Sectoral Growth, Exports, and Energy Consumption: A Case of Pakistan

Komal Urooj[1], Muhammad Ali Zafar[2]

[1] MPhil Scholar, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
  Email: komalurooj03@gmail.com
[2] MPhil Scholar, Department of Economics, The Islamia University of Bahawalpur, Pakistan.
  Email: aliizaffaar@gmail.com

ARTICLE INFO	ABSTRACT
Article History: Received: May 08, 2022 Revised: June 24, 2022 Accepted: June 28, 2022 Available Online: June 30, 2022	Economic Growth is a prominent factor to affect the energy consumption of Pakistan. This study tends to explore the influence of GDP growth of sectoral growth, agricultural, industrial, and service sector on the level of energy consumption fossil fuel in Pakistan from 1990 to 2019 long period of time. The data was obtained from WDI (World Development Indicators). ARDL (Auto Regressive Distributive Lag Model) econometric model was designed to look into the impacts of fossil fuel or energy consumption on Pakistan's economic growth in both the short and long run. Results revealed the negative effect of energy consumption or fossil fuel use on the industry, personal expenditures, and exports of goods and the positive impact on agriculture and services, and the model is significant. These results showed that economic expansion plays an important role in increasing energy consumption in Pakistan.
Keywords: Sectoral growth Energy consumption Fossil fuel Economic growth Pakistan	
JEL Classification Codes: O47, Q41, R11	
Funding: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.	

1.   Introduction

The agriculture sector has significantly contributed to Pakistan's economy as it is the main and dominant sector in Pakistan. The energy demand is much higher, so traditional sources of energy production are used for the growing energy demand. Such things become critical for the growth and development of the country. A suitable stock of energy is inevitable for the fulfillment of the needs of the country. Energy is necessary to reduce poverty. Energy is necessary for the services sector and agriculture services. Sectoral growth will raise the energy demand. In agriculture, we need the energy to run tube wells and tractors. In the industrial sector, energy is used in production activities. Services sectors use energy in different forms. Energy is essential as an engine in the economic expansion of a country in the long run. Energy conservation might hinder economic expansion. Energy production and use are crucial for a nation's economic development.

Abundant use of energy resources is essential for a country's economic growth. The investor's return can be increased by maximizing the utilization of energy resources. Due to the rise in sectorial growth, per capita income increases, increasing energy demand. Coal is

the cheapest resource of energy all over the world (Satti, Hassan, Mahmood, & Shahbaz, 2014). According to estimations, the depletion time for the world's coal resources is 14 decades. Pakistan has trillion tonnes of coil reserves that are enough to produce a surplus of electricity for many decades. Electricity produced by coal is the cheapest way in Pakistan (Government of Pakistan, 2014; SDPI, 2014). According to Shahbaz and Dube (2012), economic growth and coal consumption share a two-way relationship in Pakistan.
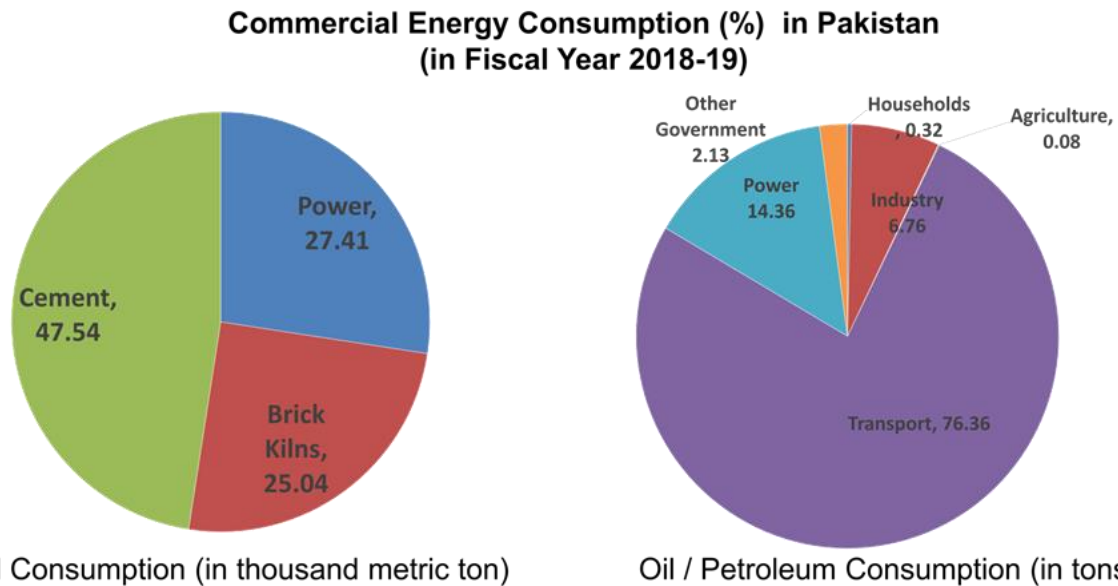

Figure 1: Commercial Energy Consumption in Pakistan

Figure 1 shows that in the case of Pakistan, the coal consumption in the Cement industry is 47.54 thousand metric tons. In contrast, in the Power sector and Brick Kilns, this consumption is 27.41 thousand metric tons and 25.04 thousand metric tons, respectively. The petroleum or oil consumption by industrial, transport, and power sectors is 6.76 thousand metric tons, 76.36 thousand metric tons, and 14.36 thousand metric tons, respectively. The agriculture and household sector use 0.08 thousand metric tons and 0.32 thousand metric tons, respectively, while the energy consumed by other government sectors use 2.13 thousand metric tons (Ahmad, Bashir, & Zafar, 2021).

The developing countries fear that low energy consumption can hinder their economic growth. Developed countries also face energy shortfalls due to increasing oil prices from the 2000s. This study seeks to establish the recently popular association between economic development and energy use. Identifying the substantial correlation between energy consumption and economic growth is necessary since energy is crucial for economic growth (Jamil & Ahmad, 2010).

Many researchers explored the relationship between these two vital factors. The results exposed two contrary arguments, and one concluded that energy impacts economic growth significantly (Abbasi, Lv, Nadeem, Khan, & Shaheen, 2020; Hondroyiannis, 2004; Lin & Liu, 2016; Shahbaz & Feridun, 2012; Tang & Shahbaz, 2013). However, according to some researchers, electricity has little impact on a nation's economic development (Hirsh & Koomey, 2015; Soytas & Sari, 2003; Stern, Burke, & Bruns, 2019).

Concerning the policy, knowing the precise ratio and direction of the relationship between energy use and economic development is essential, which can be helpful to make the economic growth of a country strengthen (Tang & Shahbaz, 2013). This study aimed to examine the effects of sectoral expansion, agricultural, industrial, and services sector's GDP growth of energy consumption in Pakistan.

2.   Literature Review

Komal and Abbas (2015) conducted research on Pakistan's energy usage and economic growth. The outputs revealed a healthy relationship between economic growth with urbanization in Pakistan's capacity for energy consumption. On the other side, Pakistan's energy usage is significantly and highly negatively impacted by energy expenditures. In addition, Nasreen and Anwar (2014) examined how economic development in fifteen Asian nations affected energy use. In Asian countries, there was a clear inverse link between energy use and trade possibilities, economic progress, and casualties. Kourtzidis, Tzeremes, and Tzeremes (2018) examined how economic growth affected energy consumption in the United States and found that it had a favorable effect on economic development in the United States. Rafindadi (2016) conducted research to examine how economic development affects energy use in developing nations. His research showed a positive correlation between economic development and energy use in developing nations throughout the world.

Asafu-Adjaye (2000) also determined the correlation between economic development, energy prices, and energy usage at the level of developed and developing nations. The study verifies the long- and short-term relationships between the variables in the case of industrialized and emerging countries. M. K. Khan, Khan, and Rehan (2020) examined how Pakistan's economic development affected energy use. The findings showed that economic expansion had a favorable effect on energy use. Still, an increase in energy usage in the industry can become the reason for environmental degradation, which can cause health issues in the long run. Studies conducted in all GCC countries showed a bidirectional relation between energy usage and economic development both in the long and short terms (Osman, Gachino, & Hoque, 2016; Ozturk, Aslan, & Kalyoncu, 2010). A study carried out in 17 Arab nations using data from 1980 to 2011 revealed a two-way or bidirectional association between these two factors (Shahateet, 2014).

A study conducted in 11 selected oil exporting but developing countries showed that in Qatar, Nigeria, Iran, Saudi Arabia, and UAE, economic growth is influencing energy consumption as a direct relationship exists between them, while in Qatar and Saudi Arabia, a short run relationship was observed between these two variables (Mehrara, 2007). Damette and Seghir (2013) conducted a study of 5 non-OPEC (Russia, Canada, Norway, Mexico) and 7 OPEC (Angola, Algeria, Venezuela, Nigeria, Iran, UAE, Saudi Arabia) oil-exporting countries, which showed that economic development is affecting the energy usage in the long run.

Narayan and Smyth (2009) also conducted a study in six countries in the Middle East: Israel, Oman, Kuwait, Saudi Arabia, Syria, and Iran. The findings of this study showed a bidirectional relationship showing long-term and short-term relationship between economic growth and energy consumption. A study conducted in Turkish states Kazakhstan and Azerbaijan showed a panel analysis showing a bidirectional relationship between economic development and energy use over the long and short terms (Sentürk & Sataf, 2015). Rahman, Nepal, and Alam (2021) explored the impact of energy usage and economic development on the environment at the level of newly developed industrial countries from 1979-2017. The researcher used MOLS (Modified Ordinary Least Squares) to analyze data. Results revealed improvement of economic expansion in a long-run relationship, although exports have a long-term detrimental impact on energy usage. Results of Doğanlar, Mike, Kızılkaya, and Karlılar (2021) also showed a positive relationship between economic expansion on energy usage, while the research of Wang, Zhang, and Zhang (2021) revealed a negative relationship between economic consumption in long-run.

Z. A. Khan, Koondhar, Khan, Ali, and Tianjun (2021) determined the relationship between agriculture exports and energy consumption. Pakistan time series data from 1976 to 2017 was used. For the examination of partnerships in the short- and long-term, ARDL was utilized. Both in the short and long terms, exports have a positive and considerable impact on energy consumption. The study of Rehman, Ma, Irfan, and Ahmad (2020)

confirmed that exports have a significant long-term impact on energy use. The study of Ahmed and Zeshan (2014); Nazia and Normaz (2019) confirmed an important and optimistic relationship between exports on energy consumption. Liu et al. (2018) investigated the impact of sectoral expansion on energy consumption in China. Granger causality tests were applied for analysis. This study revealed a long-term but unidirectional correlation between sectoral development and energy usage. Results confirmed with research of Zhang et al. (2012) that revealed an unidirectional relationship among sectoral expansion and energy utilization.

Energy use and economic growth have been the subject of extensive investigation in the past. Environment Kuznets Curve (EKC) proposes an inverted U-shaped curve when Per Capita Income works in the opposite direction to pollution. Dasgupta, Laplante, Wang, and Wheeler (2002) explored in their research that people are concerned more with income and jobs than an unspotted environment at the initial stage of industrialization. That's why pollution increases speedily. Much stress is placed on the world environment due to the economic growth in the second phase of industrialization. The side effects of environmental pollution have been ignored because people cannot pay for the reduction. People that concerned with the environment are willing to pay and build environment-friendly policies. The EKC hypothesis identifies a link between economic expansion and environmental deterioration.

EKC hypothesis identifies a connection between economic expansion and environmental deterioration. M. Khan and Ozturk (2021) explored the immediate and long-term impacts of financial development on the environment's quality by using data from 88 selected underdeveloped nations. The research concluded that pollution holds a nature of financial development in underdeveloped areas, and output further added to two major hypotheses in those countries– the pollution heaven hypothesis and the EKC hypothesis. Where Human capital does not support CO_2 emission, increasing population size is the booster of CO_2 and pollution emissions. Gyamfi, Bein, Udemba, and Bekun (2021) investigated the pollution heaven theory for Sub-Saharan African oil and non-oil economies. According to Gyamfi, Bein, Udemba, and Bekun (2021) findings, FDI incursion into the region threatens the quality of the environment for the region's economies since the hypothesis mentioned above. An inverse relationship between economic growth and CO_2 emissions was found by M. Khan and Ozturk (2021), which points to Pakistan's economy as an emitter.

The detrimental effects of economic growth and the use of natural resources on environmental quality were revealed by Nathaniel, Yalçiner, and Bekun (2021), just like M. Ahmad et al. (2021). The second largest source of pollutant emissions in South Africa after coal use, according to Joshua and Alola (2020); Sarkodie, Ackom, Bekun, and Owusu (2020). The connection between coal use, economic expansion, and CO_2 emissions in South Africa is examined by Joshua and Alola (2020). The outcome showed that the economy's largest emitter is coal use, but the FDI influx reduces CO_2 emissions. M. K. Khan et al. (2020) investigated the relationship between a nation's financial progress and environmental quality in the economies of the OECD (Organization for Economic Cooperation and Development). The results showed that financial growth takes place with enhanced environmental quality and energy innovation.

Al-Mulali and Ozturk (2015) investigated the causes of environmental degradation in the MENA (Middle East and North Africa) region, which is made up of 14 economies, using the Pedroni Cointegration Test and the Modified Ordinary Least Square Approach, which is made up of 14 economies. The test's outcome shows that the relevant factors cointegrated, even if the long-term environmental quality is ultimately degraded by energy use, urbanization, trade openness, and industrial growth. However, political stability acts as a catalyst for the improvement of the environment. Fodha and Zaghdoud (2010) investigated whether EKC hypothesis supports Tunisia's economic growth and pollutants (CO_2 and SO_2) for the duration 1961 to 2004.

The research results showed that GDP and CO_2 excessive release have a monotonically growing connection, but SO_2 and GDP have an inverted U relationship. For the Middle East and North Africa (MENA) area between 1981 and 2005, Arouri, Youssef, M'henni, and Rault (2012) looked at the connection between CO_2 excretion and economic growth. Their findings suggest that all 12 MENA countries have long-run CO_2-EKC; however, the turning points vary across countries, with some having very low turning points and others having very high turning points, which provides weak support for the EKC hypothesis at the national level. Ozcan (2013) examined whether the EKC hypothesis is supportive and applicable for 12 Middle Eastern Nations between 1990 and 2008. The output of this study strengthens the position of the U-shaped EKC curve in five of the nations, the inverted U-shaped EKC in three, and the lack of a fundamental relation between CO_2 excretion and economic expansion in four of the target nations. According to Joshua and Alola (2020), the excessive use of fossil fuels threatens environmental quality, but the use of energy improves it.

Al-Rawashdeh, Jaradat, and Al-Shboul (2014) looked at how the EKC theory and two significant environmental contaminants, SO_2 and CO_2, relate to one another. On a national scale, they found that the pollutant SO_2-KEC affects Turkey, Jordan, Morocco, and Yemen, while CO_2 (U-shaped or inverted relationship) is also found in Turkey, Jordan, Tunisia, and Morocco; As a whole, they just found a monotonically linear and positive relation but no traces or evidence for excretions of both pollutants, SO_2 and CO_2 for the MENA region which includes Saudi Arabia. Farhani, Mrizak, Chaibi, and Rault (2014) also confirmed the use of the KEC hypothesis. Their study's findings demonstrate that the KEC hypothesis holds strength at the panel level but that it dissipates at the national level, indicating that Saudi Arabia's CO_2 emissions are positively impacted by income and have a negative-positive effect on energy consumption as well.

A number of researches are conducted to examine the impact of remittances on energy consumption for different countries with different specifications. But in this study, we check the sector-wise impact on energy. This study used fossil fuel as the dependent variable.

3. Data and Methodology

The research collected data from 1990 to 2019 (annually). The source of the data is WDI (World Development Indicators). After data collection, data is subjected to estimation, followed by analysis and an important conclusion.

Table 1
Description of Variables

Variables	Measurements	Source of Data
AGRI (Agricultural growth)	Annual % Growth	World Development Indicators (WDI)
IND (Industrial sector growth)	Annual % Growth	WDI
SER (Services sector growth)	Annual % GDP	WDI
REMIT (remittances)	Annual % Growth	WDI
EXP (Exports of goods)	Annual % Growth	WDI
Fossil fuel energy consumption		WDI

3.1 Model Specifications

An econometric model is constructed in which energy consumption (Fossil fuel) is the dependent variable. The first model may be expressed as follows in the econometric form:

$$EC = \alpha_0 + \alpha_1 AGRI + \alpha_2 IND + \alpha_3 SER + \alpha_4 REMIT + \alpha_5 EXP + \mu \qquad (1)$$

$\alpha_0 =$ intercept and α_1 to $\alpha_5 =$ co-efficient represent the change in fossil fuel due to the change in agriculture, industries, services, exports of goods, and personal remittances and μ indicates error term.

ARDL bounds testing model has been constructed among variables to find long-run relationships.

$$\Delta EC_t = \theta_0 + \theta_1 AGRI_{t-i} + \theta_2 IND_{t-i} + \theta_3 SER_{t-i} + \theta_4 REMIT_{t-i} + \theta_5 EXP_{t-i} + \sum_{i=1}^{q} \sigma_1 \Delta AGRI_{t-i} + \sum_{i=1}^{q} \sigma_2 \Delta IND_{t-i} + \sum_{i=1}^{q} \sigma_3 \Delta SER_{t-i} + \sum_{i=1}^{q} \sigma_4 \Delta REMIT_{t-i} + \sum_{i=1}^{q} \sigma_5 \Delta EXP_{t-i} + \mu_t \tag{2}$$

For the short-run ARDL calculations, the following ECM equation would require the form shown below (equation 2)

$$EC = \sigma_0 + \sum_{i=1}^{q} \sigma_1 \Delta AGRI_{t-i} + \sum_{i=1}^{q} \sigma_2 \Delta IND_{t-i} + \sum_{i=1}^{q} \sigma_3 \Delta SER_{t-i} + \sum_{i=1}^{q} \sigma_4 \Delta REMIT_{t-i} + \sum_{i=1}^{q} \sigma_5 \Delta EXP_{t-i} + \theta ECT_{t-i} + \mu_t \tag{3}$$

3.2   Methodological Framework

Firstly, it is vital to keep an eye on the variables' stationary levels for time series analysis. Mostly, time series data exhibits trends that imply non-stationary, due to which regression results could be spurious. At two different levels, the ADF (Augmented Dicky-Fuller) test was used to observe the stationary of the acquired data.

The co-integration has been examined using the ARDL bounds test. A conditional unconstrained ECM estimate is used as the foundation for the bounds test in a co-integration study using ordinary least squares (OLS) (Pesaran, Shin, & Smith, 2001). To utilize ARDL, the variable series must have a mixed order of integration (either I (0) or I (1)). The values of the F-statistics (provided by Pesaran, 2001) cannot be comprehended if variable(s) stationary at the second difference (i.e., with an order of integration I (2)) are present. ARDL's coefficients describe the connection in long-run equilibrium, while ECM exhibits equilibrium throughout the long-term and short-run dynamics.

4.   Conclusion and Results
4.1   Unit Root Results

According to ADF, whether the probability value is ≥ 5%, the void hypothesis accepts or rejects the alternative hypothesis, and in case of probability value is ≤ 5%, it is assumed that it rejects the alternative hypothesis. According to the results of the ADF stat, the variables have an integration order between zero and one.

Table 2
ADF Results

Variables	statistics of Level Test (Prob.)	statistics of First difference Test (Prob.)	Decision
Fossil Fuel	-2.1386 (0.2319)	-5.4818 (0.001)	I (1)
R.E.C	-2.2371 (0.1983)	-5.3986** (0.0001)	I (1)
Agri	-6.3248** (0.000)	-8.6191** (0.000)	I (0)
Export	-4.5360** (0.0012)	-6.4252** (0.0000)	I (0)
Ind	-4.6197** (0.001)	-7.3049** (0.000)	I (0)
P. W	-0.2444* (0.0210)	-4.9711** (0.004)	I (1)
Services	-1.3433 (0.5956)	-4.5635** (0.0012)	I (1)

*Variable stationary at 10%
**Variable stationary at 5%
***Variable stationary at 1%

4.2   Diagnostic Tests

This study used the Breusch-Godfrey Serial Correlation LM test, which is appropriate for this model, to evaluate the autocorrelation in the given model. The table shows the results of diagnostic tests which are employed in the model. The study's findings imply that there is not any autocorrelation in this investigation. Furthermore, the Breuch-Pagan-Godfry test's results detected no heteroskedasticity issue in this model.

Table 3
Results of Diagnostics Tests

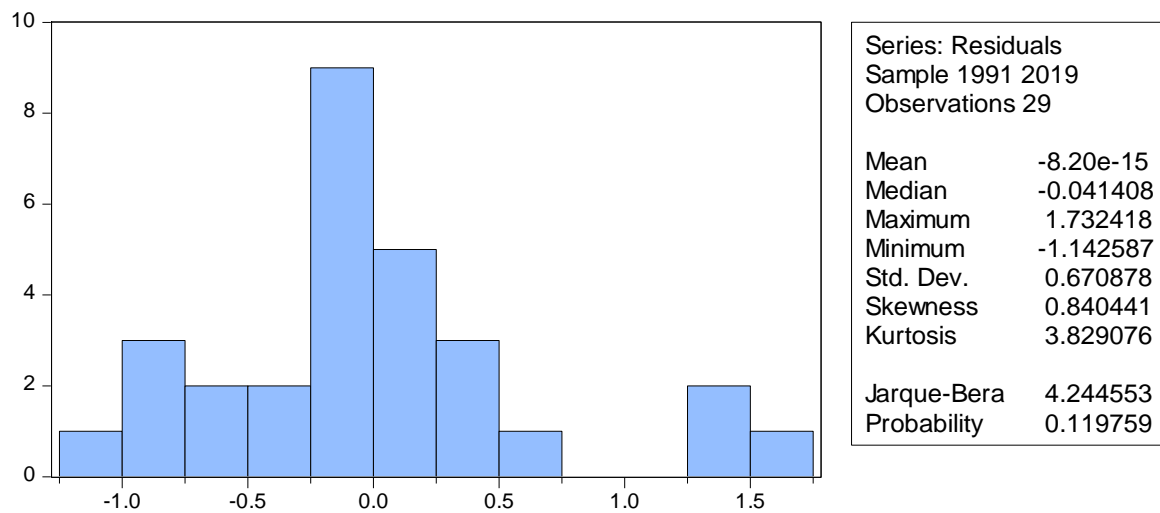| LM Test for Breusch-Godfrey Serial Correlation		
F-statistic	1.314877	Prob. F (2,19)
Obs*R-squared	3.525832	Prob. Chi-Square (2)
Heteroskedasticity Test: Breusch-Pagan-Godfrey		
F-statistic	0.423841	Prob. F (7,21)
Obs*R-squared	3.589940	Prob. Chi-Square (7)
Scaled explained SS	2.662836	Prob. Chi-Square (7)

Figure 2: Jarque-Bera Diagnostic Test Graphical Presentation

4.3   Estimation of Short-run Relationship

The table shows the relationship between short-run dynamics. The Error Correction Term (ECM) is important in terms of statistics. The ECM value is negative (-0.577427) and significant statistically (0.006). The value of ECM (-0.577427) showed that if the model is in disequilibrium, it will move towards equilibrium with a speed of adjustment of 57%. However, ECM's negative value demonstrates the presence of a long-run relationship.

Table 4
Short-run Forecasts

Dependent Variable: Fossil Fuel Energy Consumption		
Independent variables/Agents	**Coefficients**	**Prob.**
AGRI	0.143206**	0.040
IND	-0.393172**	0.038
SER	1.800199***	0.001
REMIT	-2.846156***	0.003
EXP	-0.041157**	0.058
Coint (-1)	-0.577427***	0.006

*Variable stationary at 10%
**Variable stationary at 5%
***Variable stationary at 1%

4.4 Estimation of Long-run Relationship

Table shows the connection between fossil fuel and sector of the economic Growth.

Table 5
Long-run Forecasts

Dependent variable: Fossil Fuel Energy Consumption		
Variables/Agents	**Coefficients**	**Prob.**
AGRI	0.371522***	0.007
IND	-0.281925***	0.002
SER	0.899821***	0.000
REMIT	-0.056635*	0.455
EXP	-0.015968**	0.025
C	14.250053***	0.000

*Variable stationary at 10%
**Variable stationary at 5%
***Variable stationary at 1%

The rise of agriculture and the use of fossil fuels is significantly and positively correlated. These findings depict that a 1% increase in agriculture growth causes fossil fuel to increase by 0.371522 in Pakistan. On the other hand, there is a strong inverse link between the use of fossil fuels and the expansion of the industry. A 1% increase in the industrial sector's growth causes fossil fuel to 0.281925 decreases in Pakistan. A 1% increase in the growth of the services sector causes fossil fuel to 0.899821 increases in Pakistan. This result shows the significant and positive relationship between fossil fuel and services sector growth. A 1% increase in exports of goods causes fossil fuel to 0.015968 decreases in Pakistan. Results show a significant but negative relationship between fossil fuels and exports of goods. A 1% increase in personal remittances causes fossil fuel to 0.056635 decreases in Pakistan. The result shows the negative and insignificant relationship between fossil fuel and personal remittances.

5. Conclusion

This paper aims to examine the effects of sectoral and economic expansion on energy consumption. This research empirically looked at how economic expansion affects energy use and other selected variables (fossil fuel, renewable energy consumption, agriculture, industry, services, personal remittances and exports of goods) in Pakistan using the ARDL bound testing procedure proposed by Pearson Shin & Smith (2001). The primary goals of this study were to determine the impact of Pakistan's economic growth on energy or fossil fuel consumption and on the basis of the finding, suggest recommendations to improve the economy. According to our knowledge as no study was done on sector-wise economic growth's impact on energy consumption (renewable and non-renewable) in Pakistan. In this regard, data had taken from the period 1990 to 2020. Economic growth has been measured by taking a number of agriculture, industry, and services, while energy consumption is measured by the usage of fossil fuels and alternative energy, and data for target indicators were derived from WDI (world development indicators).

5.1 Recommendations for Policy Making

The study recommends implementing policy suggestions based on its results:

- It is recommended that economic growth should be managed, which will directly improve energy consumption.
- Policy authorities must take developing causalities into consideration while designing policy actions. In this respect, the energy policies must be reformed according to the relationship between energy use and economic expansion and whether a specific direction is temporary or permanent, in other words, whether it changes with time passage.

Authors Contribution
Komal Urooj: study design and concept, introduction, methodology, conclusion
Muhammad Ali Zafar: literature search, data collection, analysis, results, and discussion

Conflict of Interests/Disclosures
The authors declared no potential conflicts of interest w.r.t the research, authorship and/or publication of this article.

References
Abbasi, K., Lv, K., Nadeem, M., Khan, A., & Shaheen, R. (2020). Agricultural and manufacturing sector determinants consumption, price, and real GDP from Pakistan of electricity. *North Am Acad Res, 3*, 21-44.

Ahmad, M., Işık, C., Jabeen, G., Ali, T., Ozturk, I., & Atchike, D. W. (2021). Heterogeneous links among urban concentration, non-renewable energy use intensity, economic development, and environmental emissions across regional development levels. *Science of The Total Environment, 765*, 144527.

Ahmad, T. I., Bashir, F., & Zafar, M. A. (2021). Gas-and Coal-based Power Generation to Spur Economic Growth in Pakistan? *iRASD Journal of Energy & Environment, 2*(1), 12-23. doi:https://doi.org/10.52131/jee.2021.0201.0012

Ahmed, V., & Zeshan, M. (2014). Decomposing change in energy consumption of the agricultural sector in Pakistan. *Agrarian South: Journal of Political Economy, 3*(3), 369-402. doi:https://doi.org/10.1177/2277976014560944

Al-Mulali, U., & Ozturk, I. (2015). The effect of energy consumption, urbanization, trade openness, industrial output, and the political stability on the environmental degradation in the MENA (Middle East and North African) region. *Energy, 84*, 382-389.

Al-Rawashdeh, R., Jaradat, A. Q., & Al-Shboul, M. (2014). Air pollution and economic growth in MENA countries: testing EKC hypothesis. *Environmental Research, Engineering and Management, 70*(4), 54-65.

Arouri, M. E. H., Youssef, A. B., M'henni, H., & Rault, C. (2012). Energy consumption, economic growth and CO2 emissions in Middle East and North African countries. *Energy policy, 45*, 342-349.

Asafu-Adjaye, J. (2000). The relationship between energy consumption, energy prices and economic growth: time series evidence from Asian developing countries. *Energy economics, 22*(6), 615-625.

Damette, O., & Seghir, M. (2013). Energy as a driver of growth in oil exporting countries? *Energy economics, 37*, 193-199. doi:https://doi.org/10.1016/j.eneco.2012.12.011

Dasgupta, S., Laplante, B., Wang, H., & Wheeler, D. (2002). Confronting the environmental Kuznets curve. *Journal of economic perspectives, 16*(1), 147-168.

Doğanlar, M., Mike, F., Kızılkaya, O., & Karlılar, S. (2021). Testing the long-run effects of economic growth, financial development and energy consumption on CO2 emissions in Turkey: new evidence from RALS cointegration test. *Environmental Science and Pollution Research, 28*(25), 32554-32563.

Farhani, S., Mrizak, S., Chaibi, A., & Rault, C. (2014). The environmental Kuznets curve and sustainability: A panel data analysis. *Energy policy, 71*, 189-198.

Fodha, M., & Zaghdoud, O. (2010). Economic growth and pollutant emissions in Tunisia: an empirical analysis of the environmental Kuznets curve. *Energy policy, 38*(2), 1150-1156.

Government of Pakistan. (2014). Pakistan Vision 2025: One Nation-One Vision, Planning Commission; Ministry of Planning, Development & Reform Islamabad

In: Planning Commission; Ministry of Planning, Development & Reform Islamabad.

Gyamfi, B. A., Bein, M. A., Udemba, E. N., & Bekun, F. V. (2021). Investigating the pollution haven hypothesis in oil and non-oil sub-Saharan Africa countries: evidence from quantile regression technique. *Resources Policy, 73*, 102119.

Hirsh, R. F., & Koomey, J. G. (2015). Electricity consumption and economic growth: a new relationship with significant consequences? *The Electricity Journal, 28*(9), 72-84. doi:https://doi.org/10.1016/j.tej.2015.10.002

Hondroyiannis, G. (2004). Estimating residential demand for electricity in Greece. *Energy economics, 26*(3), 319-334. doi:https://doi.org/10.1016/j.eneco.2004.04.001

Jamil, F., & Ahmad, E. (2010). The relationship between electricity consumption, electricity prices and GDP in Pakistan. *Energy policy, 38*(10), 6016-6025.

Joshua, U., & Alola, A. A. (2020). Accounting for environmental sustainability from coal-led growth in South Africa: the role of employment and FDI. *Environmental Science and Pollution Research, 27*(15), 17706-17716.

Khan, M., & Ozturk, I. (2021). Examining the direct and indirect effects of financial development on CO2 emissions for 88 developing countries. *Journal of environmental management, 293*, 112812.

Khan, M. K., Khan, M. I., & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. *Financial Innovation, 6*(1), 1-13.

Khan, Z. A., Koondhar, M. A., Khan, I., Ali, U., & Tianjun, L. (2021). Dynamic linkage between industrialization, energy consumption, carbon emission, and agricultural products export of Pakistan: an ARDL approach. *Environmental Science and Pollution Research, 28*(32), 43698-43710.

Komal, R., & Abbas, F. (2015). Linking financial development, economic growth and energy consumption in Pakistan. *Renewable and sustainable energy reviews, 44*, 211-220.

Kourtzidis, S. A., Tzeremes, P., & Tzeremes, N. G. (2018). Re-evaluating the energy consumption-economic growth nexus for the United States: An asymmetric threshold cointegration analysis. *Energy, 148*, 537-545.

Lin, B., & Liu, C. (2016). Why is electricity consumption inconsistent with economic growth in China? *Energy policy, 88*, 310-316. doi:https://doi.org/10.1016/j.enpol.2015.10.031

Liu, D., Ruan, L., Liu, J., Huan, H., Zhang, G., Feng, Y., & Li, Y. (2018). Electricity consumption and economic growth nexus in Beijing: A causal analysis of quarterly sectoral data. *Renewable and sustainable energy reviews, 82*, 2498-2503.

Mehrara, M. (2007). Energy consumption and economic growth: the case of oil exporting countries. *Energy policy, 35*(5), 2939-2945. doi:https://doi.org/10.1016/j.enpol.2006.10.018

Narayan, P. K., & Smyth, R. (2009). Multivariate Granger causality between electricity consumption, exports and GDP: evidence from a panel of Middle Eastern countries. *Energy policy, 37*(1), 229-236. doi:https://doi.org/10.1016/j.enpol.2008.08.020

Nasreen, S., & Anwar, S. (2014). Causal relationship between trade openness, economic growth and energy consumption: A panel data analysis of Asian countries. *Energy policy, 69*, 82-91.

Nathaniel, S. P., Yalçiner, K., & Bekun, F. V. (2021). Assessing the environmental sustainability corridor: Linking natural resources, renewable energy, human capital, and ecological footprint in BRICS. *Resources Policy, 70*, 101924.

Nazia, T., & Normaz, W. I. (2019). Transportation infrastructure of Pakistan's agricultural export. *Journal of Development and Agricultural Economics, 11*(4), 92-101. doi:https://doi.org/10.5897/JDAE2019.1053

Osman, M., Gachino, G., & Hoque, A. (2016). Electricity consumption and economic growth in the GCC countries: Panel data analysis. *Energy policy, 98*, 318-327. doi:https://doi.org/10.1016/j.enpol.2016.07.050

Ozcan, B. (2013). The nexus between carbon emissions, energy consumption and economic growth in Middle East countries: a panel data analysis. *Energy policy, 62*, 1138-1147.

Ozturk, I., Aslan, A., & Kalyoncu, H. (2010). Energy consumption and economic growth relationship: Evidence from panel data for low and middle income countries. *Energy policy, 38*(8), 4422-4428. doi:https://doi.org/10.1016/j.enpol.2010.03.071

Rafindadi, A. A. (2016). Does the need for economic growth influence energy consumption and CO2 emissions in Nigeria? Evidence from the innovation accounting test. *Renewable and sustainable energy reviews, 62*, 1209-1225.

Rahman, M. M., Nepal, R., & Alam, K. (2021). Impacts of human capital, exports, economic growth and energy consumption on CO2 emissions of a cross-sectionally dependent

panel: Evidence from the newly industrialized countries (NICs). *Environmental Science & Policy, 121*, 24-36. doi:https://doi.org/10.1016/j.envsci.2021.03.017

Rehman, A., Ma, H., Irfan, M., & Ahmad, M. (2020). Does carbon dioxide, methane, nitrous oxide, and GHG emissions influence the agriculture? Evidence from China. *Environmental Science and Pollution Research, 27*(23), 28768-28779.

Sarkodie, S. A., Ackom, E., Bekun, F. V., & Owusu, P. A. (2020). Energy–climate–economy–population nexus: an empirical analysis in Kenya, Senegal, and Eswatini. *Sustainability, 12*(15), 6202.

Satti, S. L., Hassan, M. S., Mahmood, H., & Shahbaz, M. (2014). Coal consumption: An alternate energy resource to fuel economic growth in Pakistan. *Economic Modelling, 36*, 282-287. doi:https://doi.org/10.1016/j.econmod.2013.09.046

SDPI. (2014). *Pakistan Energy Vision 2035, Sustainable Development Policy Institute (SDPI), Islamabad, Pakistan. https://sdpi.org/sdpiweb/publications/files/Pakistan%20Energy%202035-FINAL%2020th%20October%202014.pdf*. Retrieved from

Sentürk, C., & Sataf, C. (2015). The determination of panel causality analysis on the relationship between economic growth and primary energy resources consumption of Turkey and Central Asian Turkish Republics. *Procedia-Social and Behavioral Sciences, 195*, 393-402. doi:https://doi.org/10.1016/j.sbspro.2015.06.342

Shahateet, M. I. (2014). Modeling economic growth and energy consumption in Arab countries: Cointegration and causality analysis. *International Journal of Energy Economics and Policy, 4*(3), 349-359.

Shahbaz, M., & Dube, S. (2012). Revisiting the relationship between coal consumption and economic growth: cointegration and causality analysis in Pakistan. *Applied Econometrics and International Development, 12*(1), 1-13.

Shahbaz, M., & Feridun, M. (2012). Electricity consumption and economic growth empirical evidence from Pakistan. *Quality & Quantity, 46*(5), 1583-1599.

Soytas, U., & Sari, R. (2003). Energy consumption and GDP: causality relationship in G-7 countries and emerging markets. *Energy economics, 25*(1), 33-37. doi:https://doi.org/10.1016/S0140-9883(02)00009-9

Stern, D. I., Burke, P. J., & Bruns, S. B. (2019). The impact of electricity on economic development: a macroeconomic perspective.

Tang, C. F., & Shahbaz, M. (2013). Sectoral analysis of the causal relationship between electricity consumption and real output in Pakistan. *Energy policy, 60*, 885-891. doi:https://doi.org/10.1016/j.enpol.2013.05.077

Wang, J., Zhang, S., & Zhang, Q. (2021). The relationship of renewable energy consumption to financial development and economic growth in China. *Renewable Energy, 170*, 897-904. doi:https://doi.org/10.1016/j.renene.2021.02.038

Zhang, X.-H., Hu, H., Han, J., Deng, S.-H., Xiao, H., Peng, H., . . . Wu, J. (2012). Several novel indicators being applied to analyze the relationships between Chinese economic growth, energy consumption and its impact of emissions. *Ecological indicators, 15*(1), 52-62. doi:https://doi.org/10.1016/j.ecolind.2011.09.026