Pakistan Energy Crises: Determinants and Consequences

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ABSTRACT

The basic objective of this study is to discuss the energy crises in Pakistan, Energy or the power sector of any country is the backbone upon which whole of the economy is standing. Now a day when everything is operated on electricity, energy proved to be the major need. Without electricity there is no life, from offices to households and from shops to industries. Therefore, energy plays an important role in the working and stabilizing of any country. The number of the variables used in this study are electricity production, and other determinants of the electricity i.e gas, coal, petroleum products and oil production, GDP, industrial growth rate, and consumption of the electricity in different sector of the economy in Pakistan. The bound testing approach to cointegration and error correction models developed within ARDL framework by using data from 1990 to 2012 in order to analyze the cointegration among the variables. To check the stationary of variables the Unit root test is used at the difference 1 or sometime 2. In long run gas production raise the electricity production, the consumption of electricity in household sector raises the GDP, consumption of electricity in industry increases the industrial growth rate in the long run. Also, the inflation and GDP raise the agriculture growth rate in long run. The coefficient gas and oil shows rise in electricity production in short run, the coefficients GDP and consumption of electricity in agriculture raise the agriculture in the short run.

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1.   Introduction

Energy or the power sector of any country in the world is the backbone upon which whole of the economy is standing. It acts like a driving force for any institute. Now a day when everything is operated on electricity, energy proved to be the major need. Without electricity there is no life, from offices to households and from shops to industries. Therefore, energy is playing an important role in working and stabilizing of any country or more precisely any economy (Xu & Chen, 2006).

Pakistan is facing the most severe energy crisis of its 65 years of existence. As we know that sufficiency in energy is the only assurance to maintain and develop any country's economy. According to an international analysis it is forecasted that the oil and gas reserves are only sufficient for the next half century, so there is a strong need to explore and switch to additional and alternative sources of energy. Unfortunately, Pakistan is the country who is blessed with sufficient resources but utilizing the minimum of it. According

to some statistics there are 929 billion tons' coal reserves in the whole world, from which 40% is used to produce electricity (Capik, Kolayli, & Yılmaz, 2013). Whereas 178 billion tons of coal exists in Pakistan whose price is almost 30 trillion dollars which is 187 times greater than Pakistan's current GDP (Awan & Khan, 2014).

If we take a glance of history, we come to know easily that the present crisis did not just happen to us. We gradually cause it to happen to us. There are many factors involved in it. The biggest one is poor policy making by the governments. Corruption plays its vital role. Theft of funds, foreign hand and poor leading capabilities of government keep the energy sector of Pakistan challenged. In 1970 the Director of Atomic Energy of Pakistan predicts that by the end of 20th century Pakistan is going to face the cruelest energy crisis of history and to face that it needs not less than 70 Atomic Power Plants. But unfortunately we only have 3 nuclear plants in function.

Institutions who are concerned to the production of electricity did not achieve their targets due to a large number of factors including line losses, corruption, poor policy making, less maintenance and high and ever growing prices of oil in international market (Nilsson, Nilsson, & Ericsson, 2009). But no one has not ever put question to their performance. If we take a quick look at over all energy production and consumption of energy in Pakistan, detail of which will be discussed later in the text, we come to some alarming facts like the leading consumer of electricity is household in Pakistan that is 43% of total, Industrial sector consumes 30%, Agriculture 13%, Government 7%, commercial sector 6% and city governments consumes on street lights about 1%.

Pakistan has been facing an energy crisis from the year 2007. The main reason for these crises is that because no hard work was prepared in the past to ensure an increase in the generation of power resources (Khalil & Zaidi, 2014). By energy crisis we mean the huge shortfall in the supply of electricity and demand for electricity of resources of energy in an economy.

In Pakistan demand for energy necessities is increasing day by day because the economic growth in a country depends on energy, but political stability also depends on the accessibility of resources of energy. Energy crises are destroying the 50 % of our industrial sector and due to these crises the rate of unemployment rate rises. It is poorly affecting the fixed income group because charge of services and goods increases. The shortfall of energy in the country is 3700 MW and without warning load shedding in rural and urban area of Pakistan has been increasing, generation of electricity is 13375 MW and demand is 17,000 MW as it is seen that demand is more than the supply. WAPDA and KESC are the main authorities for the production of electricity they purchase the costly oil and transfer its price to customers. The power deficiency is very dangerous for the country and it is pulling down the GDP growth of Pakistan (Saghir et al., 2019).

In the situation of energy crisis, the nation suffers from a disturbance of energy Supplies (oil in our case,) is due to the rapid increase in energy prices that warn the financial and state security. The danger to financial security is representing the possibility of increase in inflation decreasing the economic growth, increasing the unemployment rate, and lose of billions of dollars is happening in the investment process. The technological advancement which is achieved during the oil period has cited the world at a situation where many of the practical opportunity are available in the form of renewable energy resources. These include: solar, hydro, wind, wave energy, and tidal. All the resources have their own advantage and disadvantage. Whether we are at work any place either it is our home or in job place or at home, all the people are affected by the current electricity crisis, either during unpredicted power outages or un- planned load shedding (Shah & Solangi, 2019).

The major sectors of the economy such as industry and mining consume the major share of electricity generation in South Africa, with 44% and26% correspondingly. The lack of electricity in industry and mining is showing a negative impact on including job losses economic growth. Energy Crises is one of the harsh challenges that Pakistan is facing now a day. Thousands of people are losing their jobs, their businesses and also their life becomes miserable.

Pakistan's energy crisis energy has been increasing from the last few years. The problem is becoming severe during the summer. During the severe crisis there is an influence outage of 3-4 hours every day. Those who have no facility of UPS and generators and face more problems than others who have the facility. The price of these both generator and UPS rises in summer due to the sharp rise in their demands. Higher increase in energy demands and higher import bills of oil are pushing the developing nations to the budget deficits like Pakistan. Continuous power shut down has closed the many of factories and mills in the country. Doing many people unemployed and jobless.

An energy crisis occurs when there is a severe shortage (or price increase) of energy supplies in a country's economy. It is usually referring the scarcity of oil and other determinants of energy i.e., coal, gas and other resources of the nature. The energy crisis often affected the economy, with many ups and downs energy crisis are the cause of these problems. In Pakistan' electricity sector is characterized by serious problems of low Production, and low monetary prosperity. Due to this, there is severe shortage of electricity. For the solutions of these problems the long-term strong development plans are necessary for the solution of this chronic problem of energy crisis. Energy offices should be administered by competent, dedicated, and justified individuals who have been given the necessary license. The personnel in charge of relevant authorities and departments should be restructured.

1. To find the basic determinants of energy crisis in Pakistan.
2. To find the link between electricity crisis and its determinants.
3. To find the impact of energy crisis on economic growth and sectoral growth.

As it is explained that the first chapter deals to introduction. In chapter 2 literature review has been explained from the previous studies. And in chapter 3 Theoretical framework is discussed while the chapter 4 deals with results and Discussion and in chapter 5 data and methodology has been discussed while in the last conclusion and Policy recommendation has been given.

2.   Literature Review

Hasan, Subhani, and Osman (2012) showed that the short fall effects of energy which decided the per unit price of energy usage for household sector as well as for Industrial sector in Karachi. The monthly data for this purpose was collected for the period of Jan 2009 to Dec 2011. The aim of this research was to determine and estimate Karachi's power consumption and supply. In this analysis, the following variables were used: KESC's supply of electricity, demand for electricity, load shedding of electricity, KESC, per unit price for consumers, per unit price for industrial consumers, and per unit price for government customers. Pearson correlation, Vector Auto Regression (VAR), and the Tobit model were the methodologies employed in this study. They found that there was a gap between the supply of electricity and demand for electricity. They also found an association between electricity demand and electricity supply by KESC and significant relation between the Load shedding for Karachi region. According to Tobit model the results were changed and showed that the load shedding will not reduce the gap between the supply for electricity and demand for electricity in Karachi region. The results of VAR show that the gap of demand and supply for electricity effect the price for industrial use and second result shows the gap of demand and supply for electricity will not affect the per unit price for government use.

Oko, Ubi, Efisue, and Dambaba (2012) estimated the determinants of electricity supply in Nigeria. The authorities of Nigerian economy tried to boosting the electricity supply but their effort didn't give the positive results. The study used the time series data from 1970 to 2009. This study used the econometric methods of co-integration test, ordinary least squares and stationarity test. They have found that government funding of electricity, price of electricity per megawatt, the state of technology and quantity of rainfall had a positive effect on electricity supply. Also the power lost or quantity of electricity had a negative effect on electricity supply because as the power lost is higher, it will lower the electricity supply i.e. there exists a negative relationship between the power loss and electricity supply.

Masood and Shah (2012) investigated the problems of Pakistan energy crisis. This study explained the energy crisis in the developing nations of the world. Pakistan is facing critical problems in all the sectors, but energy crisis is a most serious issue and it is directly affected the economic development of country. Pakistan has faced serious energy crisis in the shape of demand and supply gap, energy conservation, quality of energy services, lack of infrastructure and nuclear energy issues. In 2011 Pakistan was at its worst. Problems of electricity and gas were badly affected the industrial sector of the economy. These were the economic crisis of Pakistan, while there were many other problems like electricity issues, petroleum product issues, coal, natural gas, and infrastructure issues. For the solution of this, some tools of management were needed to eliminate the all existing problems. Also there was a need of stainable policies and solution for circular debt issues. Iran and China have offered the supply of electricity at the very cheap cost but the Government of Pakistan had not taken the sufficient measures to solve this issue. Pakistan needs more development plans to make the energy sector more powerful and strong.

Alter and Syed (2011) analyzed the empirical analysis of electricity demand in Pakistan and demonstrated that electricity played an important role in socio-economic development. The study used the data of time series from the year 1970 to 2010. Johanson co-integration method has used to determine the long run and short run dynamics between electricity demand and its determinants. The impact of pricing, real income, the number of customers, and the stock of electric appliances on energy demand was investigated in this study. All of the variables' data was gathered from a variety of sources, including the Pakistan economic survey, world development indicators, Pakistan energy yearbook, and Asian Development Bank. They resulted that the long run relationship exists between the determinants of electricity and demand. They also concluded that electricity prices had negative effect on electricity consumption but electric appliances, customers and real income had positive impact on electricity demand.

Akhtar, Mugal, Khan, and Aslam (2011) found the effect of oil on generation of electricity and economic growth in the Pakistan. Coal considered as a cheap source of energy. For the purpose of economic growth, the supply of electricity has less than demands for electricity. The impacts of economic growth had been discussed on different elements of energy generation i.e. hydro, coal, Oil, Gas and nuclear. The data has taken from the period 1995-2007. Numbers of variables used in this study were electricity, other energy resources and coal, electricity was dependent variable and cola and other energy resources were the independent variables. This study analyzed that coal was a useful source of energy, and it had a significant impact on electricity generation. There is need a more investment in Thar-Coal Projects. Govt. should take measures in these projects. Generation of coal will bring development and employment to that area.

Bekhet and bt Othman (2011) examined the "Causality analysis between the electricity consumption, gross domestic product, consumer price index and foreign direct investment". The period of study was from 1971 to 2009. The model used for that study was vector error correction model and that model was used to estimate the causal relationship between the given variables. All the variables were co-integrated and they showed long run relationship among them. The study concluded that electricity consumption was an important variable to determine the economic growth in Malaysia.

Udah (2010) analyzed the "Causality and long run connection between Industrialization electricity supply and financially viable development in Nigeria". The study used time series data from period 1970 to 2008 and Autoregressive Distributed Model, widely employed by Pearson and Shin (1996). The main aim of the study was to examine the impact of capital, labor force, technology, industrial output and electricity supply on Nigeria's economic presentation. The paper also used the Granger Causality Test to estimate the causality between GDP per capita, capital industrial output, labor force, technology and electricity supply. While there was no causality between the industrial output and GDP. There was unidirectional relation between labor force and electricity supply without feedback effect. The unidirectional relationship was observed between capital and electricity supply. The results have showed that there was causality between electricity supply and per capita GDP. Also unidirectional causality was present between GDP per capita and capital with no feedback result.

Noor and Siddiqi (2010) found the link between energy consumption and economic growth in South Asian countries. The study showed that energy consumption tends to discourage economic growth. It has also shown that the short run and long run relationship between these two points out energy shortages problems in South Asia due to high energy consumption joined with inadequate energy supply. That study used panel data consisting on five countries i.e. Bangladesh, Sri Lanka India, Pakistan and Nepal. Gross domestic product per capita, gross fixed capital creation, total labor force, and per capita energy usage were the factors examined in the study. The study employed Panel co-integration framework and data was consisting of four steps i.e (i) Panel unit root test (ii) co-integration test (iii) Panel fully modified OLS estimates (iv) Granger Causality Test. The f OLS (FMOLS) had been used to approximate the relationship in case of long run and short run for this purpose the, (ECM) Error correction model was used to study long run and short run causality between the energy consumption and GDP.

Chaudhry (2010) estimated the demand for electricity in Pakistan. Two types of demand had been estimated in this study i.e. firm level demand and economy-wide dam electricity in Pakistan. The economy demand for electricity showed that due to increase in the per capita income, the demand for electricity increases. In firm level estimation, data was collected from the world Banks enterprise survey for Pakistan. The study concluded that due to increase in electricity prices the demand for electricity across firms will be decreased. Also, this study focused on the estimates of electricity shortages on industry sector mainly manufacturing output. The results of the study showed that due to increase in per capital income the demand for electricity per capita will increase in Pakistan.

Javaid et al. (2011) analyzed the shortage in the supply of electrical energy and also the present picture of energy crisis in Pakistan and also suggests the measures to improve this crisis. Pakistan has the rich resources of coal and water and these are the main resources for the production of electricity in Pakistan. The most serious and burning issue the whole world is facing now a day is Energy crisis. The solution of this crisis was very compulsory to check the economic development in the country also for the improvement in the standard of living. In this study different sources of energy production are discussed i.e. hydroelectricity, nuclear energy and Power generation (oil and gas). The share of hydroelectricity electricity generation is 35%, nuclear energy share is 2.84% and the share of Power sector is 60%. The resources of renewable energy are in abundance in Pakistan such as solar energy and wind energy and are used to meet the energy needs. For the solution of these crises the government should take the bold steps to increase energy security for the sustainable energy future.

Hye and Riaz (2008) estimated the relationship between economic growth and energy consumption by using the two approaches known as Autoregressive Distributed Lag (ARDL) Pearson et al. (2001) and Granger Causality Test. They used the annual data from 1971 to 2007 and data for both variables i.e. energy growth and economic consumption was collected from World Development Indicators. The study's findings revealed that in the long run, there was unidirectional causation between economic development and energy consumption, whereas in the short run, bidirectional causality was discovered.

Tariq, Ali, and Shah (2006) estimated the residential demand for electricity in Pakistan by using the time series data from 1979 to 2006. The study used Autoregressive Distributed Lag (ARDL) model to estimate price and income elasticities of electricity demand and variables were income, price and household size. They found that price elasticity in short run is -0.63 and -0.77 in long run, and the electricity demand is price inelastic. The income elasticity was 1.05 in short run and 1.29 in long run. It showed that 1% in electricity demand in short run caused more than 1% increase in the long run. The third variable showed positive signs in short run elasticity was 4.70 and 5.76 in long run. Which showed electricity demand was highly elastic to household size in both long run and short run.

Hussain, Hamid, and Khattak (2006) examined the consumption of gas energy in Pakistan. As the main determinants of energy are petroleum products, gas, oil, electricity and coal. Gas is consumed in many sectors of economy i.e. cement, household, power industry, fertilizer and for commercial use. The study used time series data from 1971 to 2006 collected from Economic survey of Pakistan. While, Augmened Dickey Fuller (ADF)

test, ordinary least square and Johnson co-Integration technique had been used. The explanatory variables were cement, household, power, fertilizer, and industry. The consumption of gas energy in these sectors showed 1% increase in consumption of gas will bring 1.04% increase in household, o.95% increase in fertilizer, 1.03% increase in cement, 1.37% increase in industrial sector and 0.97% increase in power sector. All the explanatory variables were significant at both 1% and 5% significance level. It is very compulsory to enhance the energy supply to meet the needs of industry and household sectors.

Saleem (2007) analyzed the technical efficiency in generation of electricity in the sectors of Pakistan. They used the panel data of 6years (1998-2003). Two methodologies were used i.e. stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA) to determine the efficiency of the firms. The results supported the private plants because they had less variation and were generally more efficient then public firms.

3.   Data and Methodology

To explore the links between all the variables which are being used in the present study, annually time series data of Pakistan from 1990-2012 have been used. We well check the following links in this study:

- For the determinants the Link between Energy determinants and their production.
- For the consequences consumption of electricity in different sectors and their impact on GDP.

In this study following Econometric tests are used to check the link between variables.

3.1.   Unit Root Test

Under the unit root procedure, the variables' stationarity is verified. When the variance and auto covariance of a variable stay constant regardless of where we estimate them, the variable is said to be stationary. Many techniques are available in the literature to determine if a series has a unit root or not. The Dickey Fuller test can be used if the stochastic factors are not linked. However, if the stochastic term is correlated, the Dickey Fuller test is useless. The Augmented Dickey Fuller (ADF) test is used to address this issue. The ADF test solves this problem by adding the lagged values of the endogenous variable to the DF test equations. In order to address this issue, The ADF (Augmented Dickey Fuller) test has been included. The ADF test solves this problem by inserting the lagged values of the endogenous variable to the DF test equations. To assess the stationary nature of the variables, we used the Augmented Dickey Fuller (ADF) test on their growth rates.

3.2.   ARDL Technique

Present study uses ARDL "Bounds Test" method, which is centered on OLS estimation of a conditional unconstrained error correction model for co integration examination (Pearson et al., 2001). This approach was used to assess the co integration in this case. The ARDL coefficients will indicate a long - term equilibrium connection, but the ECM coefficients will combine short run dynamics with long run equilibrium. The method used in this work provides significant advantages, including the ability to handle tiny samples quickly. This test may be used even if the integration order of the variables is not the same. Another advantage of this method is that it allows for the inclusion of dummy variables in the model. While in VAR, the order of lags is the same for all variables, this technique allows us to incorporate distinct delays for each variable. As a result, the ARDL method can create a sort-term and long-term relationship.

$$(ELC)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 (ELC)_{t-1} + \sum_{i=0}^{p} \alpha_2 (Coal)_{t-1} + \sum_{i=0}^{p} \alpha_3 (Pet)_{t-1} + \sum_{i=0}^{p} \alpha_4 (Gas)_{t-1} +$$

$$\sum_{i=0}^{p} \alpha_5 (Oil)_{t-1} + \gamma_1 (Elc)_{t-1} + \gamma_2 (Coal)_{t-1} + \gamma_3 (Pet)_{t-1} + \gamma_{41} (Gas)_{t-1} + \gamma_5 (Oil)_{t-1} + v_i$$

ELC = Electricity production
COAL = Coal production
PET = Petroleum products
Gas = Gas production
Oil = Oil production

In above equation $\alpha_1 \alpha_2 .... \alpha_5$ represent the short run dynamics of the model while parameters $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5$ represent long run relationship. The null hypothesis is

H₀: $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = \gamma_5 = 0$

H₁: $\gamma_1 \neq \gamma_2 \neq \gamma_3 \neq \gamma_4 \neq \gamma_5 \neq 0$

The rejection of H₀ will confirm the existence of co-integration. If cointegration exists then we will move to second step to find long run relationship by estimating the following equation.

$$(ELC)_t = \alpha_0 + \sum_{i=1}^{p}\alpha_{1i}(ELC)_{t-1} + \sum_{i=0}^{p}\alpha_{2i}(Coal)_{t-1} + \sum_{i=0}^{p}\alpha_{3i}(Pet)_{t-1} + \sum_{i=0}^{p}\alpha_{4i}(Gas)_{t-1} +$$

$$\sum_{i=0}^{p}\alpha_{5i}(Oil)_{t-1} + u_i$$

If the evidence found of long run relationship then we'll go on to the third stage, where we'll calculate ECM, which demonstrates how quickly short-run disequilibrium returns to long-run equilibrium. For this purpose we will estimate the following ECM.

$$(ELC)_t = \alpha_0 + \sum_{i=1}^{p}\alpha_{1i}(ELC)_{t-1} + \sum_{i=0}^{p}\alpha_{2i}(Coal)_{t-1} + \sum_{i=0}^{p}\alpha_{3i}(Pet)_{t-1} + \sum_{i=0}^{p}\alpha_{4i}(Gas)_{t-1} +$$

$$\sum_{i=0}^{p}\alpha_{5i}(Oil)_{t-1} + \beta(ECM) + u_i$$

4. Results and Discussion
4.1. Empirical Results OF MODEL 1

Before evaluating cointegration across variables, the ADF test was used to determine the cointegration among variables. The main reason for using ADF is to see if the variables can be employed in ARDL. The following table indicates that the variables are I(0) or I(1), indicating that they could be used in ARDL estimation.

4.2. Unit Root Test

The stationary characteristics of the variables are verified using the Augmented Dickey-Fuller (ADF) unit root test before undertaking tests for cointegration and causality. On the level, along with on the first difference and second difference, the unit root test is used to identify the order of integration of time series. The ADF unit root test is shown in the table below. The intercept and trend were used to test the stationarity of all variables. When the unit root hypothesis is accepted at the level, time series become stationary in the first difference and occasionally in the second difference, in other words, all variables are integrated to order one (1)

Table 1
Unit Root Estimation (ADF Test)

Variables	Level	First difference
Ele pro	-1.449	-4.5068*
Coal	-2.04	-4.48*
Oil	-1.38	-4.72*
Gas	-1.76	-2.60
Pet pro	-1.06	-5.30*

The ARDL (1, 1, 0, 1, 1) the coefficient is represented in the table below.

Table 2
ARDL Estimates Based on AIC

Regressor	Coefficient	t-Ratio	Prob
ELC(-1)	.48757	2.8233	.015
Coal	-.8428	-,50482	.623
Coal(-1)	5.1325	3.2949	.006
Pet	-.4353	-.52999	.606
Gas	.052603	4.3220	.001
Gas(-1)	-.032007	-2.5346	.026
Oil	2.1048	3.1599	.008
Oil(-1)	-1.8892	-3.5704	.004
R^2=.9867	Adj.R^2=.9790	D.W=2.309	F(7 , 12)= 127.9678(.000)

The computed value of F-static in the ARDL model is 5.1805, which is more than the upper critical value of the upper bound at a 5% level of significance. It demonstrates that we reject the null hypothesis, which states that there is no cointegration and that the variables have a cointegrated connection.

The presence of cointegration among variables is confirmed in the table below.

Table 3
level of relationship exist in ARDL model test

F-Static	95% Lower Boundary	95% Upper Boundary	90% Lower Boundary	90% Upper Boundary
5.1805	2.9207	4.4602	2.2829	3.5866

The long run coefficients of the ARDL model are provided in the following step. ARDL represents the ideal number of lags for each variable (1,1,0,1,1). Long-term projections suggest that gas production increases electricity generation, but coal, petroleum products, and oil production lowers electricity output in the long run. The findings demonstrate that increasing gas output by one unit leads in an increase in electricity production of around 4 MW/GWH in the long run, but coal, petroleum, and oil have no meaningful influence on electricity production in the long run.
The ARDL coefficient represent in following table.

Table 4
Long Run Estimated Coefficients using ARDL technique

Regressor	Coefficient	T-Ratio	Prob
Coal	8.3712	1.6665	.121
Pet	-.84960	-.51285	.617
Gas	.04019	4.8207	.000
Oil	.42058	.57176	.578

In the following step is to get ECM. The following table shows the results of ECM coefficients.

Table 5
Short Run Estimated ECM Model

Regressor	Coefficient	t-Ratio	Prob
Dcoal	-.84283	-.50482	.621
dPet	-.43536	-.52999	.604
dGas	.052603	4.3220	.001
dOil	2.1048	3.1599	.006
Ecm(-1)	-.51243	-2.9673	.010

With a negative sign, the error correction term is statistically significant. The coefficient of ECM is -.51243, implying that departure from the long-run equilibrium Electricity path is corrected by nearly 51% during the next several years. This shows the adjustment speed is very quick. The coefficients gas and oil shows a rise in electricity production while the coefficient petroleum products and coal decreases the electricity production in short run.

The diagnostic tests below demonstrate that the model passes all of the diagnostic tests that have been recorded.

Table 6
Diagnostic tests Results

Diagnostic Test	LM Version
Serial Correlation	CHSQ(1)=1,0456(0.307)
Functional Form	CHSQ(1)=.15224(0.696)
Normality	CHSQ(2)=1.3173(0.518)
Hetroscedaticity	CHSQ(1)=.29090(0.590)

Model 2

$$(Gdp)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 (Gdp)_{t-1} + \sum_{i=0}^{p} \alpha_2 (h.hold)_{t-1} + \sum_{i=0}^{p} \alpha_3 (agri)_{t-1} + \sum_{i=0}^{p} \alpha_4 (ind)_{t-1} +$$

$$\gamma_1 (Gdp)_{t-1} + \gamma_2 (h.hold)_{t-1} + \gamma_3 (Agri)_{t-1} + \gamma_{41} (Ind)_{t-1} + v_i$$

GDP	= GDP	
h.HOLD	= Consumption of electricity in household sector	
Agri	= consumption of electricity in agriculture sector	
Ind	= Consumption of electricity in Industrial sector	

The existence of cointegration will be confirmed if H0 is rejected. If cointegration occurs, we will proceed to the second phase of determining the long run connection by estimating the equation below.

$$(Gdp)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} (GDP)_{t-1} + \sum_{i=0}^{p} \alpha_{2i} (h.hold)_{t-1} + \sum_{i=0}^{p} \alpha_{3i} (Agri)_{t-1} + \sum_{i=0}^{p} \alpha_{4i} (INd)_{t-1} + u_i$$

If the evidence found of long run relationship then we will move to third step where we check the estimation of ECM which shows the speed of modification back to long run equilibrium after short run disequilibrium. For this purpose we will estimate the following ECM.

$$(Gdp)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} (Gdp)_{t-1} + \sum_{i=0}^{p} \alpha_{2i} (h.hold)_{t-1} + \sum_{i=0}^{p} \alpha_{3i} (Agri)_{t-1} + \sum_{i=0}^{p} \alpha_{4i} (Ind)_{t-1} + \sum_{i=0}^{p} \beta (ECM) + u_i$$

Model 2 Estimation Results

Before evaluating cointegration among variables, the ADF test was used to determine the order of integration among variables. The main reason for using ADF is to see if the variables can be utilized in ARDL. The following table indicates that the variables are I (0) or I(1), indicating that they may be used in ARDL estimation.

Table 6
ADF Test Unit Root Estimation

Variables	Level	First Difference
GDP	-0.26	-4.45*
h.hold	-0.22	-3.62*
Ind	-1.33	-4.63*
Agri	-3.05*	-1.86

* Represent significance at 5%

The ARDL (2, 2, 2, 1) coefficient represent in below table

Table 7
ARDL Estimates Based on AIC

Regressor	Coefficient	t-Ratio	Prob
GDP(-1)	.10900	.48923	.638
GDP(-2)	.27062	1.3225	.223
h.hold	113.0174	.41486	.689
h.hold(-1)	-151.5420	-.53195	.609
h.hold(-2)	242.7799	1.6769	.132
Agri	-449.4572	-1.3826	.204
Agri(-1)	939.0659	2.1962	.059
Agri(-2)	-1256.6	-3.7746	.005
Ind	-210.0488	-.56196	.590
Ind(-1)	363.4161	.99866	.347
R^2=.9809	Adj.R^2=.9595 D.W=2.1354	F(9 , 8)= 45.3983(.000)	

In the ARDL model, the estimated value of F-static is 5.8382, which is more than the upper bound critical value at the 5% level of significance. The null hypothesis of no cointegration is rejected, showing that there is a cointegration relationship between the variables.

Table 8
Existence of level of relationship test in ARDL model

F-Static	95% Lower Boundary	95% Upper Boundary	90% Lower Boundary	90% Upper Boundary
5.1805	2.9207	4.4602	2.2829	3.5866

The long run coefficients of the ARDL model are presented in the following step. ARDL represents the ideal number of lags for each variable (2,2,2,1). , The results shows that the dependent variable changes due to an additional unit change in independent variable.   Our findings suggest that an additional one Gwh change in consumption of electricity in agriculture sector decrease the GDP by 1236.3 million rupees. Similarly one Gwh change in consumption of electricity in household increase GDP by 329.240 million rupees. The consumption of electricity in Industry has no significant long run effect on GDP.

 The ARDL coefficient represent in table below

Table 9
Long Run Estimated Coefficients using ARDL Technique

Regressor	Coefficient	T-Ratio	Prob
H.hold	329.2403	3.2316	.012
Agri	-1236.3	-4.2437	.003
Ind	247.2137	1.0686	.316

In the next step we obtain ECM. The result of ECM coefficients reported in the following table

Table 10
Short Run Estimated ECM Model

Regressor	Coefficient	T-Ratio	Prob
dGDP1	-.27062	-1.3225	.213
dh.hold	113.0174	.41486	.686
dh.hold1	-242.7799	-1.6769	.122
dAgri	-449.4572	-1.3826	.194
dAgri1	1256.6	3.7746	.003
dInd	-210.0488	-.56196	.585
Ecm(-1)	-.62038	-4.3056	.001

Error correction term is statistically significant with negative sign. The coefficient of ECM is -.62038 suggesting that deviation from the equilibrium long run GDP path is corrected by about 62% over the following years. This shows the adjustment speed is very quick. The results of short run shows that consumption of electricity in agriculture cause increase in GDP the consumption in industry and household have no significant impact on GDP in short run.

The diagnostic tests below demonstrate that the model passes all of the diagnostic tests that have been recorded.

Table 11
Diagnostic tests Results

Diagnostic Test	LM Version
Serial Correlation	CHSQ(1)=.87829(0.349)
Functional Form	CHSQ(1)=5.3354(0.021)
Normality	CHSQ(2)=1.0796(0.583)
Hetroscedaticity	CHSQ(1)=.043213(0.835)

The results of diagnostic tests imply that the model satisfies all the conducted diagnostic tests.

Model 3

$$\Delta \ln(INDgrowth)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_1 \Delta \ln(INDgrowth)_{t-1} + \sum_{i=0}^{p} \alpha_2 \Delta \ln(GDP)_{t-1} + \sum_{i=0}^{p} \alpha_3 \Delta \ln(TREND)_{t-1} + \sum_{i=0}^{p} \alpha_4 \Delta \ln(INDCON)_{t-1} +$$

$$\gamma_1 \ln(INDgrowth)_{t-1} + \gamma_2 \ln(GDP)_{t-1} + \gamma_3 \ln(TREND)_{t-1} + \gamma_{41} \ln(INDCON)_{t-1} + v_i$$

Ind growth   = industrial growth rate
Ind Con   = Consumption of electricity industrial sector
GDP   = GDP

The existence of co-integration will be confirmed if H0 is rejected. If cointegration occurs, we will proceed to the second phase of estimating the following equation to discover the long run connection.

$$\ln(INDgrowth)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \ln(INDgrowth)_{t-1} + \sum_{i=0}^{p} \alpha_{2i} \ln(GDP)_{t-1} + \sum_{i=0}^{p} \alpha_{3i} \ln(TREND)_{t-1} + \sum_{i=0}^{p} \alpha_{4i} \ln(INDCON)_{t-1} + u_i$$

If the evidence found of long run relationship then we will move to third step where we calculate ECM, which depicts the time it takes to return to long-run equilibrium following a short-term disequilibrium. For this purpose we will estimate the following ECM.

$$\ln(INDgrowth)_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln(INDgrowth)_{t-1} + \sum_{i=0}^{p} \alpha_{2i} \Delta \ln(GDP)_{t-1} + \sum_{i=0}^{p} \alpha_{3i} \Delta \ln(TREND)_{t-1} + \sum_{i=0}^{p} \alpha_{4i} \Delta \ln(INDCON)_{t-1} +$$

$$\beta(ECM) + u_i$$

Model 3 Estimation Results

Before evaluating cointegration across variables, the ADF test was used to determine the order of integration among variables. The main reason for using ADF is to see if the variables can be utilized in ARDL. The following table indicates that the variables are I(0) or I(1), indicating that they may be used in estimation of ARDL.

Table 12
ADF Test Unit Root Estimation

Variables	Level	First Difference
IND growth	-4.11*	-5.74
GDP	-0.79	-
Indcon	-1.29	-3.803*

The ARDL (1, 1, 0, 1, 1) coefficient represent in following table

Table 13
Autoregressive Distributed Lag Estimates Based on AIC

Regressor	Coefficient	T-Ratio	Prob
INDgrowth(-1)	-.28730	-1.2199	.243
Trend	-40.3434	-2.4366	.029
Trend(-1)	40.3244	2.4409	.029
GDP	-1.0279	-2.5415	.024
INDCON	.93257	.70153	.494
INDCON(-1)	5.0151	2.3748	.032
R^2=.3925	Adj.R^2=.17556	D.W=1.7624	F(5 , 14)= 1.8092(.000)

At a 10% level of significance, the estimated value of F-static in the ARDL model is 4.1304, which is more than the upper bound critical value. The null hypothesis of no cointegration is rejected, showing that there is a cointegration relationship between the variables.

The presence of cointegration among variables is confirmed in the table below.

Table 14
Existence of level test of relationship in ARDL model

F-Static	95% Lower Boundary	95% Upper Boundary	90% Lower Boundary	90% Upper Boundary
4.1304	2.9999	4.3871	2.3550	3.5588

The long run coefficients of the ARDL model are presented in the following step. ARDL represents the ideal number of lags for each variable (1,1,0,1,1) Our findings suggest that an additional 1% change in GDP decrease the industrial growth rate by 79% .Similarly one Gwh change in consumption of electricity in industry increase the industrial growth rate by 4.620% in the long run . It is clear that GDP has no significant impact on industrial growth rate in long run.

The ARDL coefficient represent in following table

Table 15
Long Run Estimated Coefficients using ARDL Technique

Regressor	Coefficient	T-Ratio	Prob
TREND	-.014735	-.29689	.771
GDP	-.79851	-2.6778	.018
INDCON	4.6204	3.1240	.007

The next stage is to get ECM. The following table shows the results of ECM coefficients.

Table 16
Estimated Short Run Model ECM

Regressor	Coefficient	T-Ratio	Prob
dTREND	-40.3434	-2.4366	.027
dGDP	-1.0279	-2.5415	.022
dINDCON	.93257	.70153	.493
Ecm(-1)	-1.2873	-5.4658	.000

With a negative sign, the error correction term is statistically significant. The ECM coefficient is -1.2873, implying that divergence from the long-run equilibrium industrial path is corrected by roughly 12% during the next several years. This demonstrates that the adjusting speed is really fast. The results shows that an additional 1% change in GDP decrease the industrial growth rate by 1.02% in short run, while the industrial electricity consumption have no significant impact on industrial growth rate in short run.

The diagnostic tests below demonstrate that the model passes all of the diagnostic tests that have been recorded.

Table 6
Diagnostic tests Results

Diagnostic Test	LM Version
Serial Correlation	CHSQ(1)=.88923(0.346)
Functional Form	CHSQ(1)=.68904(0.406)
Normality	CHSQ(2)=.49074(0.782)
Hetro scediticity	CHSQ(1)=.024767(0.875)

Diagnostic tests result implies that the model satisfies all the conducted diagnostic tests.

5.   Conclusion and Policy Recommendation

After discussing the whole literature of the report we are reached at this conclusion that the Crises of Energy in Pakistan is a severe problem and the urgent solution of these crises is the need of this time. Three models are discussed to check determinants and consequences of Energy crises To check the determinants the number of variables used in this study are Electricity production and all the strong determinants of energy like production of gas, production of coal, production of petroleum products and the production of oil is estimated. The ARDL technique is used to check the long run and short run relationship between all the variables used in this study. As there are many sources of energy for the production of electricity in Pakistan. Results show that due to increase in the production of gas the electricity production also increases but the coal production, petroleum products and oil production decreases the electricity production in long run. The coefficients gas and oil shows a rise in electricity production while the coefficient petroleum products and coal decreases the electricity production in short run. For the consequences the consumption of electricity in household cause increase in the GDP but the consumption in industry and agriculture has no significant impact on GDP in the long run. But in the short run the agriculture consumption cause increase in the GDP but industry and household have no significant impact. The results of other variables shows that Inflation and GDP raise the agriculture growth rate but the consumption of electricity in agriculture and industry have no significant impact in case of the long run. But in the short run the consumption of electricity in agriculture and GDP raise the agriculture growth rate. Also the consumption of electricity in industry cause increase in the industrial growth rate.

The solution of all these problems is hidden in the solution of energy crises. Following steps should be taken for the solution i.e. Wind energy, solar energy, nuclear power plants, and dam building are all examples of renewable energy production. The promotion of alternative energy sources is necessary. Electricity should be imported from Iran since it is available at a reasonable price. The government should support programs that are both effective and efficient. Pakistan has to need of project oriented rather than goal oriented policies. For the solutions of these problems the long term strong development plans are necessary for the solution of this chronic problem of energy crisis. Energy offices should be run by qualified, devoted and justified people prepared with due permission. Relevant authorities and department's people should be overhauled.

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