Energy Consumption and Economic Growth Nexus: Evidence from Pakistan

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Abstract: Energy is considered a key ingredient for economic growth of a country. It increases not only the employment but also the living standards of individuals. This paper has objective to find the extensive association between energy consumption and economic growth in Pakistan from the periods of 1978 to 2012 by applying Johansen co integration, error correction model and the granger causality test which present the unidirectional causality between energy consumption and economic growth, it starts from consumption to growth. The results also conclude that less prices and drop off energy shortfalls, favourable policies and reduced uncertainty may lead to economic growth for Pakistan. This study also defines the significance of energy sector and suggests direct investment in this sector by utilizing local energy resources.

Keywords: GDP; productivity; granger causality

JEL Classification: C22; E23; O47

1. Introduction

Power is always considered an important factor for economic growth of a country which not only enhances the productivity as well as the employment which may lead to increase living standards of the people. In Pakistan, with the passage of time increase in industrialization the demand of energy has risen. But due to squeeze resources and poor management the energy crisis is rising day by day. Now it is a prominent threat for the present scenario and also a big hurdle for future advancement. As the result, Pakistan has inverse relation with other world in a

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technological era. But in the United States, there is not any association found between energy consumption and GDP which may lead to increase employment and economic development (Yu et al, 1987). The other developing countries are working on alternatives energy sources e.g. solar energy, air energy and coal etc and having positive results but governments of Pakistan are just trying individually to defuse the crises and struggling to fulfil the basic needs of life.

Electricity has strong significance for economic prosperity and developing socio-economic status of the country. There is strong integration is found between energy consumption and gross domestic product for economic growth by showing unidirectional relationship (Kraft & Kraft, 1978). It is important for domestic use, industrialization and also to maintain strategic rationale because bidirectional association between Gross Net Product and economic growth may lead to economic development of the country (Gum & Hwang, 1992). The both energy consumption and economic growth have co integration and unidirectional causality with each other and their direction of causality starts from consumption to development (Alam & Butt, 2002)

Now a day, Pakistan is suffering a serious energy crisis in shape of gas and electricity load shedding for almost 20 hours in rural areas and 12 hours in urban areas. It has disturbed all the social sectors education, agriculture, transportation and industrial sector etc. All these sectors are not only facing energy crises but also suffering enormous financial losses. It is investigated in Pakistan that there is strong correlation found between energy consumption and economic growth by using log linear regression measures. Energy resources like coal, gas and electricity have positive association with the economic development of developing countries like Pakistan. It is also concluded that capital, labor, power spending and economic growth were strongly integrated and causality from power spending to economic escalation (Hwang & Gum, 1992).

2. Objective of the Study

- To find the relationship between energy consumption and economic growth in Pakistan
- To suggest some policy implications for the development of energy sector

3. Problem Statement

Energy consumption is considered a key element for economic development. It is important to investigate that the energy consumption has any relationship to economic growth (GDP) or not. If the relationship is found then what is the direction of the relationship? Does energy consumption affect the GDP? This paper addresses all these questions.

4. Literature Review

The inefficiency of energy sector in Pakistan has been investigated more than many times by the different researchers. Pakistan has been facing energy crises for many years which have made the confused situation in the socio-economic condition of Pakistan.

Filippini and Pachauri (2004) analyze that the increasing inclination of industry, rising population, income escalation, and developed urbanization become the causes of rising energy consumption in the past and it will also improve in future. It is the dire need of heavy investment to handle the demand of power resources. They also conclude that the demand of energy consumption is high as compare to the limited supply of resources. It is very necessary for the time the good economic progression and promotion and also managing the exploited demand of energy is done by efficient utilization of power resources and proper management for maintaining demand.

Adnan and Riaz (2008) investigate that energy consumption and economic growth has bidirectional relationship between each other in the short run while they have unidirectional relationship between energy consumption and economic growth in the long run. The fact is that the energy consumption does not escort the economic growth in the long term; it is because of the high energy prices increase the cost of business which has negative impact on economic growth. Moreover, when energy price changes, it creates uncertainty that also distresses the economic development of the country.

Qayyam and Khan (2008) conclude that there are 60 to 70 percent people of Pakistan who have accessed to energy consumption. They are interconnected with the nation's energy network which presents that as the electrification will increase the demand and also needs more efficient planning for electricity management. The fluctuated prices and use of both domestic and industrial equipments have increased the consumption of electricity.

Ankasha et al (2009) state that the rising energy prices in international market has accelerated the electricity prices which have faultily exaggerated the people of Pakistan. There has been immense load shedding of about 8 hours to 16 hours daily started in all over the country.

Jamil and Ahmad (2010) define the unidirectional relationship between electricity prices and real income for electricity consumption. The results show that outcomes of long run elasticity analyze the electricity demand as income elastic while the price is inelastic with predictable symbols and implication. On the other hand, in short run major sectors present both income and price inelastic electricity demand.

Haider and Alter (2011) investigate that the current energy crises have captured the whole economy. These crises have seriously affected the household

consumption and the industrial demand that may lead to increase unemployment, poverty and other social problems. They also state that industrial sector has faced huge financial losses for 160 Billion rupees and the employment loss of 4, 30,000 laborers. The industrial growth has decreased from 2.4 to 1.2 percent in the last few years due to rising power shortfalls. It has not only affected the growth of industrial sector but also pulled back the economy of Pakistan.

5. Hypothesis

H_0:   There is no significant relationship between energy consumption and economic growth.

H_1:   There is a significant relationship between energy consumption and economic growth.

6. Research Methodology

This paper analyzes the extensive association between power spending and economic escalation in Pakistan for the period of years 1978 to 2012. The Gross Domestic Product (GDP) has been taken as dependent variables which is presenting economic growth while energy consumption is taken as independent variable. The data is obtained from Economic Survey of Pakistan (1978-2012) and Pakistan Energy Year Book (various issues). The Log Linear Model is designed as following:

LNGDP = β_o + β_1(LNEC) + μ

Where:

LN = Natural Logarithm

GDP = Annual Growth Rate of GDP

EC = Energy Consumption

μ = Error Term

β_o = Constant

β_1 = Slope of Coefficient (Energy Consumption)

This is a time series data which may have the problem of unit root. Therefore, Augmented Dickey Fuller (ADF) test is applied to make the data stationary while Johnson co integration test is also used to measure the long run relationship between the variables. Moreover, Granger causality test is applied to find out the causal relationship between the variables.

7. Results and Discussion

The paper has the objective to find the relationship between energy consumption and economic growth of Pakistan from period of years 1978 to 2012. The time series data mostly presents the non stationary tendency and the measured regression results may define false outcomes. Therefore, it is important to insure the stationary of the data, so Augmented Dickey Fuller (ADF) has been applied at level and at first difference. The Table 1 describes the results that the variables are non stationary at level carry unit root but at first difference the data is stationary which indicates that the difficulty of unit root has been cut off from data. The variables are incorporated with order of 1, I (1).

Table 1. ADF Unit Root Test

VAR	Levels	First Derivative	Results of ADF
LNGDP	-4.457587	-7.971727*	I(1)
LNEC	-4.256294	-4.437432**	I(1)

*Note: * 5% level of Significance*
*** 10% level of Significance*

The Johansen co integration test has been applied to measure the relationship between the variables. The Vector Autoregressive (VAR) model has been applied to estimate the best Lag length and strengthen the orders. The "FPE, AIC AND SC" criteria describe the Lag length and carry the "Lag 1" as supreme choice. The Johansen co-integration results present the trace and maximum eigenvalues in both Table 2(a) and Table 2(b) respectively. The trace result (Statistics) points out two co integrated equations and greatest eigenvalue which defines two co integrating association. Thus, it is concluded that all the variables are found co integrated and have long run relationship.

Table 2(a). Johansen Co Integration Test (Trace Statistics)

Hypothesized No. of CE(s)	Eigenvalue	Trace Stat	5% Critical Value	Prob
None *	0.546215	38.39445	19.29881	0.0001
At most 1 *	0.482745	14.26489	4.892469	0.0001
* presents the rejection of the null hypothesis at the 5% level significance				

Table 2(b). Co-Integration Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Trace Stat	5% Critical Value	Prob
None *	0.546215	23.78116	13.12465	0.0071
At most 1 *	0.482745	14.26489	4.892469	0.0000
* presents the rejection of null hypothesis at the 5% level significance				

Source: Researchers' own calculations

The existence of co integration between variables shows the extensive association between variables. It presents the existence of error correction model that combines the short and long term effects describing how much the prior disequilibrium is removed from the present year. Table 3 shows the existence of error correction term in the model. The value of "-0.37" for increase in GDP that describes about 37% of the prior disequilibrium has been removed from current year.

Table 3. VEC Model

Err. Cor:	D(LNGDPGR)	D(LNEC)
Coint-Eq1	-0.376470	0.006578
	(0.24221)	(0.01075)
	[-1.54352]	[0.61531]
D(LNGDPGR(-1))	-0.020303	-0.004745
	(0.28243)	(0.00743)
	[-0.07238]	[-0.56198]
D(LNGDPGR(-2))	0.062119	0.008202
	(0.21657)	(0.00647)
	[0.29741]	[0.26045]
D(LNEC(-1))	12.26242	0.357456
	(7.62841)	(0.25924)
	[1.43627]	[1.38668]
D(LNEC(-2))	-11.00620	-0.387918
	(8.17874)	(0.24498)
	[-1.32671]	[-1.57844]
C	-0.287987	0.066542
	(0.89416)	(0.02713)
	[-0.32978]	[0.57181]

Source: Researchers' own calculations

Table 4 present the results of Granger Causality test which describe the directions of relationship between variables. There is unidirectional causality is found between energy consumption and economic growth and the direction of causality starts from energy consumption and economic growth. It indicates that energy consumption lead to economic growth.

Table 4. Granger Causality Test

Null Hypothesis:	N	F-Stat	Prob
LNEC does not Cause LNGDP	35	3.50634	0.13227
LNGDP does not Cause LNEC	35	0.53302	0.06779

Source: Researches' own calculations

Table 5. Results of Coefficients

VAR	Coefficient	t-stat	Prob
Constant	1.34691	7.13227	0.00001
Energy Consumption	0.57692	5.06779	0.00000
R2: 0.972791			
F-Statistics: 649.3621			

Source: Researches' own calculations

The results of regression analysis are presented in Table No 5 which describes that all the coefficients are found significant at 5% level of significance. Coefficient value of energy consumption indicates that 1% increase in energy consumption lead to 57% increase in GDP of country.

8. Policy Implication

- There should be an efficient use of energy resources both in domestic and industrial sector by managing demand and supply of energy.
- Government should focus on alternate energy resources like coal, wind power, solar energy etc and may establish more dams for hydel power generation.
- The government should introduce bio-gas projects as alternative source of energy.
- The policy makers should invite foreign invest
- ors to make joint ventures in both air and coal power generation in Pakistan.

9. Conclusion

The paper identifies the relationship between energy consumption and economic growth in Pakistan for the years 1978 to 2012 by applying Johansen Co Integration, Vector Error Correction model and Granger Causality test. The results conclude that energy consumption has significant and long run relationship to GDP. A unidirectional causality is found between energy consumption and economic growth from Granger Causality test. It proves that energy consumption is one of

the important factors for economic growth. Energy consumption enhances the production level in the economy and when production increases it generates employment opportunities in the country, hence reduces the unemployment and poverty as well.

The paper concludes that energy consumption plays a vital role for the development of the country. Currently, Pakistan is facing number of economic problems like unemployment, inflation and low production level etc. At the same time there is a serious short fall of electricity in the country. Therefore it is a dire need to fulfil the shortage of energy by increasing the production of electricity or by using some other alternates energy resources like solar and wind etc. So that Pakistan may become a developing country by overcoming the sluggish growth in the economy.

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