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THE NEXUS BETWEEN RENEWABLE ENERGY, URBANIZATION, INDUSTRIALIZATION AND ECONOMIC GROWTH IN PAKISTAN

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Abstract

This study has investigated the relationship between renewable energy, urbanization, industrialization and economic growth, in Pakistan, through the years 1990-2016. All the three explanatory variables play a pivotal role in their contribution to the economic growth in any economy, specially a developing one such as Pakistan. Auto Regressive Distributive Lag (ARDL) Model has been used to determine the Cointegration and relationship between the variables. The empirical results indicate that there exists a positive and significant relationship between all the three variables and economic growth and that there is a stable, long run relationship among them. Policy suggestions that incorporate the results include having a larger share of renewable energy in the energy sector, using urbanization as a means to remove the big city trend and move towards, smaller sustainable cities etc.

1. Introduction

The economic growth in Pakistan is and has been driven by several forces over all these years varying in degree of importance constantly. Urbanization and Industrialization are old school ways of increasing economic activity in any economy (Sadorsky, 2013) but Pakistan itself has been heavily dependent on both these independent variable looking for avenues that might postively skew its Economic Growth.). Most of the literature about the energy-growth nexus has come from old school energy sources such as coal, oil or natural gas- all of which are highly detrimental for the environment & the use of these resources is on the decline (Dogan, 2016). Transition towards renewable energy is coming out to be a solution to the issue of energy crisis and energy security globally. The World Energy Outlook, 2017, states that by mid 2020s renewables will be in even more demand given that the rise in efficiency policies will eventually lead to restricted fosil and natural gas use. The research reiterated that renewables will be the major players in creating low-carbon transition from the high carbon emitting sources such as fossil use and synchronizing the policy implementations and market system- more so in residential areas, given this source will be more pocket friendly. It has also been stated that by the 2040, Renewables will be fasting growing energy sector, showing that the markets are also supporting this transition (Pickl, 2019).

Pakistan has been facing a severe energy crisis, mainly due to its burgeoning population which has resulted in an increase in demand of energy whereas the supply is not growing that quickly. The country presently is facing an acute energy crisis, probably the worst that it has ever seen in a long time. The people, specially that live in less urbanized areas, face long term electricity cuts in the summers, where each year the heat levels are on the rise too (Aized *et al.*, 2017).

The three variables selected for the study are highly linked to the SDGs and are relevant in the global dynamics where there is an upward slope in cohabitation of land even in regions of the world that seemed out of reach until a few years ago. A number of SDGs encompass these variables and their sustainability is of crucial importance to the economists and environmentalists that are concerned about the exponentially increasing population and rise in the Global Climate. The increase in urbanization and industrialization is rampant in developing nations who ironically even in today's day and time highly rely on fossil fuels and old school energy production techniques. Reneweable energy has successfully been able to reduce emissions even in economies that face income inequality. Developing nations like Pakistan are high on the scales where income inequality is prevalent and that seems to exist in full momentum (McGee & Greiner , 2019**).** For instance, Goal 9 i.e. Industry, Infrastructure and Innovation where they re-emphasize that less developed countries would need more contribution to the GDP from the Industrial front and will have to build adequate infrastructure,

required for a steadier process of development. This goal further has sub targets which aim to work towards the enhancement of the Industrial Sector, adequate infrastructure and progress in the innovation required to increase the technical efficiency- globally. Similarly, Goal 11 caters to the trend and process of Urbanization, i.e. Sustainable Cities and Communities. This goal basically talks about how cities and communities are centers for economic activity, cultural exchange and safekeeping of heritage, and contribute significantly in the social development of any society and thus there is a dire need to maintain and create cities in a way that they promote and create job opportunities and don not bound the already scarce land and resources. This can be specifically observed when it comes to Pakistan, whose large cities are over populated to such an extent that instead of creating positive externalities, they are creating negative ones. The SDGs also show a very extended effort towards Cleaner energy resources or Renewable Energy resources, which they cover under Goal 7 i.e. Affordable and Clean Energy. The need for this goal was not just to provide access to energy but to make sure that it is clean energy. Under Goal 13 i.e. Climate Action we see that the environmental damage by humans is at a tipping point and if measures are not taken to curb the damage, the world will await its doom.

Thus, this reinforces the significance and role of renewable energy in the developing world and recapitulates the importance this area of research holds for future policy designing and implementation. This trend is more so prevelant than in Pakistan with the developed countries shifting their policy measures and market trends and moving from oil majors to renewable; making it one of the most critical change in strategic direction for furher research areas and future generations. (Pickl, 2019)

2. Data and Methodology

In this research, ARDL approach and time series data has been used. The impact of Renewable Energy (Combustible Renewables and Energy), Industrialization (Industry Value Added), and Urbanization (Urban Population) is being measured on Economic Growth (GDP Growth). The data for Industrialization (Industry Value Added) and Renewable Energy (Combustible Renewables and Waste) has been extracted from the World Bank Development Indicators. The data for Urbanization (Urban Population) has been collected from various issues of Economics Survey of Pakistan. The time horizon being analysed is from 1990 to 2016.

$GDP_t = \beta0 + \beta1RE_t + \beta2UR_t + \beta3I_t + ut$

(Here,

- GDP is GDP growth (annual %)
- RE is Renewable Energy (Combustible Renewables and Waste)
- UR is Urbanization (Urban Population, millions)
- I is the Industry Value Added Added (% of GDP)
- u is the error term)

Augmented Dickey Fuller test has been applied to check for the stationarity of the variables. The

Equation used in ADF, Random Walk Model (TYPE 1) is represented as:

$\Delta Y_t = \gamma Y_{t-1} + \sum \beta_i \Delta Y_{t-1} + \mu_t$

The other model is the Random Walk Model with drift (TYPE 2). The equation for that is as follows:

$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \sum \beta_i \Delta Y_{t-1} + \mu_t$

The third model for ADF is Random Walk Model with drift and trend (TYPE 3). The equation for that is as follows:

$\Delta Y_t = \alpha_0 + \gamma Y_{t-1} + \alpha_{2t} + \sum \beta_i \Delta Y_{t-1} + \mu_t$

ARDL has been applied on the variables where first, the bound test is used to test for the presence of Long Run Relationship among the variables. According to the test, null hypothesis which implies no co-integration is H0: $\beta5=\beta6=\beta7=\beta8 =0$ against the alternative hypothesis H1: $\beta5\neq\beta6\neq\beta7\neq\beta8\neq0$. If the computed value of our F-Statistics falls below the lower bound critical value, the null hypothesis of no-cointegration cannot be rejected. On the contrary, if the computed F-statistic lies above the upper bound critical value, the null hypothesis is rejected, implying that there is a long-run relationship amongst the variables in the model. In case the calculated F-statistics falls within the bounds then then there is indecision about cointegration.

Secondly, the equation is estimated using ARDL under the Schwartz Criterion or AIC which generates R^2, adjusted R^2 and F statistics. This helps us select the optimal number of lags. The general equation for ARDL is as follows:

$\Delta GDP_t = \alpha + \sum_{i=0}^{m} \beta1i \Delta GDP_{t-1} + \sum_{i=0}^{m} \beta2i \Delta RE_{t-1} + \sum_{i=0}^{m} \beta3i \Delta I_{t-1} + \sum_{i=0}^{m} \beta4i \Delta UR_{t-1} + \beta_5 GDP_{t-1} + \beta_6 RE_{t-1} + \beta_7 I_{t-1} + \beta_8 UR_{t-1} + \mu_t$

The last and final step is to obtain the short-run dynamics by estimating the Error Correction Model associated with the long run estimates. This may be specified as follows:

$\Delta GDP_t = \beta_0 + \sum_{i=0}^{p} \delta1i \Delta GDP_{t-1} + \sum_{i=0}^{q} \delta2i \Delta RE_{t-1} + \sum_{i=0}^{r} \beta\delta3i \Delta I_{t-1} + \sum_{i=0}^{s} \delta4i \Delta UR_{2t-1} + \Lambda ECM_{t-1} + \mu_t$

The ECM gives us the adjustment factors which represent how long will it take for the economy to revert back to its equilibrium position if hit by an external shock. Finally, for furthers testation and checking the accuracy of the models, serial correlation LM test, Breusch Pagan heteroskedasticity test and CUSUM Stability Tests have been conducted.

Empirical findings

Table 1

Stationarity Check via ADF

Variable	**Test for Unit Root**	**Statistical Value**	**Critical Value**	**Probability**	**ADF Model Type**	**Result**
GDP Growth	1st Difference	-4.569	-3.600	0.0012	3	I (1)
Renewable Energy	1st Difference	-2.142	-1.950	-	1	I (1)

Industrialization	1st Difference	-5.808	-3.600	0.0000	3	I (1)
Urbanization	1st Difference	-4.863	-3.600	0.0004	3	I (1)

Table 1 shows the results of checking the stationarity by using Augmented Dickey Fuller Test
(ADF). In this test we conclude the variable to be stationary if the statistical value is less than the critical value, we reject H_0, concluding that the variable is stationary. The hypothesis is as follows:

H_0: There is unit root (Variable is not Stationary)

H_1: There is no unit root (Variable is Stationary)

The above variables are thus all stationary at their 1st difference, as their statistical values are less than their critical values, as shown in Table 1. The table also shows that at which model is the variable stationary, from the three types mentioned in the methodology.

Table 2

Results of ARDL Bounds Testing

Calculated Value	Lower Bound at 5%	Upper Bound at 5%
34.796	3.23	4.35

Table 2 shows us the results for our Bounds test, where If the value of calculated F Statistic is greater than the upper bound we reject H_0. If the value calculated is below the lower beyond, we accept H_0. If the value lies between the bounds we are indecisive about the existence of cointegration in the model.

H_0: There is no cointegration in the model

H_1: There is cointegration in the model

Since, the F stat lies above the upper and lower bound, we can conclude that there is cointegration in the estimated model.

Table 3

Error Correction Model

Variable Name	Calculated Value
ΛECM_{t-1}	-1.8382

The ECM Adjustment factor is -1.8382. This means that if the economy is hit by an external shock, GDP Growth will revert back to its equilibrium position by 1.83 units/year.

Table 4

Results of Long Run Coefficients

Variable	Coefficient	Probability
Industrialization	1.896822	0.000
Urbanization	0.2884385	0.000
Renewable Energy	0.3618766	0.014

The long run coefficients for all the three variables are positive and significant (at significance level of 5 %). In order to test for our variables, we further run the Breusch Pagan Test to check for heteroskedasticity in our model.

Table 5

Results of Breusch-Pagan Test

F statistic	**Probability**
0.23	0.6347

Table 5 shows that our p value is greater than alpha, which means that there is no heteroskedasticity in the model.

Table 6

Results of LM test

F statistic	**Probability**
0.056	0.8122

LM test has been used to check for auto correlation. Table 6 shows that our p value is less than our calculated probability value, which means that there is no problem of auto correlation in the model.

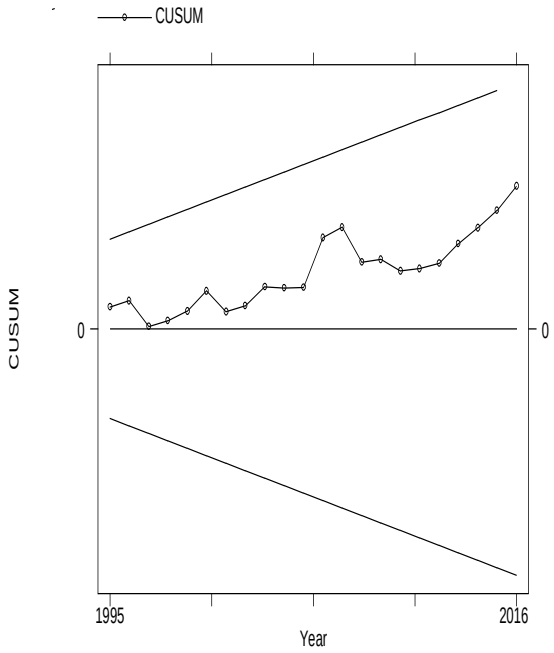

Figure 1: Stability Test: CUSUM Test

Since our CUSUM line lies between our two boundaries, it indicates that our model is dynamically stable i.e. it is stable to external shocks.

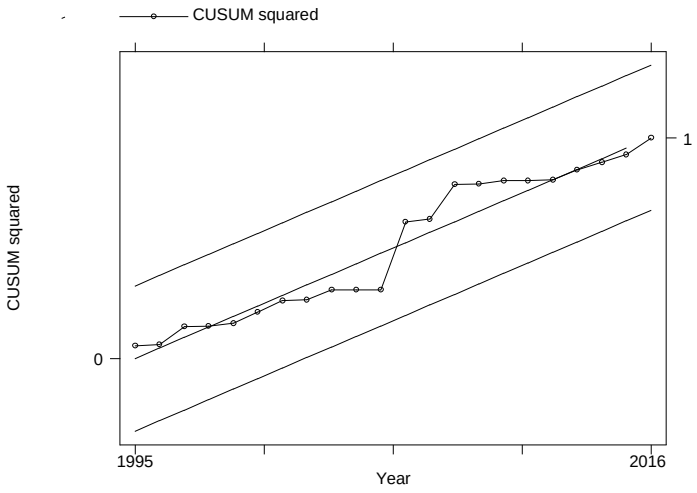

Figure 2:CUSUM Squares Test

Since the CUSUM squared line lies in between our boundaries, it indicates that our model is dynamically stable i.e. it is stable to external shocks.

3. Discussion

The paper's econometric analysis via ARDL Bounds Testing Approach indicates that there is a positive and significant relationship among urbanization, industrialization, renewable energy and economic growth and there also exists a stable, long run relationship between them, for the years, 1990-2016.

The studies conducted mostly have used non-renewable energy consumption or general energy consumption in models that have incorporated urbanization, industrialization and economic

growth simultaneously in them; also, hardly anyone of them discuss the case of Pakistan, under time series, specifically. Panel studies have incorporated Pakistan where appropriate, but studies, dedicated to Pakistan, under this light, where all these variables have been studied together, have not surfaced yet.

Energy Security has become a pressing issue for the world today and there is a need to shift or transition towards cleaner energy resources, to build a more sustainable world for the future generations. Markets and policy makers, economists and environmentalists, holistically, need proof as to how and why the transition and strategic decision to make the shift is necessary in the first place and this research provides the positively supported argument in clear light. \ The results calculated show that there is a positive relationship between renewable energy and economic growth. These results correspond with the study of Shahbaz *et al.*, (2015) who inspected the relationship between renewable energy and economic growth in Pakistan, by incorporating labor and capital as control variables. His study confirms a bidirectional relationship between economic growth and renewable energy. The most basic reason being that as a developing country Pakistan heavily depends on its energy sources; since modernization, development and most crucially production can't take place without an unhindered supply of energy. In the light of the energy crisis that the country has been facing it is bound to shift its reliance on other sources of energy other than non-renewable, depletable resources such as coal and oil; also known as fossil fuels. Pakistan doing this won't be a new trend as globally oil majors themselves are considering shifting to cost efficient and eco-friendly production, all of which majorly revolve around, Renewable Energy (Pickl, 2019). Shahbaz *et al.*, (2015) argues that renewable energy sources, such as solar energy, cater to Pakistanis in the downtrodden areas of provinces such as Balochistan and that too at cheaper rates as compared to the energy consumed from non-renewable energy sources. And hence contribute positively to economic growth.

Just like energy and its supply, industrialization is also highly crucial for Pakistan and its economy; rather, it always has been. Industrialization has played a key role in bringing Pakistan to the economic forefront that it is at, currently and has helped build the foundation of the economy. From the early years, of no industrial base at the time of independence, Pakistan has managed to come a long road. The results of the study show a positive relationship among industrialization and economic growth, which correspond with the results of Szirmai & Verspagen, (2015). The paper investigates the relationship between manufacturing and economic growth, for a panel of 88 countries (67 developing and 21 advanced economies) for the years 1950-2005 and confirms that there is a positive impact of manufacturing on the economic growth. Industrialization and manufacturing were the only factors that could

drive the economic growth engine in the earlier literatures, as is argued by Szirmai & Verspagen, (2015), but over the years, the services sector has taken over that role; especially for the advanced economies and the developing countries are catching up pretty quickly, on this trend.

Similar is the case in Pakistan, where almost two thirds of the GDP share, is a contribution of the services sector. But this does not, in any way, cut down the importance of industrialization for the economic growth of the country. Pakistan has been trying to shift its resources from its typical agricultural and manufacturing sectors, to the services sector, which might result in a structural change burden, as discussed by Baumol, (1967). And as per Baumol's law, the increase in the share of services towards GDP will result in a fall of the aggregate per capita growth. This claim has been counter attacked in recent literature but has nonetheless been a part of the engine or driver of growth argument. This emphasizes the importance of industrialization to economies, specially developing ones, like Pakistan itself. Also, manufacturing sector is what has a greater potential for the development of economies of scale as compared to other sectors- such as agriculture and services. The industrial sectors are what lead the growth in technological advances in an economy and from there it seeps into other sectors. Additionally, manufacturing is also of heavy importance for economic growth because it creates very strong forward and backward linkages and thus has a greater spillover effect for the economy, in the form of positive externalities which help boost the economy; and this has indeed happened for Pakistan, as indicated by the results of the study.

The last explanatory variable that was used in the study was urbanization, which is again, one of the key drivers of economic growth; specially in developing countries. The results of the study indicate that there is a positive relationship between urbanization and economic growth and this is in sync with the results of the study by Bai, Chen & Shi, (2012); which studies the relationship between urbanization and economic growth for China. Since urbanization is a multi-faceted concept, there cannot be a linear description of the relationship between urbanization and economic growth. Turok & Mcgranahan, (2013) suggest that the degree of positive impact that urbanization would cause to the economic growth heavily depends on the structure, fairness and setting of the infrastructure and institutional settings of the concerned nation. In Pakistan, over the last few years, infrastructural development has been on the rise which confirms why urbanization has showed a positive relationship with economic growth. But with brapid urbanization and urbani agglomeration, the risk of rising temperatures and disturbance in the natural ecosystem of the area tend to be disturbed highly as supported by (Yu, *et al.,* 2019*)* which is why this research has focused on the aspect of renewable energy so heavily.

Urbanization causes free mobility of labor which enhances the productivity and the wages that

workers receive. This improvement in the living standards and a greater availability of facilities like education, health care centers etc. is also what causes the people to become more productive; thus, contributing positively to the economic growth. Theories in development economics often eye urbanization as a very important driver of economic development and growth for economies and the study lines in sync this stance with its results.

4. Conclusion and Policy Recommendations

All the three variables that have been used have had massive literature that shows how they contribute positively towards economic growth. Renewable energy is considerably a newer variable, especially for developing economies, to study with economic growth; but over the recent years a great amount of literature has emerged in this area; with the trend of renewable energy resources being on a rise. As for Industrialization and Urbanization, old literature and theories from development economics, have confirmed a positive relationship among them and economic growth; though their impact differs on several internal and external factors; but for the case of Pakistan the above reasons explain why they both tend to positively contribute to the economic growth. The following are the policy recommendations, which further open more avenues for research that can be conducted in the given areas that have been touched upon.

- A centralized, all supreme, energy policy with a compulsory, extra focus on Renewable Energy Resources apart from hydel sources such as biomass, wind and solar energy should be enforced by the federation.
- The importation of technology and expertise for working with Renewable Energy and developing its set up, under the Free Trade Agreement with China, needs to be facilitated in the country.
- There should be planned urban development schemes made under a central authority instead of separate provincial authorities- such as the ones taken up by developed nations.
- More attention should be paid on creating smaller, sustainable cities rather than expanding the old ones.
- There should be establishment of more Special Economic Zones in the downtrodden regions of Balochistan & KPK.
- A federal and centralized action plan needs to be prepared for the further work that is to be done on the SDGs rather than separate provincial action plans.

References

(2013). *Pakistan Millennium Development Goals Report 2013.* Ministry of Planning, Development and Reform. United Nation Development Program, Pakistan.

(2018). *Special Section 1: CPEC and Potential Opportunities for Industrial*

Transformation in Pakistan. State Bank of Pakistan.

Afonso, T. L., Marques, A. C., & Fuinhas, J. A. (2017). Strategies to make renewable energy sources compatible with economic growth. *Energy Strategy Reviews*(18), 121-126.

Aized, T., Shahid, M., Bhatti, A. A., Saleem, M., & Anandarajah, G. (2017). Energy security and renewable energy policy analysis of Pakistan. *Renewable and Sustainable Energy Reviews*.

Apergis, N. (2014). Renewable Energy and Economic Growth: Evidence from the Sign of Panel Long-Run Causality. *International Journal of Energy Economics and Policy, 4*(4), 578-587.

Bai, X., Chen, J., & Shi, P. (2012). Landscape Urbanization and Economic Growth in China: Positive Feedbacks and Sustainability Dilemmas. *Environmental Science & Technology*(46), 133-139.

Baumol, W. J. (1967). Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis. *The American Economic Review, 57*, 415-426.

Bhattacharya, M., Paramati, S. R., Ozturk, I., & Bhattacharya, S. (2016). The effect of renewable energy consumption on economic growth: Evidence from top 38 countries. *Applied Energy 162*, 733-741.

Cherni, A., & Jouini, S. E. (2017). An ARDL approach to the CO2 emissions, renewable energy and growth nexus: Tunisian evidence. *Internation Journal of Hydrogen Energy*.

Dogan, E. (2016). Analyzing the linkage between renewable and non-renewable energy consumption and economic growth by considering structural break in time-series data. *Renewable Energy*(99), 1126-1136.

Ghosh, S., & Kanjilal, K. (2014). Long-term equilibrium relationship between urbanization, energy consumption and economic activity: Empirical evidence from India. *Energy*(66), 324-331.

IEA. (2018). *Power Capacity Additions by Fuel.*

Jiang, Z., & Lin, B. (2012). China's energy demand and its characteristics in the industrialization and urbanization process. *Energy Policy*(49), 608-615.

Khalil, H. B., & Zaidi, S. J. (2014). Energy crisis and potential of solar energy in Pakistan. *Renewable and Sustainable Energy Reviews*(31), 194-201.

Kocak, E., & Sarkgunesi, A. (2017). The renewable energy and economic growth nexus in black sea and Balkan Countries. *Energy Policy*(100), 51-57.

Liu, Y. (2009). Exploring the relationship between urbanization and energy consumption in China using ARDL (autoregressive distributed lag) and FDM (factor decomposition model). *Energy*(34), 1846-1854.

McGee, J. A., & Greiner , P. T. (2019, October). Renewable energy injustice: The socio-

environmental implications of renewable energy consumption. *Energy Research & Social Sciences, 56*.

Nations, U. (2018). *Sustainable Development Goals*.

Pesaran, M. H. (1999). An Autoregressive Distributed-Lag Modelling Approach to Cointegration Analysis. *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, 371-413.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326.

Pickl, M. J. (2019). The renewable energy strategies of oil majors. *Energy Strategy Reviews, 26*.

Pkistan, S. B. (2018). *Special Section 1: CPEC and Potential Opportunities for Industrial Transformation in Pakistan.*

Sadorsky, P. (2009). Renewable energy consumption and income in emerging economies. *Energy Policy*(37), 4021-4028.

Sadorsky, P. (2013). Do urbanization and industrialization affect energy intensity in developing countries? *Energy Economics, 37*, 52-59.

Shahbaz, M., & Lean, H. H. (2012). Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia. *Energy Policy, 40*, 473-479.

Shahbaz, M., Loganathan, N., Zeshan, M., & Zaman, K. (2015). Does renewable energy consumption add in economic growth? An application ofauto-regressive distributed lag model in Pakistan. *Renewable and Sustainable Energy Reviews, 44*, 576-585.

Shahbaz, M., Sbia, R., Hamdi, H., & Ozturk, I. (2014). Economic growth, electricity consumption, urbanization andenvironmental degradation relationship in United Arab Emirates. *Ecological Indicators, 45*, 622-631.

Szirmai, A. (2012). Industrialisation as an engine of growth in developing countries, 1950–2005. *Structural Change and Economic Dynamics, 23*, 406-420.

Szirmai, A., & Verspagen, B. (2015). Manufacturing and economic growth in developingcountries, 1950–2005. *Structural Change and Economic Dynamics, 34*, 46-59.

Turok, I., & Mcgranahan, G. (2013). Urbanization and economic growth:the arguments and evidence for Africa and Asia. *Environment & Urbanization, 25*(2), 465-482.

United Nations. (2018). *Sustainable Development Goals.*

Wang, Z., Danish, Zang, B., & Wang, B. (2018). Renewable energy consumption, economic growth and human development index in Pakistan: Evidence

form simultaneous equation model. *Journal of Cleaner Production*.

World Energy Outlook. (n.d.). *Power Capacity Additions by Fuel from 2017 to 2040.* International Energy Agency.

Yu, Z., Yao, Y., Yang, G., Wang, X., & Vejre, H. (2019). Strong contribution of rapid urbanization and urban agglomeration development to regional thermal environment dynamics and evolution. *Forest Ecology and Management*(446), 214-225.

Zaidi, S. A. (2015). In *Issues in Pakistan's Economy* (pp. 1-12). Oxford University Press.