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Electricity Consumption and Economic Growth in Pakistan: An Empirical Analysis

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Abstract
The purpose of this research is to investigate the influence of electricity usage on economic growth in Pakistan from 1980 to 2008. The autoregressive distributed lag co-integration test was employed. The findings of the co-integration boundaries test reveal the long-run co-integration relationship between economic growth, electricity consumption, and trade. Furthermore, empirical data show that electricity consumption and commerce have a beneficial long-run and short-run influence on economic growth. According to the research, Pakistan should make significant investments in the power industry. In terms of energy supply, the government should assure an increase in domestic energy supplies. Because there is a shortage of energy, society should be educated on the efficient and effective use of resources.
Keywords: economic growth, electricity consumption
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1. INTRODUCTION

Energy is defined as everything with the power to change and transform. Energy is the driving factor behind all economic activity and industrial output. It is seen as economic support and assistance. It's also crucial for socio-economic growth. Energy is the primary factor of societal progress and wealth. As the globe has become a global village, energy has become a commodity that can be traded. When a country's need for energy resources exceeds its supply, the country begins importing that resource to meet the demand. Coal, natural gas, petroleum, electricity, solar energy, wind power, geothermal energy, and hydropower are a few examples of energy resources. The usage of various energy resources varies according to industry. The industrial sector consumes more energy than the agriculture sector. Because of their importance, energy resources are seen as a global priority. Everything we utilise in our everyday lives, whether good or service, is made using energy. Exporting goods and services results in the creation of wealth for the country. Economic growth is defined as the intensification and increase in the market value of products and services, as measured by the percentage change in GDP.

Energy is so important in an economy, and the link between energy use and economic growth has been extensively examined in the literature. A large amount of research is devoted to the subject of whether economic growth generates energy consumption or if energy consumption causes economic growth. As a result, the purpose of this research is to investigate the link between energy use and economic growth. We compared this relationship for Pakistan using power usage. Numerous research on the relationship between energy use and the economic growth rate have made significant recommendations. This connection serves as the cornerstone for energy and environmental policy. It is vital to understand the direction of causation between energy consumption and economic growth to explore and implement energy policy.

The significance of energy resides in many realities of growth and expansion when items are exchanged, countries generate earnings via marketing, employment increases in energy businesses, and expansion in roads, train, communications, and other socioeconomic activities. As a result, investment in many industries is critical. Energy consumption per capita is a critical indicator of economic change. Countries with high energy consumption are more developed than low energy consumption countries. Because countries such as Pakistan are developing, the need for energy consumption is increasing with time. It is discovered that Pakistan's reliance on power consumption is growing, and that electricity is a critical role in enhancing economic growth and agricultural productivity.

2. LITERATURE REVIEW

A long-run link between energy consumption and economic growth is explored, and it is discovered that energy is an accelerating element of economic growth in South Asia from 1980 to 2010. They also discovered a bidirectional causal association between energy use and economic growth. A U-shaped curve is established between energy consumption and economic growth, indicating that if energy consumption is low, energy consumption promotes economic growth. The author discovered that in the short term, causation runs from GDP to energy consumption, but in the long run, the converse is true.

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It also discovered that restricted access to modern energy services might stimulate economic growth. The dynamic relationship is studied in 12 oil-exporting nations from 1990 to 2010, and a long-run association between economic development and the energy consumption is discovered. In the short run, unidirectional causality flows from energy consumption to growth rate, however, in the long run, the energy consumption trend is determined.

Using the vector autoregressive technique, the literature demonstrated that economic expansion induces energy consumption proxy by electricity and petroleum products used in Ghana. This finding is consistent with the findings of (Omotor, 2008), who found a bidirectional relationship between energy consumption disaggregated into (electricity, oil, and coal) and economic growth in Nigeria, although both countries appear to be on the same economic structure and development ladder.

In South Asia, the incidental association between energy usage and economic growth can also be noticed. According to the literature, there is a unidirectional correlation between electricity to GDP (Mushtaq et al., 2007). Between 1970 and 2010, the significance of electricity in the industrial sector was stressed in Pakistan, revealing that power is the primary source of industrial disease. In terms of energy supply, the government should assure increased domestic energy supplies. Because the energy industry in Pakistan is in low supply, customers should be educated on the efficient and effective use of resources. The extensive usage of energy may be a concern in maintaining environmental quality. So, it is necessary to explore the impact of the use of electricity resources on output in Pakistan.

3. THE MODEL

The purpose of this study is to determine the influence of electricity consumption on economic growth in Pakistan, utilising the production function as a baseline model that is dependent on two inputs: capital and labour.

$$Y = f(K, L) \quad (1)$$

Where Y represents production, K represents capital, and L represents labour. Production is determined by the quantity of capital and manpower available. Aside from K and L, energy is the most important ingredient in manufacturing. Energy is seen not just as an intermediate product, but also as a value-creating component in the industry. The production function is expanded by including energy as a third input component.

$$Y = f(K, L, E) \quad (2)$$

This production function demonstrates that energy is a primary predictor of output production. The overall amount of energy consumed by human civilisation is referred to as energy consumption. Energy consumption is dependent on the usage of oil, gas, coal, and electricity (electricity). The goal of this research is to examine the impact of electricity usage on economic growth. Trade is also important for economic growth since it is employed in the production function.

$$Y = f(K, L, E, T) \quad (3)$$

The functional form of our model with natural logarithm is given:

$$Y_t = a_0 + a_1 K_t + a_2 L_t + a_3 E_t + a_4 T_t + \mu_t \quad (4)$$

Here, Y represents economic growth, t represents time, $a0$ represents the intercept, $a1$ represents the elasticity of capital for economic growth, a 2 represents the coefficient of labour, $a3$ represents the elasticity of electricity for economic growth, $a4$ represents the coefficient of trade, and _t represents the error term. The data is from WDI (2015) and spans the years 1980 to 2015. Because it is a time series model with yearly data, we first used the unit root test to ensure that the variables are stable. GDP per capita (at constant 2007 US dollars) is used as a proxy for economic growth, as is commerce as a proportion of GDP, gross capital creation as a percentage of GDP, labour force participation rate (as a percentage of the total population), and electric power energy as electricity consumption. The data for all variables is from WDI (2008) for Pakistan from 1980 to 2008. Pakistan is a growing economy with an abundance of renewable and nonrenewable energy resources. Its energy consumption is increasing with time, but because of a lack of technical equipment, it is unable to explore all resources.

4. RESULTS AND DISCUSSION

The results of the ADF unit root test are shown in Table 1. The results show that all variables are non-stationary at their level, while some are stationary at the level and others are at first different. We used the autoregressive bounds test to estimate equation 4. The results of the ARDL bounds testing for co-integration are shown in Table 2. In Pakistan, the F-stat value exceeds the critical value of upper and lower limits at 1% and 5% levels of significance, indicating a long-term co-integration link between economic growth, energy consumption, and trade.

The empirical findings of short and long-term co-integration are shown in Table 3. In the short run, capital, labour, and power consumption all have a major positive influence on economic growth, but trade has a negative impact. According to the findings, power consumption is one of the factors boosting economic growth. The word 'coinEq' is negative and significant, indicating that there is a long-run relationship between economic growth, trade, and electricity consumption.

Capital, labour, and power consumption all have a beneficial long-term impact on economic growth. Trade has a favourable influence on economic growth, although the coefficient is small. The coefficient of capital is 1.06, indicating that a 1% increase in capital formation leads to a 1.06% increase in economic growth, the elasticity of labour is 1.6, indicating that a 1% increase in labour force leads to a 1.6% increase in economic growth, and the coefficient of trade is 0.53, indicating that a 1% increase in trade leads to a 0.53% increase in economic growth. The elasticity of energy consumption with economic

growth is 0.04; this means that a one per cent increase in power use roots 0.04% of economic growth. Overall, the findings show that electricity use boosts economic growth in Pakistan.

Table 1: Outcomes of ADF Unit Test

Variables	Level I(0)		First Difference I(1)	
	t-stat	P-value	t-stat	P-value
Y			-4.8895	0.0053
K			-6.8963	0.0000
L	-4.4806	0.0312		
E	-6.0190	0.0004		
T			-8.5614	0.0000

Table 2: F-test for Co-Integration

ARDL Model 2	Lag length	F-statistics	Critical Value 1%		Critical Value 5%	
			I(0)	I(1)	I(0)	I(1)
Y | K L E T	(1,1,1,1,1)	8.7843	4.29	4.47	3.56	4.49

Table 3: Short and Long Run Outcomes

Variables	Short run coefficients with Prob.		Long run coefficients with Prob.	
	Coefficient	P-value	Coefficient	P-value
Y (-1)	0.7817	(0.0000)		
K	0.0741	(0.1142)	1.0696	(0.0380)
K (-4)	0.0617	(0.1827)		
L	0.0268	(0.2925)	1.6155	(0.0209)
L (-4)	0.0670	(0.0332)		
E	0.3044	(0.0004)	0.0471	(0.0001)
E (-1)	0.2486	(0.0021)		
T	-0.0047	(0.9069)	0.5344	(0.3359)
T (-4)	-0.0917	(0.0186)		
Constant	-0.1213	(0.7463)	0.9601	(0.6165)
CointEq (-1)	-0.1182	0.0000		
R^2	0.9854			

5. CONCLUSIONS

The purpose of this research is to investigate the influence of electricity usage on economic growth in Pakistan from 1980 to 2008. The autoregressive distributed lag co-integration test was employed. The findings of the co-integration boundaries test reveal the long-run co-integration relationship between economic growth, electricity consumption, and trade. Furthermore, empirical data show that electricity consumption and commerce have a beneficial long-run and short-run influence on economic growth. Countries imply diverse energy resource compositions to satisfy and fulfil the various energy requirements. This energy mix includes both renewable and non-renewable energy sources. There is an urgent need to investigate these energy resources at a lower cost. There are several reserves of power sources in Pakistan, such as solar energy and hydropower. The government should implement systems that make use of such natural energy resources. The government can also build hydropower projects to help reduce energy shortfalls. Pakistan's energy policy is presently concentrating on resources such as nuclear energy, solar energy, and wind power. The findings revealed that there is room for development in energy firms. This sector should be given appropriate resources to develop. Participants in this field should be trained in the newest technologies and have enhanced managerial skills. Effective policies should be developed and made available to all inhabitants of the country. Despite the availability of coal reserves, the coal sector remains the most inefficient energy sector. Private investment should be encouraged for the coal deposits to be utilised as a source of electricity. There is a requirement for competent guidance for transparent policies and keeping in mind worldwide trends for the entire reconstruction of the energy sector to an open energy market.

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