Electrical Consumption in the Industrial Sector of Pakistan: A Structural Time Series Analysis

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ARTICLE DETAILS	ABSTRACT
History: *Accepted 30 May 2022* *Available Online June 2022*	*The usage of energy is the central factor in promoting the contribution of the industrial sector economy to develop the economy. Indeed, Pakistan is a growing but recently united country with severe shortages of electricity resources. Therefore, the industry has a growing quantity*
Keywords: *Oil, Gas, Electricity Consumption, Economy of Pakistan*	*of growth that leads to economic progress and also prioritizes inevitable challenges to stimulate industrial growth. The purpose of the study is to investigate the relationship between electrical consumption, oil consumption, and gas usage in manufacturing and its impact on the economic growth in Pakistan. Results declared electricity and gas have a*
JEL Classification: *L95*	*positive and significant impact in the short and long run while fuel consumption has a negative shock on the economy in the short run but is positive in long run. The fault correction model (VECM) ensures bilateral*
DOI: 10.47067/reads.v8i2.453	*relations in the industrialized sector, oil consumption and financial progress in Pakistan. In addition, findings revealed a strong correlation between the variables tested and suggested that the Pakistani government must develop a strong policy to reduce gas and oil to produce electricity, instead of relying on solar energy, water, airstream and biomass sources. Therefore, the government should increase stokes and storage of oil and gas to provide the industrial sector at a cheap rate.*

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1. Introduction

Policymakers are trying to control the problem of global warming for the last few decades at the lowest cost. According to different reports, energy consumption in the industrial sector has a vital role

in the long run and sages of energy are increasing day by day. Pakistan is a developing country where energy is produced at high rates and the usage of energy consumption in industries is costly but its impact on the economy of Pakistan is positive and significant. So, energy consumption in the industrial sector should be produced by cheap sources like wind, fuel and biomass following the term and conditions to control the environmental changes (Akhtar et al. 2018). Many organizations are working to achieve these targets but it's not only the duty of the private sector but the government should try to resolve the problems and facilities of the industrial sector because when the industrial sector grows then the economy of that country also grow (Abdoli, Gudarzi Farahani & Dastan, 2015). Pakistan is the richest country in the world with coal of $ 189 billion tonnes which is available in Makarwal and this can be used in the industry after proper cleaning and if we control the crisis of electricity then it will boost the economy. The combination of electricity from different sources from 2014 to 2015 was different as 65000 MW through hydropower was limited to 12 present, the electricity that was generated through water was increased by 42% and it is predicted that local electricity demand can reach 82.5% till 2035 (Kamran, 2018). According to different surveys and reports, the growth rate of Pakistan's economy Increased from 2019 to 2021 in different sectors and to achieve this sustainable situation government tries its best through policies and different strategies. The Increasing ratio in growth rate recorded a strong relationship between the energy consumption in the production process so there exists a significant relationship between energy consumption and production. Further petroleum consumption decreased by less than 1 percent while energy, Oil and gas consumption increased by 1 % during the last 3 years. Household consumption of energy sources is less than 60% of its total stock and the remaining use for the industrial sector and others that are most costly due to use of the nonrenewable sources.

The purpose of this paper is to analyze the electric consumption in the industrial sector and its impact on the economy of Pakistan for this we use the data from 1982- 2021. ARDL approach uses to check the long run and short relationship between the variables. Dickey Fuller (ADF) and Phillips-Peron root tests use to check the stationarity of variables. The Granger causality test is used for the forecasting values of the model for the future.

2. Literature Review

Kraft and Kraft (1978) defined the relationship between energy and gross domestic product using the different investigation statistic approaches such as Granger and Cointegration approaches. Results showed nonstationarity between variables. The use of force plays an important role in the economic enhancement of an economy. Campbell and Person (1991) presented the energy relative and financial growth in the short run (Xu & Pan, 2009).

Xu and Pan (2009) displayed a linkage between energy and economic growth in the long run, results declared a positive relationship to economic growth (Kim & Lee, 2021). Shahbaz et al. (2013) used the time series data from 1970 to 2010 to indicate an analysis of the positive effect of energy and oil consumption and Sari also verified it. Dastan et al. (2015) declared electricity consumption and growth showed the deviation effects due to the disagreed of oil consumption for growth as Zhang and Chandio (2019) in carbon emission, energy consumption and economic growth (Zhang & Cheng, 2009).

Hassan et al. (2018) well-defined using data from 1977 to 2013 for long run relations in Pakistan and showed the significant analysis of oil consumption on the economic growth (Rafique and Rehman 2017). Chandio, Jiang and Rehman (2018) defined the consumption of gas and electricity in agriculture positive impact In the long and short run and was estimated at 1 %,0.5%,0.6% and 0.4 %. Johnson approach and ARDL were used and results remained stable till 2016.

Aized et al. (2018) in structural changing and economic growth defined that change in temperature due to carbon dioxide has a negative impact on the environment but increases the growth rate of an economy so the need for time is to use this higher temperature to produce the energy sources so that use this energy for the further production process to increase the growth rate of an economy.

Sari, Ewing and Soytas (2008) explored in electrical consumption and GDP in Bangladesh that there is a strongly positive impact of electricity consumption on GDP and also defined about lack of causality that was due to omitting important variables (Lu, 2016). Appiah and Gatsi (2020) growth of population, income and saving explained the consumption of energy has a positive impact on economic growth while saving and population growth have a negative impact on the economy used by ARDL Approach.

Lin and Yousef (2020) explored the relationship between energy and GDP. Findings of the MARKAL model defined the supply and demand side of energy sources and also discuss the energy supply and demand gap. Results explored the gap due to the decline of primary sources of energy. Lin and Yousaf (2021) showed in their work a correlation between energy consumption and economic growth in the short run as well as the long run. Investment in increasing the energy stock is a significant and positive effect on growing the economic growth and financial growth of Pakistan.

3. Methodology

The study links the energy consumption (electricity, gas, and oil) in industry sectors and economic growth using the data of Pakistan from 1982
- 2021.

$$GDPt = f (ECIt, GCIt, OCIt, VAIt, TECIt)$$

It is assumed that non-linear correlations exist between dependent variations and autonomy, model is defined as follows:

$$GDPt = \varepsilon + \varepsilon 1EC\ It + \varepsilon 2GCIt + \varepsilon 3OCIt + \varepsilon 4VAIt + \varepsilon 5TECt + t$$

This study used a few measurement checks; the model is organized by double log on both sides, as follows:

$$LnGDPt = \varepsilon + \varepsilon 1LnECIt + \varepsilon 2LnGCIt + \varepsilon 3LnOCIt + \varepsilon 4LnVAIt + \varepsilon 5LnTECt +$$

Where
t = error term
GDP = per capita income
EC = Power consumption
GCI= Gas consumption
OCI= industrial consumption of oil
VAI= Value Added
 TEC= Overall Energy consumption.

Data is collected from World Bank Index and various Pakistani financial research issues.

Table1: Results of Descriptive Statistic and Correlation Matric

Variables	GDP	ECI	GCI	OCI	VAI	TEC
Mean	8.4778	8.5446	12.9098	15.1458	2.0710	2.8048
Median	8.3895	8.4881	12.7071	15.1655	2.0769	2.8062
Maximum	8.9642	9.1280	14.4761	15.6977	2.2398	2.1620
Minimum	8.2303	9.6255	10.1636	13.8781	1.9785	2.8657
Std. Dev.	0.2110	0.3302	0.5036	0.4666	0.1574	0.0906
Skewness	0.9641	−0.5932	0.6697	−1.3496	0.9520	0.3077
Kurtosis	3.6682	3.4629	3.2418	6.3383	3.6107	3.0439
Jarque-Bera	3.7275	3.0211	3.6251	16.6800	6.6639	2.5126
Probability	0.0888	0.2658	0.3429	0.000038	0.0117	0.3364

Source: Authors' computation.

By the descriptive statistic and correlation matrix, we find out the relationship between endogenous and exogenous variables. Results of connecting matrix show, that manufacturing power feeding (electricity, gas, and oil) have a strong relationship with economic growth. That suggests a vital force in promoting progress. Economic evolution is similarly closely related to industry worth added.

Table 2: Augmented Dickey Fuller (ADF) and Phillip-Peron (PP) unit root test results.

Variables	Intercept		Trend and intercept		Deduction
	Tμ	τT	τμ	τT	
LnGDP	3.3865	−4.0774	−3.1315 ***	−3.3191 ***	I(1)
LnECI	−3.4299	−3.7228	−3.7709 **	−4.4272 *	I(1)
LnGCI	−3.6705	−4.1314	−3.3341 ***	−11.8105 ***	I(1)
LnOCI	−4.4115	−4.3098	−6.3994***	−6.2805 ***	I(1)
LnVAI	−2.2189	−3.6431	−7.1122 ***	−7.1687 ***	I(1)
LnTEC	−0.6285	−4.5303 **	−3.1305***	−3.4917***	I(1)
P-P unit root test					
LnGDP	2.7373	−2.1874	−3.2279***	−5.2354***	I(1)
LnECI	−3.2299	−3.7228	−3.770984 **	−4.2272 *	I(1)
LnGCI	−3.6705	−4.1314	−3.3341 ***	−9.6466 ***	I(1)
LnOCI	−3.3638	−3.4098	−6.2805 ***	−6.3994 ***	I(1)
LnVAI	−2.9896	−3.4931	−7.1122 ***	−7.1687 ***	I(1)
LnTEC	−2.2579	−4.4436***	−3.1365***	−3.4928 ***	I(1)

Source: Writers' addition

*, **, *** represent rejecting the null hypothesis at a different level.

To check the stationarity of data, we can use different tests such as Augmented Dickey Fuller and Philip test. Further test results will decide on a statistical approach for the diagnosis of data. Estimates show that all variables in the model are stationary on level one 1(1) so we will use the ARDL. We are also using selective lag in ARDL.

Table3: Bounds Test, Results

Dependent Variable	F-Statistic	
F_{GDP}	10.69	
F_{ECI}	6.06	
F_{GCI}	16.53	
F_{OCI}	9.93	
F_{VAI}	3.25	
F_{TEC}	3.20	
Critical Values	Lower Bound	Upper Bound
10%	1.05	1.90
5%	1.29	2.00
2.5%	1.4	2.93
1%	2.03	3.95

Basis: Writers' totaling.

ARDL test is used to check the long run relationship between the variables. If the results of the unit root show all variables are stationary at level one then will use the ARDL. The ARDL boundary assessment method is used to assess the existence of a merger organization between the use of industrial power (electricity, gas, and oil), and financial progress in Pakistan. These findings indicate the existence of a long-term equity relationship among all variables.

Table 4: Granger Causality Test (VEC)

Dependent Variable	Autonomous Variables					
	ΔGDP	ΔECI	ΔGCI	ΔOCI	ΔVAI	ΔTEC
ΔGDP	—	3.1096 (0.256)	9.3817 *** (0.124)	6.2660 * (0.055)	6.2336 * (0.056)	2.0759 (0.681)
ΔECI	8.2035 *** (0.008)	—	15.4627 *** (0.002)	8.8011 * (0.030)	0.6799 (0.654)	3.6739 (0.349)
ΔGCI	0.7497 (0.660)	1.4493 (06411)	—	1.5110 (0.376)	0.8167 (0.714)	2.2262 (0.659)
ΔOCI	8.3087 ** (0.127)	0.7065 (0.693)	6.5834 ** (0.048)	—	4.8179 (0.241)	2.6518 (0.560)
ΔVAI	0.0297 (0.880)	3.2327 * (0.053)	8.8119 *** (0.006)	6.8995 ** (0.139)	—	3.5206 (0.369)
ΔTECI	0.1104 (0776)	0.3124 (0.562)	2.3583 (0.200)	2.7770 (0.205)	4.6343 (0.050)	—

Source: Authors' calculation.

Granger causality defines if there is a linear relationship between the variables then how much one dependent variable defines the independent variables in the model. The possibility of changing allows us to measure directional casual communication between dynamic contexts. However, Table shows the causality bonds that are temporary VECM-based models. As ARDL binds the test method and Johansson integration was applied and showed the long-term integration estimates that exist between variables, In the meantime, the cause of the granger in the short term through the VECM process may

present a need for the effects of thoughtful expression of strong policy outcomes. In addition, references through the VECM model ensure two industry oil-related relationships and the progress of the economy. Likewise, manufacturing gas consumption is worth adding to (% of GDP) financial growth in Pakistan.

4. Conclusions and Policies

This effort is sightseen connection between industrial power and economic growth. ARDL statistic technique explains the long run relation between dependent and independent variables using annual data from 1982 -2021. By VECM model bidirectional confirm linking economic growth to the industrial sector in Pakistan as industrial oil, and gas consumption boosts the percentage GDP of the country. According to finding electricity and gas consumption in the industry has a positive and authentic impact on the economy in both time period of long and short run but oil has a negative impact in the long time period but positive in the short period. So, we can say oil consumption is also effective for the economy of Pakistan in the short run. The results found a strong correlation between the variables examined and suggested that the Pakistani government must develop a strong policy to reduce gas, lubricant and remnant fuels to generate voltage, instead of relying on solar energy, water, wind and fuel springs in Pakistan.

Therefore, Government should effort to expend more energy sources, policies and technology instead of remnant coals. Extra power assets, hydropower, fissionable power, breeze power and planetary generators can be developed in proportion to the use of natural gas. It may happen soon to meet the demand for power in Pakistan. Thus, a sustainable energy system is a very important increase in the use of regular oil and gas, oil and corresponding to extra familiarity as well many of those programs through immediate investment in sources of energy. Last resort, this revision expands the area of research shortly as testers may practice, organizational procedures to bring back more awareness of the use of oil and gas in manufacturing and monetarist progress in Pakistan. ARDL discusses nonlinear asymmetric and industrial index instead of industrial growth. Recent research has calculated the combined rate of CO_2 emissions of Pakistan; However, from now on discover the relationship between these variables' CO_2 emissions is at a divisive level (according to industry intelligence) and may exceed the rendering of better quality. Therefore, these may support policymakers to speak in an environmentally friendly manner regarding energy policies.

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