similarly 1% increase in consumption of petroleum increases economic growth by about 0.2%. Similarly 1% increase in electricity consumption brings about 1.03% increase in economic growth which is statistically insignificant. The findings of the research work propose that policy makers require to plan for environmental issue while making policies regarding the uses of energy and development of economy and also search for cheap and environmental friendly energy sources like construction of dams, provision of solar system and wind mills.

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Recommended citation: Parveen, S., Farooq, S., Sahibzada, H. E., Ali, H. (2020). Relationship of Energy Consumption and Economic Growth in Pakistan. *Journal of Business and Social Review in Emerging Economies, 6(*2), 605-617

1. Introduction

Energy is indispensable for the maintenance and development of the good quality of human life as well as for the continuation of economic activities. Energy is an important factor behind economic growth, to produce more need to consume more energy. Energy is used in many activities in one form or another; that is why economic growth is positively link with energy consumption. As argued by Alam (2006) that energy is a driving force in all economic actions. Ojinoaka (2008) also has the same view about the association of energy consumption with national product.

Studies exposed that consumption of energy per capita is the key sign of development of an economy. It is considered that energy is the most significant resource using in every production procedures and it positively contributes to foreign earnings of those nations which are exporting the energy goods. Most of the nations, particularly the less developed nations get benefited by the transfer of technologies into the procedure of research, creation and marketing. The energy sectors have also given employment opportunities to the huge amount of public who were without jobs. Developments have done in the infrastructure and socioeconomic actions of group of people in a progression of energy resource operation. On the basis of this point of view, continuous supply of energy therefore become vital for the economic and infrastructural renovation of an economy of a country (Alam, 2006). The relationship amongst the uses of energy and economic expansion has been examined over times but there is a requirement of a continuous research in this area. Number of studies is based upon whether an development of an economy increases the energy consumption and vice-versa. The results of various empirical analyses explained the strong correlation among the use of electricity and economic growth. Using the Pearsons correlation coefficient, Moremoto and Hoppe (2004) exposed that the growth of economy and uses of energy in Sri Lanka is greatly correlated. Their work is opposing to that of Stem (1993) who observed that association among GDP of United States of America and energy with the multivariate co-integration technique but no such a relation was found for these two variables. A link with uses of energy and growth of gross domestic products is a diesoline for the better investigation in research (Jobirt and karinfil, 2007: Akinllo, 2008: Errdal *et al*, 2008: Yoo and Kuu, 2009).

1.1. Energy Sector in Pakistan

The energy sources of Pakistan are mostly thermal which contributes about 87%, nuclear power contributes 1.7% and hydro-power shares 11%. The entire supply of energy in the year 2015 was around 64.5 million ton of oil equivalent. The prime sources of energy were Oil 20.96 MTOE, Coal consists of 3.8 MTOE, Gas 31.1 MTOE and Hydroelectricity was 7.1 MTOE while there was also 0.3 MTOE LPG, Nuclear electricity 1.01 MTOE while also imported energy were 0.09 MTOE with the different intensity of share. The shares of natural gas is 48.3% in the overall supply of Pakistan's energy, which is following by oil with 32.5% and 11 % by hydroelectricity, while coal having 6%, Nuclear by 1.7 %, LPG having 5% and 0.1 % energy is imported in 2015. The largest consumer of energy is industrial sector; accounted 35.5% of the 40.18 million MTOE consumption of energy, 31.6 percent were also followed by transport sector. Domestic consumption is a biggest electricity purchaser; accounting for 47.01% of a total 76789.02 GW consumption of energy, industrial sector followed it with 29.07 percent. Electricity production capability was only 10.7MW at the time of independence, it enlarged significantly from 7000MW in early of 1980 to 16000MW in 2013-14, however still the quantity of its supply is not as much of the expanding demand. Pakistan is recently facing to a severe electricity shortfall which exceeds in summer.

Natural gas has 44% share in the overall energy profile of Pakistan followed by oil about 29%. Electricity is having 16%, while coal is contributing 10% of the total energy consumption. LPG is a minor contributor of 1% in the energy profile of Pakistan (economic survey, 2017-18). Energy consumption in Pakistan has gradually increased with the fast growth of population, and industrialization, urbanization and a growth in standard of living. Energy consumption and per capita income are positively related. The per capita use of energy in Pakistan is 490 kilogram of the oil equivalent (KGOE), China having 1,320 while 7900 is given by US. Now a day, Pakistan country is facing the two main challenges while in utilization of energy. The first one is to locate possible alternates for the declining resource of fossil fuel and the second one is

the link among energy consumption with environment. The relation is obvious in every stage of the energy production, exchange and its use. But Pakistan is facing a problem of energy efficiency, which is far below as compared to other countries. The commonly used measure of energy efficiency is (KGOE) per $1000 of GDP at purchasing power parity (PPP). For Pakistan this measure was 219 (KGOE) per $1000 of GDP, which is compared to India 211, UK 143, Brazil 116 and US 131 (UNDP, 2006). Energy inefficiency is due outdated techniques in production, aging vehicles in transportation, bad conditions of roads, use of smaller generators for power etc. The most important objective of this work is to empirically check the causal link of the utilization of energy on economic development of Pakistan.

The remaining paper is structured into five sections. Section 2 consists of a previous literature. Section 3 is about data along with methodology. Section 4 includes an empirical results whereas Section 5 concludes the study and presents some policy implications.

2. Literature Review

Many researchers done lots of work on consumption of energy and its impacts on the growth of economy of the developing and under developing countries by using different timeframe. Conversely, the outcomes acquired later an application of an econometric techniques expression variation on the trend of interconnection amid consumption of energy and an economic growth. This divergence in results is happen mainly to the practice of diverse econometric techniques and time periods, moreover nation specific differences in climatic situations, development guidelines, and power production and levels of consumption.

Studies that are examined for this study are as follows:
Kraft and Kraft (1978) point out a link between GNP and energy consumption and this relation is from GNP to consumption of energy. Out comes reveals that US economy is less depended on its energy sector, due to this their income does not affect by energy protection policies. Masih and Masih (1996) selected panel data of 6 Asian countries like Pakistan, Malaysia, Indonesia, Philippines, India and Singapore for examination of the sequential causation concerning income and consumption of energy. Their results revealed that three out of six countries are co-integrated and support earlier study result in case of Pakistan. Outcome reveals that in long period and also in short run energy consumption is causing income in India and in Indonesia both in long and short run, in Pakistan two-way interconnection subsists. For remaining nation state (Singapore, Philippines and Malaysia) where no long run association found unrestricted vector autoregressive (VAR) model were applied for short run connection amongst the two factors. Aqeel and Butt (2001) investigated energy and its association to money-based development in Pakistan. The studies applied co (grouping of diverse objects collected that work as single entity) and Hsiao's version of granger. The (based on actually seeing things) results showed/told about that money-based progress bases overall energy use which is relatively changed from the finding of former. The results show no (going in both directions) relationship between money-based consumption of gas and economic growth. Furthermore, the research also disclosed a (going in both directions) relationship between money-based growth and electricity use. The study decided that energy (using less of something) any policy on petroleum does not have any side special impact on money-based development in Pakistan. Islam et al. (2011), worked on the liaison concerning consumption of energy and the financial progress of Malaysia. Researcher collected the data of the years 1971 to 2008 for the study. The ARDL technique was applied. The estimates show that energy use is influencing on the growth of economy and financial development. It is concluded that the developing economies requires extra energy. Further it is also mentioned that financial growth can be helpful in decreasing energy consumption. Omri and Kahouli (2013) studied the interlink among energy use, foreign direct investment and growth of economy during the years 1990 to 2011. By employing the production function technique to discover the interrelationship with FDI, economic development and the energy consumption. The conclusion of the study shows different between the interdependency with the variables for different class countries such as middle, high and lower income nations. Komal and Abbas (2015), studied the association of economic and fiscal growth with consumption of energy in Pakistan.

For the examination The Generalized Method of Moment was used and the data was collected from the year 1972 to 2012. It is shown in current study based by previous works, that Pakistan energy sector is having crisis and facing some problems. As some technical and financial relief have been given to this sector by some international organizations to create improvement, as it plays a vital part in economic development of the country. This framework finds out an encouraging and important consequence on the development of economy upon the energy use. While there is a negative effect of energy rates upon energy consumption. This study recommends that the new ways of energy production should be find out to fulfill the demand of energy and bring development in economy.

Shahbaz et al (2016), analyzed emissions of carbon dioxide, economic development and energy use for the next eleven nations. The researcher collected the data of 11 countries annually from 1972 to 2013 for the study. For the current analysis the author used VAR model and Granger causality test. Which indicate that economic growth available at the minimal cost of environment, and suggest for policy maker to attain sustainable economic growth while maintaining long run environment quality. Brini, Amara, and Jemmali (2017), worked on the links of international trade, renewable energy consumption and economic development of Tunisia. The investigator used the data from the year of 1980 to 2011 and applied granger causality test and ARDL bounds approach which disclosed that in short run there is two-way association in international trade and renewable consumption of energy. In long run result indicated the negative effect amid economic growth and energy use from renewable sources. Bakirtas and Akpolat (2018), explored the bond amongst urbanization, energy use and economic development in the markets of new emergent nations which includes India, Malaysia, Indonesia, Mexico, Colombia, and, Kenya, on time series data over the years 1971 to 2014 for the study by applying Dumitrescu-Hurlin panel granger causality test to discover joint interconnection impact from the two series. The study concluded that due to bivariate analysis, relationship from economic development to energy usage, relation of urbanization to consumption of energy and the economic development lies panel granger causality and according to trivariate analysis from energy use and relation from urbanization to economic development and from the relation of economic growing and urbanization to energy usage and the relation of energy use to economic development to urbanization lies the panel granger causality.

Sharif et al (2019), observed the association of consumption of energy with CO2 emission. There is a number of researchers that investigated the relationship between the renewable and non-renewable usage of energy with ecological deterioration. This study also investigates the association of these variables for panel data during the span of 1990 to 2015 of 74 countries. The author investigated the long-run correlation amongst the variables by applying panel co-integration method examine the long-run effect using (FMOLS) approach. According to outcomes, it is suggested that countries of more carbon emissions must require to develop national as well as international policies to deal an environmental degradation but also the reduction of non-renewable power utilization as well. Beside this, these nations also required to encourage renewable power ingesting in all the sectors of the economy.

Table-1: Summary of research work done about effects of energy consumption on economic development of Pakistan and other countries of the world

Authors	Sample Area	Time period	Variables	Methodology	Results
Masih and Massih(1996)	6 Asian countries	1955-1991	Growth of GDP, energy consumption	Johansen co-integration, VECM Grranger causality test	Existance of long run link in growth of GDP and energy usage in India, Pakistan and Indonesia.
Ahmad and Ansaari (1998)	Pakistan, India and Bangladesh	1973-1991	Financial development, economic growth	Granger causality test	Financial development having impacts on economic development.
Soytas et al	Turkey	1960-	Energy	Johansen-	Unidirectional causal

(2001)		1995	consumption, GDP	Juselious co-integration,and VECM	link from energy expenditure to GDP. energy consumption positively affects GDP.
Charles (2004)	Malaawi	1970-1999	Electricity usage, GDP, agricultural, GDP non-agricultural	Granger causality and error correction techniques	Bidirectional relationship exist with Electricity consumption and GDP while one way relationship exist among GDP from non-agricultural , GDP and consumption of electricity
Khan et al (2005)	Pakistan	1971-2004	Financial depth, economic growth GDP, investment	ARDL and ECM	financial depth and investment has positive impact on GDP growth
Asghar and Zahid (2008)	5 south Asian countries	1971-2003	Petroleum consumption, electricity consumption, gas and coal utilization, total energy consumption and real GDP	Dickey-Fuller, error correction model, Toda and Yamamoto approach	For Pakistan uni directional relationship exists coal to GDP, GDP to use of electricity and overall energyy consumption.
Jamil and Ahmed (2010)	Pakistan	1960-2008	Energy consumption, GDP, energy price	Johansen co-integration and VECM causality test	Relationship exists amongst Economic development, energy use and energy price in long run.
Islam et al (2011)	Malaysia	1971-2008	Energy consumption, GDP, Total population, Financial development	ARDL Co-integration technique, Chow forecast test.	Financial development and, Population growth and puts positive impact on the consumption of energy.
Abbas and Choudhary(2013)	Pakistan and India	1972-2008	Agriculture, GDP, energy consumption	Johansen co-integration and ECM causality test	Agriculture, GDP and energy use have impact on each other's for Pakistan while agriculture GDP has significant impact on the energy consumption.
Omrri and kahoulii (2013)	65 countries	1990-2011	FDI, energy consumption, economic development, capital stock, labor force, inflation	Cobb-Douglas production function, GMM estimation	FDI has a positive influence on energy use, capital stock is significant to determine economic growth while inflation and labor are insignificant.
Rabia and Abbas	Pakistan	1972-	Urbanization,	GMM	Urbanization, GDP

(2015)		2012	energy consumption, energy prices, Financial development, GDP, Investment, Government size, Trade openness	estimation technique	growth, financial development have positive significant impact while energy price has significant negative impact on energy consumption.
R. Brini et al (2017)	Tunisia	1980-2011	Renewable energy consumption, oil prices, trade(import and export)	Bound testing approach to co-integration and ARDL technique	In short run unidirectional relationship exist with renewable energy and oil price and bidirectional association exist with energy consumption and international trade.
Bakirtas and Akpolat (2018)	Colombia, India, Indonasia, Keniya, Malaysia and Mexico	1971-2014	GDP, Energy consumption, urbanization	Bivarriate and trivariate panel Grranger causality analyses	Urbanization and income have impact on energy consumption.

3. Methodology

3.1. Source of Data and Variables

Time series data is used for this work for the span of 1972 to 2017 that is retrieved from Economic survey of Pakistan, 2017-18. The Main variables that are employed in the study are economic growth proxied by GDP; natural gas used in millions of cubic meters; total oil consumption in millions of liters;, and total electricity consumption in millions of Kilo Watt during. The study Used Jhoansen-Juselius co-integration method and Vector Error Correction (VEC) model for identifying causalities among the macroeconomic variables namely, economic growth, electricity consumption, total oil consumption, and natural gas consumption.

3.2. Model Specification

The causal link between energy consumption with macroeconomic variables has been analyzed by different econometric techniques. The present study follows the analytical techniques used by Jamil and Ahmad (2010) and Abbas and Choudhury (2013). Prior to conducting econometric techniques, the data is analyzed for stationarity through Augmented Dickey- Fuller (1979) both with intercept, and with an intercept and a linear deterministic trend. Stationarity of the variables allow us to use co-integration test for identifying long run association in the variables. For this purpose, Johansen co-integration (1991, 1995) test is used. The paper deals with the empirical examination of the causal association amongst economic development, energy and electricity consumption , gas, and oil consumption using Pakistan economic survey data. For empirical analysis the model is as follows:

$$GDP = f(NG, PET, ELC) \qquad (1)$$

Equation-1 can be re-written as:

$$GDP_t = \beta_0 + \beta_1 NG_t + \beta_2 PET_t + \beta_3 ELC_t + U_t \quad (2)$$

Where NG is representing natural gas, PET is representing total oil consumption, ELC is representing total electricity consumption and GDP is representing economic growth of Pakistan .Ut is the error term in the model.

4. Empirical Results

4.1 Results of Augmented Dickey Fuller (ADF) Test

In order to check stationary, Augmented Dickey Fuller (ADF) assessment is conceded out on both level and difference form of the time series. It is essential to choice suitable criteria for lag length selection. Schwarz information criteria (SIC) are applied for optimum lag selection, under this criterion the optimum lags are 1. The derived values of ADF are compared with critical values, if the ADF value is larger than the critical value of 1%, 5% or 10% and the p value is smaller than 0.05, then the series is said to be a stationary. The series might be stationary on a level I (0), on first difference I (1) or on second difference I (2). The order of integration determines technique for co-integration. The consequences of the ADF are given in table 5.1; the results show that the whole variables having a unit root and non-stationary in their level; they become stationary by taking first difference.

Table-2: ADF test for Unit Root

Variables	At level		At First Difference		Outcomes
	Statistic	P-value	Statistic	P-value	
lnGDP	0.697939	0.9895	-7.563906*	0.0034	I(1)
lnNG	-0.807895	0.9763	3.662004**	0.0465	I(1)
lnPET	-2.142902	0.0841	-5.024374*	0.0011	I(1)
lnEL	-2.417658	0.3756	-4.568070*	0.0039	I(1)

The ADF unit root outcomes indicates that all the ADF values at level are less than1% and 5% critical values. It means that they have unit root (non-stationary). Taking the first difference of all the variables, there ADF values become greater than the critical values at 1% as well as 5%. On the basis of ADF test it can be decided that the variables (GDP, NG, PET) are incorporated of order one I (1), while ELC is included of order 0. Now Johansen co-integration would be the best option for a long run relationship.

4.2 Results of Johansen Co-integration Test

The Johansen co-integration technique stays appropriate when all the variables in the time series are fixed on first difference or incorporated of order one I(1). In this model all of the variables are I (1) as shown in the ADF table, so Johansen maximum likelihood co-integration test is applied to the data. The Johansen test is starting from the hypothesis that there is not co-integration amongst the variables that is (r = 0). Johansen and Juselus (1990) proposed two tests for the investigation of co-integration, one is trace test and the other is Maximum-Eigen values.

Outcomes of trace test are specified in table 4.2 shows four co-integrating equations and discard the null hypothesis that there is not co-integration. The value of trace statistics is 147.3545 exceeds 95% critical values 95.75366 for none. The trace statistics values are more than 95% critical values up to null

hypothesis 3 (At most 3). So the values of trace test accept null hypothesis 4 (At most 4) which confirms the presence of four co-integration equations. Here is long run association amongst variables.

Table-3: Trace values of the Johansen Co-integration Test

Hypothesized No of CE(s)	Eigenvalue	Trace statistic	0.05 critical values	Prob.
None *	0.761319	147.344	96.75376	0.0000
At most 1*	0.617049	91.46580	70.81989	0.0004
At most 2*	0.451642	54.13339	48.85713	0.0115
At most 3*	0.385095	30.70915	30.79717	0.0382
At most 4	0.258350	11.74369	16.49571	0.1696

Trace test specifies 4 co-integrating equations at 0.05 levels
*indicates refusal of null hypothesis at 0.05 level

The outcomes of the Johansen trace test ratify that all the variables, i.e. GDP, petroleum, natural gas and electricity consumption are associated in the long run.

The outcomes of maximum eigenvalues are shown in table 4.3 which given two co-integrating equations. Max-Eigen values for none and at null hypothsis1 are bigger than 95% Critical values, that confirm the existence of two co-integrating equations. On this basis of this test null hypothesis 2 is accepted which confirm 2 co-integrating equations. This test also shows that there is long run association amongst variables.

Table-4: Maximum Eigenvalues of the Johansen co-integration test

Hypothesized no of CE (s)	Eigenvalue	Max-Eigen statistic	0.05 critical value	Prob.
None *	0.76142	55.8888	40.0769	0.0004
At most 1 *	0.61605	37.3324	33.8758	0.0186
At most 2	0.45154	23.4251	27.5834	0.1561
At most 3	0.38509	18.9646	21.1309	0.0979
At most 4	0.25935	11.7089	14.2639	0.1221

Trace test indicates 2cointegrating equations at 0.05 levels
*denotes refusal of null hypothesis at 0.05 level

Both the tests indicate the long run co-integrating association among dependent and independent variables, in both test p values are greater than 5% significance level for none.

4.3 Long Run Or Co-integrating Co-efficient

Now we can estimate long run coefficients from the co-integration test. Table 4.5 shows long run coefficients of the Johansen co-integration test. While making interpretation of the long run coefficients of variables, it is important to consider the sign of the variable. Signs which took by the normalized

coefficients in e views are generally reversed in interpretation. Negative sign of the coefficient indicates a positive relationship amid dependent and independent variable. Additional, positive sign confirms a negative association amongst variables.

Signs of the coefficients of variables, their standard deviation and t values are given the table below which show that all the coefficients are having correct signs and t values.

Table-5: Long Run Co-integration Coefficients

Variables	Coefficients	Standard error	T-statistics	Prob.
lnNG	1.577	0.484	3.257	0.0001
LnPET	0.206	0.055	3.737	0.0001
LnELC	1.033	0.099	10.40	0.0021

All the three variables (natural gas, petroleum, electricity consumption,) can significantly and positively explain economic growth. All the coefficients of natural gas, petroleum, electricity consumption are having positive sign, show that increase in the values of these variables cause economic growth. Furthermore, the outcomes indicate that 1% increase in the consumption of natural gas causes a 1.5% rise in economic growth, similarly 1% increase in consumption of petroleum increase economic growth about 0.2 %. Similarly, electricity consumption increases economic growth by 1.03%.

The coefficients of all the variables have accurate signs and substantial influence on the economic development of Pakistan.

4.4 Diagnostic Checks

4.5 Tests of Normality

The following result shows normally distributed series of the data.

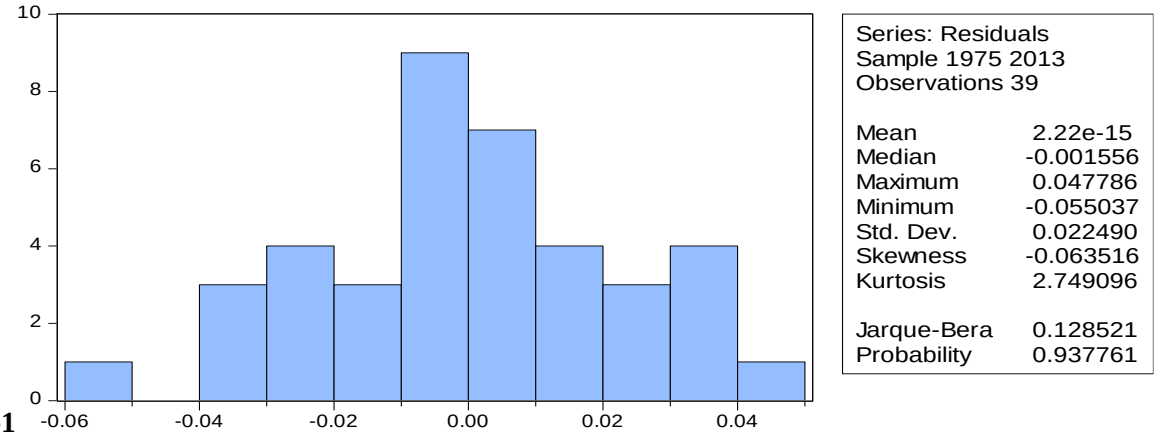


Figure-1

Normality Test: The distribution is normal

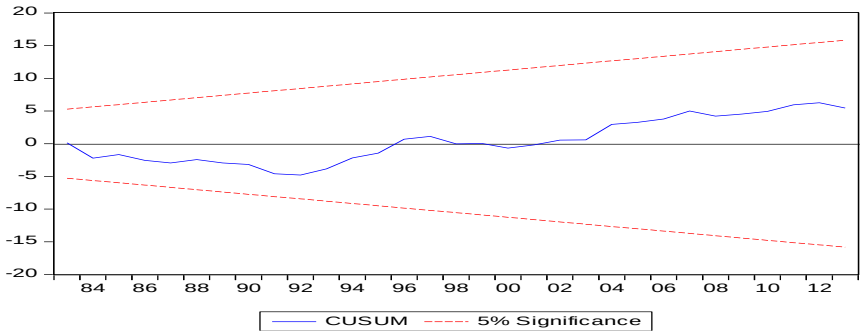
Serial Correlation is not exists as the LM test has a P-value of more than 5 percent. See the below

Table-6: Breusch-Godfrey Serial Correlation LM Test Results

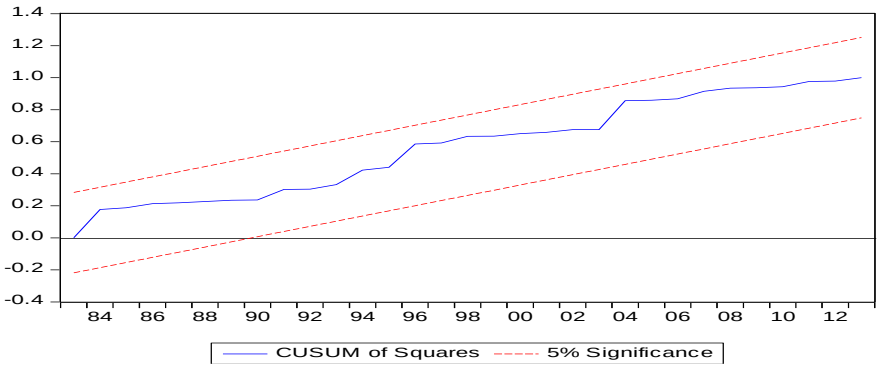
F-statistic	0.068132	Prob. F(2,29)	0.9353
Obs*R-squared	**0.183389**	**Prob. Chi-Square(2)**	**0.9147**

The Breush-Godfrey serial correlation LM test indicates serial correlation is not there in the series. The model is stable because the critical the blue lines are within the critical limits. The of Chi-Square (2) probability is 0.9128 which is greater than 5% critical value. The CUSUM test confirms the stability of the model.

Figure-2: Cumulative sum (CUSUM) at 5% significance



Cumulative sum (CUSUM) of square at 5% significance



The model is said to stable after diagnostic test, now we can conduct various tests for empirical analysis of the model. Mostly of economic variables are non-stationary in nature. As a first step for empirical analysis, stationary of the data are checked.

The uses of Energy and growth in economy are the utmost important contemporary concerns among the emerging economies. Number of studies revealed that per capita energy consumption is significant sign of economic development. Energy is considered as an important resources employed in many production processes; also a major source of foreign earnings for exporting countries. There have been developments in the infrastructure and socioeconomic behaviors of the public in the procedure of energy resource exploitation. Keeping in view the exceeding point's consistence supply of energy thus becomes vital for economic and infrastructural transformation of the economy of country.

A cheap, safe and efficient energy source is the most challenging task to the countries like Pakistan. For sustainable economic development, environment friendly and renewable energy resources are indispensable. Countries with traditional sources of energy cannot attend sustainable development. Due

to strong correlation among economic growth and energy consumption there are dire need to look for the most efficient and safe energy resources, and to also ensure excess of all the segments of society to these resources.

The aim of the present research is to discover the influence of energy consumption on economic development using time series data between1972 to 2017. GDP is used as indicator for economic growth, while natural gas, petroleum and electricity are used as energy resources in Pakistan. Stationary of the variables are checked through ADF and Johansson co-integration used for the model for the investigation of long run association. The results sanction the presence of positive relation amongst economic growth and energy consumption.

5. Conclusion and Recommendations

Energy consumption is indispensable for continued growth and rise in standard of living. The Prosperity of a nation depends on rational energy policies in the long run. Unluckily, in Pakistan the issue of energy is not taken seriously and ignored at all levels. The country is paying a huge cost in the form of low economic growth rate. On the foundation of the study it can be determined, that the factors of energy consumption are important determinants of energy, the increasing gap among demand for and amount of energy is affecting economic development in Pakistan. If problem of energy shortage remained unchecked, it would threaten the future growth of the country.

On the basis of the study there are few recommendations which are given as: Energy is one of the important components of growth, Pakistan have to search for cheap and environmental friendly energy sources like construction of dams, provision of solar system and wind mills. Provision of advance technology in the energy sector is also needed, so that energy efficiency can be obtained for the maximum utilization of resources.

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