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EFFECT OF DISAGGREGATED ENERGY CONSUMPTION ON PAKISTAN ECONOMIC GROWTH (ARDL APPROACH)

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Abstract

Important aim of the study is to explore the effect of disaggregated energy consumption on the economic growth of Pakistan. The empirical analysis is based on the time series data for the era 1972 to 2018 and data source is World Bank (WB) and Pakistan Economic Survey. Gross Domestic Product (GDP) and Gross Fixed Capital Formation are used as the proxies of the economic growth and Domestic Investment respectively in this model. Bound Test for Co-integration, Error Correction Mechanism (ECM) and Pairwise Granger Causality Tests are applied to get the results in the study. According to the ARDL analysis ELEC is significant but has negative effect on the GDP of Pakistan in the short-run and long-run both. DI and ELF are significant and positive impact on the GDP of Pakistan' economy in the short-run and long-run both. OIL is significant and positive effect on the GDP of Pakistan in the long-run. The Pairwise Granger Causality Tests, show GDP does Granger Cause GAS, COAL does Granger Cause GDP, GDP does Granger Cause FDI, GAS does Granger Cause OIL, GAS does Granger Cause COAL, FDI does Granger Cause GAS, ELF does Granger Cause COAL, DI does Granger Cause FDI, ELF does Granger Cause FDI, all these show the uni-directional granger causalities. While DI does Granger Cause GDP and GDP does Granger Cause DI. Bi-directional granger causality exists between the DI and GDP. Similarly, FDI does Granger Cause OIL and OIL does Granger Cause FDI. Bi-directional granger causality is present in the association of FDI and OIL. Moreover, DI does Granger Cause GAS and GAS does Granger Cause DI and indicate the presence of bi-directional granger causality between them in Pakistan. The study suggests that electricity supply shortage can harm the economic growth of Pakistan. Therefore, there is a need to overcome this problem and made those policies in which electricity supply should become certain to its users. The usage of Pakistan's others energy sources like oil, gas and coal might be enhance for the Pakistan's economic growth.

Keywords

Gross Domestic Product, Total Oil, Total Gas, Total Electricity, Total Coal, Foreign Direct Investment, Domestic Investment, Employed Labor Force, Pakistan.

1 Introduction

According to Apergis, and Payne, (2009) the Commonwealth of Independent States (CIS) came into being in 1991, consists of twelve countries of the former Soviet Union. Although most of these countries may be regarded as transition economies but they play vital role in energy markets of the world as a producer of oil and natural gas and distributor of these resources. The aim of the study is to explore the relation of energy consumption and economic growth. This will be helpful for energy and environmental policy making. According to Hondroyiannis, Lolos, and Papapetrou (2002), in 1970 the crises of energy and unpredicted high prices of oil had harmful impact on economic growth. There has been lot of studies conducted on the causality between economic growth and energy consumption by taking real GDP or employment as a proxy of economic growth.

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According to Faridi, and Murtaza, (2013) energy is considered as driving force for any economic activity and contributes important role in the production enhancement. So many important sources of energy like electricity, oil, coal etc. will increase the technological progress. The development aspect also shows the importance of energy. It plays important role in the development of any country. Proper energy supply is essential to fulfill the needs of the country. According to Lei, and Pan (2014), coal plays very important role in energy producing worldwide. Coal is the most desirable source of energy production as compared to other fuel resources. The British Petroleum public limited company (BP) in 2013 (1) quoted that in 2012 the coal consumption has reached to 29.9 percent of global primary energy consumption. It was the highest consumption level of coal since 1970.

International Energy Agency (IEA) in 2012 stated that in 2010 China, the United States of America (USA), India, Germany, Russia, and Japan were the six top largest countries whose consumption of coal was at the highest level in all over the world.

According to Govindaraju and Tang, (2013) the emerging economies China and India achieve a higher level of economic growth with the increased consumption of coal. In 1990 the energy consumption of China and India was 10% and in 2008 it was 21%. Moreover, in 2035 it is expected to increase by up to 31%. On an international forum, the debate regarding the effect of energy conservation on economic growth is of much importance. A lot of research and study has been conducted regarding the relationship between energy consumption and economic growth but yet no generally agreed result has been attained. The direction of the relationship between cause and effect is considered by the policymakers. The energy preventing policies that are aimed to reduce energy consumption may harm economic growth if the cause and effect relationship is from energy consumption to economic growth. The literature shows four different types of hypotheses in the case of causality.

The growth hypothesis claims that energy consumption is a critical factor in growth. In this situation, a reduction in energy consumption leads to a reduction in real GDP. In this way, the economy is dependent on energy consumption. On the other hand, the conservation hypothesis provides the basis of unidirectional cause and effect relation, from real GDP to energy consumption. According to this hypothesis, the reduction in the consumption of energy may not adversely affect the real GDP.

Bi-directional cause and effect relation represent the feedback hypothesis that claims that both real GDP and energy consumption depends on each other and have a simultaneous effect on one another. The last hypothesis is the neutrality hypothesis that argues that the reduction in energy consumption does not affect real GDP and vice versa.

As mentioned earlier that the consensus on the nexus of the relationship between energy consumption and economic growth is difficult to explore. The reason behind this difficulty is the consensuses are using different sets of data, alternates of econometric methodologies. Literature provides two approaches regarding the relation of energy consumption and economic growth. The supply-side examines the role of energy consumption in economic activities. While the demand side examines the relation of energy consumption, real GDP, and price level of energy

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in the tri-variate model. Many countries are concerned about the negative impact of reduced use of fossil fuels so that carbon dioxide emissions may be reduced to prevent the climate. The issue of cause-and-effect relation between energy and economic growth is of much importance as it has given a big threat of global warming so there is a need to reduce the energy consumption to cope with the problem of carbon dioxide emissions. According to Chontanawat, Hunt, and Pierse, (2008), in short, it is difficult to conclude whether energy plays the role of stimulus to economic growth or not? The answer to this question is important for policymakers.

In positive and expressive way, all energy utilization is linked to economic development (Saudi, Sinaga, Roespinoedji & Jabarullah, 2019). At a disaggregated level, both coal and oil consumption promote the GDP in China (Rahman, Khattak, Ahmad & Khan, 2020). Similarly, aim of the current study is to investigate the effect of disaggregated energy consumption on Pakistan economic growth through the ARDL approach.

2 Literature Review

Mighri and Ragoubi (2020) examined the causal link of consumption of electricity and economic development in Tunisia for the span 1971-2013 through the use of cointegration and Granger causality tests using ARDL bound research approach. The empirical results demonstrate the presence of a long relationship between the use of electricity and economic development.

Wu (2020) investigated the symmetric and asymmetric implications for the economy of non-clean energy usage through the inclusion in the production process of clean energy usage and also capital and financial creation. The results of the study indicated that the impact of non-clean energy on growth in the economy is symmetrical.

Rahman, Khattak, Ahmad and Khan (2020) investigated the link among energy generation, consumption of energy and growth of China's GDP for the era 1981-2016 at a disaggregated level. The Granger causality tests based on the VECM established a one-way causality flow from coal consumption to GDP growth; from GDP growth to gas consumption; from oil consumption to GDP growth.

Saudi, Sinaga, Roespinoedji and Jabarullah (2019) examined the effect on environmental damage of the use of industrial, commercial and agricultural energies and of the economic growth of Malaysia. The results of the ARDL bound research method assess the existence of a long-term relation between the growth of GDP, resources, labour and the country's sectoral energy usage. In addition, the study also considers empirical evidence that all energy consumption is correlated with economic growth in a positive and meaningful way

Zhi-Guo, Cheng and Dong-Ming (2018) investigated the empirical studies on the correlation between the use of natural gas and economic development in North East Asia. The study showed that Japan's coefficient of elasticity of natural gas consumption is the maximum, while Korea's coefficient of elasticity is the smallest, and China's coefficient of elasticity is in the centre of those two nations, owing to the different levels of growth and energy consumption of the

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economies. Besides that, the Granger causality findings indicate that there is only a one-way causal relation between China's consumption of natural gas and economic development, and no causal link is identified between Japan and Korea.

Nyasha, Gwenhure and Odhiambo (2018) observed the causal link between Ethiopian's energy consumption and its economic growth in the period of 1971 to 2013. Findings show that there is a distinct unidirectional Granger causality in Ethiopia, from economic growth to energy consumption, relying on the recently designed ARDL boundary test procedure to co-integration and the error correction model-based causality framework. Aneja, Banday, Hasnat and Koçoglu (2017) examined the link between economic growth and energy consumption for BRICS nations via a multivariate panel system for 1990–2012. A long-run association among GDP per capita renewable energy consumption, nonrenewable energy usage, and gross fixed capital formation is illustrated by the Pedroni (1999-2004) panel cointegration analysis. And then, the panel error correction method shows the unidirectional causality of renewable and non-renewable energy use from economic development. That means, there is no clear association between the consumption of energy and economic development.

Destek and Okumus (2017) explored the disaggregated use of energy and economic development in the nations of the G-7. The outcomes of the panel bootstrap approach show that oil consumption promotes economic growth in Germany, Italy, Japan and the USA; economic growth promotes oil consumption in Germany and the UK; natural gas consumption promotes economic growth in Italy, Japan, the USA and the UK; economic growth promotes natural gas consumption in Germany; coal consumption promotes economic growth in Canada; and economic growth in Germany.

Nain, Ahmad and Kamaiah (2017) investigated through aggregate and disaggregate (sectoral) energy usage indicators employing yearly period of 1970 to 2011, the long-term and short-run causal relations between energy consumption and GDP. The ARDL bounds test shows that these aggregates and disaggregate levels have a long-run connection between the variables mentioned. The causality tests for Toda-Yamamoto show that the long-run and short-run causal association between the variables is not uniform across sectors. The scope of the study's evidence predict that short-term causality exists between the use of electricity and economic development.

Pata and Terzi (2016) explored the relation between the Turkey's consumption of aggregated-disaggregated energy and its economic development. The outcomes of the JJ Cointegration indicate that there is no long-term co-movement between energy use and economic growth, however the DLVAR findings show that energy is an essential aspect for the short-term consistent growth of the Turkish economy. The final result is that a positive unidirectional relationship runs from the short-term economic growth of petroleum, electricity, primary energy use and carbon dioxide emissions. The findings of the DLVAR study also affirm the outcomes of generalised impulse-response and variance decomposition methods.

Govindaraju and Tang (2013) explained the relationship between CO2 emissions, GDP and coal consumption in the case study of china and India. According to this study these variables are cointegrated in china while not in India. Further it shows the long run relationship amongst

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economic growth, Co2 emission and energy consumption in case study of china. Lei, Li and Pan (2014) explore the energy consumption and GDP growth of six energy consuming countries. This study found that bidirectional relationship existing in Germany, Russia and Japan, in China existing unidirectional causality relationship but there is no relationship existing in USA and India among the coal consumption and economic growth. Further, Apergis and Payne (2009) investigated the association among energy consumption and GDP for eleven countries and concludes that in the short run unidirectional causality but in the long rum bidirectional causality existence from coal consumption and economic growth.

Asafu-Adjaye (2000) also explained the relationship of coal consumption and income. In his research co-integration and error correction technique were used for Indonesia, India, Philippines and Thailand. According to this study, unidirectional Granger causality for India and Indonesia while bidirectional Granger causality for Thailand and Philippine converts from energy to income in the short run. Belke, Dobnik & Dreger (2011) define the connection of power use, real GDP and power prices for OECD countries. They find out that the price of power use is inelastic; furthermore, this study diagnosed the existence of a bidirectional causal relationship of power use and GDP growth. Besides, Bloch, Rafiq and Salim (2015) described the relationship of coal, oil and renewable energy for producing and consuming in case study of China. This study concludes coal consumption exhale the pollution whereas renewable power consumption reduces emissions, therefore it is not found of emission in oil.

Chen, Kuo & Chen (2007) show the connections between economic growth and electricity consumption of developing Asian countries. This study indicates that huge supply of electricity gives the higher level of economic growth only on long run relationship. Chontanawat, Hunt and Pierse (2008) explains that energy played an important character in the development of economic. A large number of researchers have researched on causality among energy and economic growth but they find no consensus. Furthermore, this study checks the causality from power sector to economic growth for over 100 countries and pointed out common characters between developed OECD countries and developing Non-OECD countries. Ahmad, Hayat, Hamad and Luqman, (2012) also examined the relationship of power consumption and GDP in case study of Pakistan and conclude unidirectional causality shifting from economic growth to power consumption by using the Granger causality test. Further in this study OLS test described positive interaction between economic growth and energy consumption in Pakistan.

Faridi and Murtaza, (2013) shows in their study the disaggregate power consumption; GDP growth and productivity of agriculture are correlated each other short run and long run. According to the study use of energy and GDP puts an important role on economy of Pakistan. Furthermore, it is explained the scarcity of electricity supply at the customary level can damage the Pakistan economy. Hondroyiannis, Lolos and Papapetrou (2002) discussed experimental relationship of power consumption and economic growth in case study of Greece. In this study pragmatic evidence shows long rum relationship among energy consumption and real output. Ghosh (2002) describes Granger causality among the coal consuming per capita and GDP per capita the case study of India and find out in equilibrium connection between the variables.

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Further this study also concludes existence unidirectional Granger causality modifying from economic growth to power consumption.

Jamil and Ahmad (2010) show two sector relationship, electricity consumption and real GDP in case study of Pakistan. Therefore, this study finds out the occurrence of unidirectional causality from GDP to electricity consumption especially commercial, manufacturing and agriculture sector in Pakistan. Lee (2005) explores the causality interaction of coal consumption and economic growth of developing countries, for this purpose unit root, heterogeneous and panel-based error models were used. The evidence of the study shows that causalities go through power consumption to economic growth and it is also point out that modification may dangerous for economic growth in underdeveloped countries. Lee and Chang (2008) examine the co-movement and the causal interaction among coal consumption and real GDP for Asian countries by using the panel unit root, heterogeneous panel co-integration and panel-based error correction techniques. This study shows that connection of real GDP and energy consumption is positive in the long run co-integrated. Furthermore, it is found the shortage of GDP and power consumption in the short run causality and in the long run unidirectional causality shifting from power sector to GDP of Asian countries.

Mozumder and Marathe (2007) shows the dependency between per capita energy consumption and per capita of economic growth by applying co-integration and vector error correction model for Bangladesh. They found that there is unidirectional causality from per capita GDP to per capita energy spending in case of Bangladesh. Paul and Bhattacharya (2004) examines that by using the Johansen co-integration technique the bidirectional causality lies among the power consumption and GDP growth in case of India. Apergis and Payne (2009) describe interaction among the electricity consumption and GDP growth for selected central American countries. This study designates the existence of short run as well as long run causality power consumption to GDP growth. Wolde-Rufael (2009) explore that coal consumption has less impact on economic growth in the African countries.

3 Methodology

Time series data is used for the era 1972 to 2018 and data source is World Bank (WB) and Pakistan Economic Survey in the context of the Pakistan. Gross Domestic Product (GDP) and Gross Fixed Capital Formation are used as the proxies of the economic growth and Domestic Investment respectively in this model. Bound Test for Co-integration, Error Correction Mechanism (ECM) and Pairwise Granger Causality Tests are applied to get the results in the study. The mathematical model of the study is;

GDP=f (OIL, GAS, ELEC, COAL, DI, FDI, ELF)

And the econometric model of the study is;

$$GDP_t=\alpha_o + \alpha_1 OIL_t + \alpha_2 GAS_t + \alpha_3 ELEC_t + \alpha_4 COAL_t + \alpha_5 DI_t + \alpha_6 FDI_t + \alpha_7 ELF_t + \varepsilon$$

Details of variables;

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GDP= Gross Domestic Product (Current US $ in Millions)

OIL= Total Oil/Petroleum (tons)

GAS= Total Gas (mm cft)

ELEC= Total Electricity (Gwh)

COAL= Total Coal (000 metric ton)]

DI= Gross fixed capital formation (Current US $ in Millions)

FDI= Foreign Direct Investments (Current US $ in Millions)
ELF= Employed Labor Force, Total (Millions)
ε= Error Term

t= Time Series

Taking the log of the model:

$\ln GDP_t=\alpha_o + \alpha_1 \ln OIL_t + \alpha_2 \ln GAS_t + \alpha_3 \ln ELEC_t + \alpha_4 \ln COAL_t + \alpha_5 \ln DI_t + \alpha_6 \ln FDI_t + \alpha_7 \ln ELF_t + \varepsilon$

4 Result and Discussion

Descriptive Statistics

Descriptive measures are used to examine the correlation between dependent and independent variables and their interaction. It offers average dynamics and data distribution that allows to extend the study period and better forecast potential behavior. Of more research and policy consequences, the expected effects are a valuable help.

Table: 1 Descriptive Statistics

	GDP	OIL	GAS	ELEC	COAL	DI	FDI	ELF
Mean	92830.4	12830760	703940	43991.71	4623.097	14117.03	990.491	37.07907
Median	60636.02	13960167	582868	41737	3167.9	9356.586	382.2	31.8
Maximum	312570.1	25561946	1454697	106927	17981.1	46336.94	5594.2	61.71
Minimum	6324.884	2865859	116499	6004	1064.7	723.2574	0.2	19.24
Std. Dev.	88878.12	6816748	444012.3	29410.79	3580.732	12507.84	1366.5	13.08315
Skewness	1.159161	0.012537	0.296216	0.353905	1.484543	1.063102	1.96774	0.443919
Kurtosis	3.059217	1.81368	1.52924	1.937832	5.414152	2.980261	6.46378	1.78905
Jarque-Bera	10.53216	2.757299	4.923465	3.190505	28.67707	8.853888	53.8262	4.415368
Probability	0.005164	0.251918	0.085287	0.202857	0.000001	0.011951	0	0.109955
Sum	4363029	6.03E+08	33085179	2067611	217285.6	663500.3	46553.1	1742.716
Sum Sq.	3.63E+11	2.14E+15	9.07E+12	3.98E+10	5.9E+08	7.2E+09	8.6E+07	7873.763

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Dev.								
Observations	47	47	47	47	47	47	47	47

Source: Software E-Views 9.0

Above table show that both mean and median are applied to measure the central tendencies of data. The standard deviation indicates the average out of the used data while the larger standard deviation value indicated a wider distribution. Symmetric data pattern is calculated by skewness level. All variables as GDP, OIL, GAS, ELEC, COAL, MNF, DI, FDI and ELF are positively skewed. Kurtosis indicate about data distribution whether it is Leptokurtic or Platykurtic. Kurtosis standard value is 3, If value is more than 3, then data distribution is leptokurtic while data distribution is Platykurtic when value is less than 3. Data of COAL and FDI show the leptokurtic distribution while the data of OIL, GAS, ELEC, DI and ELF show the Platykurtic distribution. GDP has the standard value of the kurtosis.

Unit Root

Basic test to check the stationarity of the variables is Unit Root. A variable is considered to be stationary in terms of its mean, variance and auto covariance, regardless of where we calculate them. The order of integration will be calculated by pretesting the unit root, that lead for the appropriate method to be implemented in the data. There are many tests that can be used to check the problems of the unit root. Most popular are Augmented Dicky Fuller (ADF)Test and Phillip Perron (PP) Test in time series data. This study used Augmented Dicky Fuller (ADF)Test to check the stationarity of the data.

Table: 2 Unit Root Results

	Level (ADF)		1st Difference (ADF)	
Variables	t-Statistic	Prob.*	t-Statistic	Prob.*
GDP	-2.27709	0.4375	-9.4562	0.0000
OIL	-0.84583	0.9534	-6.35652	0.0000
GAS	-0.65802	0.9703	-8.67901	0.0000
ELEC	-0.14828	0.9924	-5.65554	0.0001
COAL	-4.60183	0.0033	---------	----------
DI	-2.35617	0.3967	-7.5648	0.0000
FDI	-4.22525	0.0087	---------	----------
ELF	-1.57854	0.7862	-6.4141	0.0000

Source: Software E-Views 9.0

Unit root results in which Augmented Dickey Fuller (ADF) Test is applied indicate that all the variables in the study are not stationary at the same level, some of them like COAL and FDI are stationary at level but all others variables like GDP, OIL, GAS, ELEC, DI and ELF are stationary at first difference.

Auto Regressive Distributed Lag (ARDL) Approach to Co-integrating

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Auto Regressive Distributed Lag (ARDL) estimates the parameters of both long-run and short-run at the same time using the single equation. Owing to this technique, obtained model that is estimated will be unbiased and effective. The ARDL Method can be used if the variables may be stationary at I(0) or I(1) or have both combination.

Bound test for Cointegration

Bound test for Cointegration is applied to investigate the relationship of long-run among the variables. The first reason for the usage of this method is, this is acceptable without taking into consideration either model variables are entirely 1(0), I (1) or also integrated with jointly. The second reason is, this ignores the complexity of stationary pre-testing. The third reason is, it works accurately if the size of the sample is less (Ghatak and Siddiki, 2001). Through the F-Stat, we checked the co-integration. If the value of the F-Stat is greater than upper critical values then reject the null hypothesis that is no long-run relationships exist. While if the value of the F-Stat is less than lower critical values then accept the null hypothesis

Table: 3

Test Statistic	Value		
F-statistic		4.175134	
Critical Value Bounds			
Significance		Lower Bound	Upper Bound
	10%	1.7	2.83
	5%	1.97	3.18
	2.50%	2.22	3.49
	1%	2.54	3.91

Source: Software E-Views 9.0

Bound test results indicate that value of F-statistic is 4.175134 that is more than the critical value of the lower bound and upper bound which interpret long-run relationship exist among the variables.

Short Run Estimates

Table 4: ARDL Co-integrating and Short Run Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (GDP (-1))	-0.15739	0.100247	-1.57005	0.1257
D (GDP (-2))	-0.34893	0.0667	-5.23129	0.0000
D(OIL)	0.084968	0.045751	1.857159	0.072
D(GAS)	0.078637	0.069502	1.131436	0.2658
D(COAL)	-0.03258	0.044981	-0.72427	0.4739
D(ELEC)	-0.24688	0.068646	-3.59637	0.001
D(DI)	0.641699	0.093585	6.856849	0.0000

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D(FDI)	-0.0149	0.014613	-1.01982	0.315
D(ELF)	0.583953	0.166381	3.509725	0.0013
CointEq (-1)	-0.67203	0.092439	-7.27003	0.0000

Cointeq = GDP - (0.1264*OIL + 0.1170*GAS -0.0485*COAL -0.3674*ELEC + 0.9549*DI -0.0222*FDI + 0.8689*ELF)

Source: Software E-Views 9.0

Findings indicate that ELEC is significant but has negative effect on the GDP of Pakistan. It may be due to the non-stop short fall and supply shocks of electricity are the core reasons of falling GDP in the short-run. This finding is similar with the (Kakar & Khilji, 2011; Onakoya, Onakoya, Jimi Salami & Odedairo, 2013). Di is significant and positive impact on the GDP of Pakistan' economy in the short-run. Better infrastructure of the country increases the productive activities directly and spending on other projects increase the overall production and growth. This result is similar to the (Blomstrom, Lipsey & Zejan, 1994). Moreover, ELF is significant and positive impact on the GDP of Pakistan' economy in the short-run. While other variables like OIL, GAS, Coal and FDI are insignificant.

Long Run Estimates

Table: 5 Long Run Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
OIL	0.126434	0.061901	2.04253	0.0489
GAS	0.117013	0.111918	1.045526	0.3032
COAL	-0.04848	0.06582	-0.73651	0.4665
ELEC	-0.36736	0.119478	-3.07469	0.0041
DI	0.954862	0.0805	11.8617	0.0000
FDI	-0.02218	0.020785	-1.06687	0.2936
ELF	0.868934	0.185083	4.694836	0.0000

Source: Software E-Views 9.0

Outcomes of long-run coefficients are shown in the table 5 in which the first variable OIL is significant and positive effect on the GDP of Pakistan in the long-run. Reason is that nowadays without oil, wheel of the economic life cannot be able to run due to the modernization and technical advancement. ECLEC is significant while negative effect the GDP of Pakistan in the long-run as in the short-run. DI has significantly positive effect on Pakistan's GDP in both long-run and short-run. Similarly, ELF has significantly positive effect on Pakistan's GDP in both long-run and short-run. Other variables, GAS, COAL and FDI are insignificant that means they all are not taking the part in the growth and development of Pakistan's economy.

Table: 6 Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
OIL does not Granger Cause GDP	45	1.93026	0.1584

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GDP does not Granger Cause OIL		1.85216	0.1701
GAS does not Granger Cause GDP	45	1.13232	0.3324
GDP does not Granger Cause GAS		6.62339	0.0033
COAL does not Granger Cause GDP	45	5.26693	0.0093
GDP does not Granger Cause COAL		2.227	0.1211
ELEC does not Granger Cause GDP	45	0.11091	0.8953
GDP does not Granger Cause ELEC		0.47277	0.6267
DI does not Granger Cause GDP	45	3.9014	0.0283
GDP does not Granger Cause DI		10.7319	0.0002
FDI does not Granger Cause GDP	45	0.83374	0.4418
GDP does not Granger Cause FDI		4.00463	0.026
ELF does not Granger Cause GDP	45	13.8132	3.0005
GDP does not Granger Cause ELF		0.21954	0.8038
GAS does not Granger Cause OIL	45	3.27314	0.0483
OIL does not Granger Cause GAS		2.47669	0.0968
COAL does not Granger Cause OIL	45	1.89703	0.1633
OIL does not Granger Cause COAL		0.39137	0.6787
ELEC does not Granger Cause OIL	45	2.26287	0.1172
OIL does not Granger Cause ELEC		0.69013	0.5074
DI does not Granger Cause OIL	45	2.48678	0.096
OIL does not Granger Cause DI		0.33113	0.7201
FDI does not Granger Cause OIL	45	5.198	0.0098
OIL does not Granger Cause FDI		4.36039	0.0194
ELF does not Granger Cause OIL	45	0.09503	0.9096
OIL does not Granger Cause ELF		0.10925	0.8968
COAL does not Granger Cause GAS	45	1.94326	0.1565
GAS does not Granger Cause COAL		3.34456	0.0454
ELEC does not Granger Cause GAS	45	0.30104	0.7417
GAS does not Granger Cause ELEC		0.47706	0.6241
DI does not Granger Cause GAS	45	9.17244	0.0005
GAS does not Granger Cause DI		5.89348	0.0057

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FDI does not Granger Cause GAS	45	4.24893	0.0212
GAS does not Granger Cause FDI		13.3874	4.0005
ELF does not Granger Cause GAS	45	0.08488	0.9188
GAS does not Granger Cause ELF		2.63137	0.0844
ELEC does not Granger Cause COAL	45	2.5066	0.0943
COAL does not Granger Cause ELEC		1.2548	2.9601
DI does not Granger Cause COAL	45	1.62958	0.2088
COAL does not Granger Cause DI		13.3465	4.0005
FDI does not Granger Cause COAL	45	0.19858	0.8207
COAL does not Granger Cause FDI		13.1269	4.0005
ELF does not Granger Cause COAL	45	4.08176	0.0244
COAL does not Granger Cause ELF		0.22736	0.7977
DI does not Granger Cause ELEC	45	0.70964	0.4979
ELEC does not Granger Cause DI		2.09113	1.3701
FDI does not Granger Cause ELEC	45	0.30777	0.7368
ELEC does not Granger Cause FDI		12.4711	6.0005
ELF does not Granger Cause ELEC	45	0.37446	0.69
ELEC does not Granger Cause ELF		0.84888	0.4355
FDI does not Granger Cause DI	45	0.50777	0.6057
DI does not Granger Cause FDI		3.47783	0.0405
ELF does not Granger Cause DI	45	14.4158	2.0005
DI does not Granger Cause ELF		0.27208	0.7632
ELF does not Granger Cause FDI	45	5.66733	0.0068
FDI does not Granger Cause ELF		1.06659	3.5401

Source: Software E-Views 9.0

Pairwise Granger Causality Tests

Pairwise Granger Causality Tests is used to check the causality between the variables. This study uses the 45 observations (1972-2018) for this analysis. According to the results of the Pairwise Granger Causality Tests, GDP does not Granger Cause GAS with probability value 0.0033, show GDP does Granger Cause GAS. Uni-directional causality exist between GDP and GAS. Similarly, COAL does not Granger Cause GDP with probability value 0.0093, predict COAL does Granger Cause GDP and show the uni-directional association between the COAL and GDP. While DI does not Granger Cause GDP and GDP does not Granger Cause DI with probability values 0.0283 and 0.0002 respectively, indicate that DI does Granger Cause GDP and GDP does Granger Cause DI. Bi-directional granger causality exists between the DI and GDP. So, GDP

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does not Granger Cause FDI with probability value 0.026, show GDP does Granger Cause FDI and show the existence of the uni-directional granger causality between the GDP and FDI. Similarly, GAS does not Granger Cause OIL with probability value 0.0483, forecast GAS does Granger Cause OIL. Uni-directional granger causality exist between the GAS and OIL. But FDI does not Granger Cause OIL and OIL does not Granger Cause FDI with probability values 0.0098 and 0.0194 respectively, means FDI does Granger Cause OIL and OIL does Granger Cause FDI. Bi-directional granger causality is present in the association of FDI and OIL. GAS does not Granger Cause COAL with probability value of 0.0454, means GAS does Granger Cause COAL. Uni-directional granger causality exist between the GAS and COAL. DI does not Granger Cause GAS and GAS does not Granger Cause DI with probability values 0.0005 and 0.0057 respectively, indicate the DI does Granger Cause GAS and GAS does Granger Cause DI and indicate the presence of bi-directional granger causality between them. FDI does not Granger Cause GAS with probability value 0.0212, means FDI does Granger Cause GAS and show the uni-directional granger causality between the FDI and GAS. ELF does not Granger Cause COAL with probability value 0.0244, means ELF does Granger Cause COAL, that show the uni-directional granger causality presence in the ELF and COAL. DI does not Granger Cause FDI with probability value 0.0405, means DI does Granger Cause FDI, that illustration the uni-directional granger causality presence in the DI and FDI. ELF does not Granger Cause FDI with probability value 0.0068, means ELF does Granger Cause FDI, that show the uni-directional granger causality occurrence in the ELF and FDI in the Pakistan's economy.

5 Conclusion

Key aim of the study is to explore the effect of disaggregated energy consumption on the economic growth of Pakistan. The empirical analysis is based on the time series data for the era 1972 to 2018 and data source is World Bank (WB) and Pakistan Economic Survey. Gross Domestic Product (GDP) and Gross Fixed Capital Formation are used as the proxies of the economic growth and Domestic Investment respectively in this model. Bound Test for Co-integration, Error Correction Mechanism (ECM) and Pairwise Granger Causality Tests are applied to get the results in the study.

Bound test show that long-run relationship is present among the variables. According to the short-run estimates of the ARDL show that ELEC is significant but has negative effect on the GDP of Pakistan. It may be due to the non-stop short fall and supply shocks of electricity are the core reasons of falling GDP in the short-run. This finding is similar with the (Kakar & Khilji, 2011; Onakoya, Onakoya, Jimi Salami & Odedairo, 2013). Di is significant and positive impact on the GDP of Pakistan' economy in the short-run. Better infrastructure of the country increases the productive activities directly and spending on other projects increase the overall production and growth. This result is similar to the (Blomstrom, Lipsey & Zejan, 1994). Moreover, ELF is significant and positive impact on the GDP of Pakistan' economy in the short-run. While other variables like OIL, GAS, Coal and FDI are insignificant.

According to the long-run estimates of the ARDL show that OIL is significant and positive effect on the GDP of Pakistan in the long-run. Reason is that nowadays without oil, wheel of the

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economic life cannot be able to run due to the modernization and technical advancement. ECLEC is significant while negative effect the GDP of Pakistan in the long-run as in the short-run. DI has significantly positive effect on Pakistan's GDP in both long-run and short-run. Similarly, ELF has significantly positive effect on Pakistan's GDP in both long-run and short-run. Other variables, GAS, COAL and FDI are insignificant that means they all are not taking the part in the growth and development of Pakistan's economy.

According to the results of the Pairwise Granger Causality Tests, show GDP does Granger Cause GAS. Uni-directional causality exist between GDP and GAS. Similarly, COAL does Granger Cause GDP and show the uni-directional association between the COAL and GDP. While DI does Granger Cause GDP and GDP does Granger Cause DI. Bi-directional granger causality exists between the DI and GDP. GDP does Granger Cause FDI and show the existence of the uni-directional granger causality between the GDP and FDI. Similarly, GAS does Granger Cause OIL. Uni-directional granger causality exist between the GAS and OIL. But FDI does Granger Cause OIL and OIL does Granger Cause FDI. Bi-directional granger causality is present in the association of FDI and OIL. GAS does Granger Cause COAL. Uni-directional granger causality exist between the GAS and COAL. DI does Granger Cause GAS and GAS does Granger Cause DI and indicate the presence of bi-directional granger causality between them. FDI does Granger Cause GAS and show the uni-directional granger causality between the FDI and GAS. ELF does Granger Cause COAL, that show the uni-directional granger causality presence in the ELF and COAL. DI does Granger Cause FDI, that illustration the uni-directional granger causality presence in the DI and FDI. ELF does Granger Cause FDI, that show the uni-directional granger causality occurrence in the ELF and FDI in the Pakistan's economy. According to the findings of the empirical analysis of this study, it is suggested that electricity supply shortage can harm the economic growth of Pakistan. Therefore, there is a need to overcome this problem and made those policies in which electricity supply should become certain to its users. Pakistan others energy sources like oil, gas and coal might be enhance for the Pakistan's economic growth.

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