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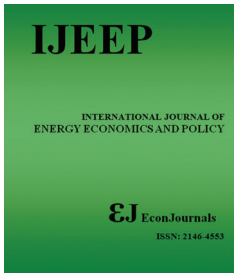

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Exploring the Impact of Economic Structure on Carbon Emissions: A Case Study of Pakistan

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ABSTRACT

Climate change has marked its effects on Pakistan in form of different problems like floods, droughts, change in crop patterns, heat waves, changes in weather conditions and health issues. One of the reason of climate change is environmental degradation that's why several studies are conducted in case of Pakistan to examine the factors of environmental degradation. This study also explores the factors of environmental degradation for Pakistan and is unique study as so for none of the empirical studies conducted in context of Pakistan analyzed the effect of economic structure on environmental degradation. So, the prime objective of this study is to explore the impact of economic structure on environmental degradation for the period of 1972-2017. The economic structure for Pakistan's economy is being captured through agriculture, industrial and service sector over the years. As energy and trade openness grab attention from researchers in examining factors of environmental degradation thus; energy consumption and trade openness are introduced in the study model as control variables. Once order of integration of time series data is determined, long run relationship is found through bound testing approach. Agricultural and service sector are found to have negative impact on environmental degradation but; service sector has insignificant effect on environmental degradation. The industrial sector is aggravating environmental degradation in long run but; is abstaining environmental degradation in short run. Hence; the different effect of industrial sector on environmental degradation in long run and short run is providing the opportunity for policy makers to come up with different policy measure for long run and short run. Energy is found to have positive and significant effect on environmental degradation in both time spans whereas trade openness has negative and significant effect on environmental degradation in long run. Policy implications are suggested on basis of findings of this study for Pakistan.

Keywords: Economic Structure, Energy, Trade Openness, Environmental Degradation, Time Series Analysis
JEL Classifications: C22, E01, F18, Q15, Q56

1. INTRODUCTION

Environmental degradation is causing global warming and consequently leading to climate change. These environmental issues are posing severe threats to human health and ecosystem. Therefore, researchers identified and examined different determinants of environmental degradation and focused on how to mitigate environmental degradation and its effects (Can and Gozgor, 2017; Wang and Zhang, 2021; Khalid, 2022). Although, various determinants of environmental degradation are examined but economic development which goes through various phases and processes may also be responsible for environmental degradation as it changes over time and its effect on environment may differ in different phases (Jaunky, 2011; Esteve and Tamarit, 2012; Al Mamun et al. 2014; Tutulmaz, 2015). In a nutshell, the development process of a country can be referring to its economic structure that can be capture through the share of agriculture, industrial and services value-added in the economy (Janicke et al., 1989; Raitzer et al., 2015). Emerging countries are considered to be major contributor to carbon emissions due to shift in the economy's economic structure from agricultural to industry and emerging countries such as China, India, Russia, Brazil,

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Indonesia, Mexico, South Africa, and Turkey generate the majority of carbon emissions. As a result, environmental deterioration is one of the most pressing concerns for policymakers in emerging countries. Many studies on carbon emissions and environmental deterioration have been conducted for this goal (Solarin and Al-Mulali, 2018; Ulucak and Lin, 2017). Now we are in a situation where neither economic development nor environmental quality can be compromised. on the other hand, economic development can be transforms into environmentally friendly growth when environment-friendly technology is applied in a proactive manner (Ahmed and Long, 2012).

Table 1 shows the contribution of agriculture, industrial and service sector to gross domestic product (GDP) of Pakistan along with carbon emissions per capita over period from 1970 to 2017. Carbon emissions per capita was 0.31 on average in 1970s and experienced continuous increase as it is recorded 0.81 on average for the period 2010-2017. The share of agriculture in GDP was above 30 percent on average for the decade of 1970s and since then, the share of agriculture is around 23 percent in GDP. The share of industrial sector was around 14 percent in 1970s and 1980s. It increased to above 15 percent in 1990s and remained around 13 percent in period from 2010 to 2017. The share of service sector in GDP is continuously increased from 1970s which was on average above 40 percent in 1970s and reached to more than 52 percent during 2000s (World Bank, 2021). The increase in carbon emissions per capita for Pakistan can be attributed to the economic structure of the economy as it was 0.3 on average in 1970s whereas the share of agriculture, industrial and service sector in GDP was 30.32, 14.26 and 40.56 respectively. The economic structure of the Pakistan's economy change over period of time as for the period 2010 to 2017 the share of agriculture, industrial and service sector in GDP is recorded 23.71, 13.11 and 52.15 respectively and consequently carbon emissions per capita increased from 0.31 to 0.81 over period from 1970s to 2017. It can be deduced from the facts and figures presented in Table 1 that economic structure has been change in Pakistan as the share of agricultural sector has been reduced from above 30 percent to around 24 percent of GDP whereas the share of service sector has been increased from above 40 percent to above 52 percent of GDP over the period of the study. The increase in the share of service sector is responsible for increase demand for electricity and transport whereas Pakistan's is fulfilling the electricity demand above 60 percent from thermal resources thus; it is accumulating the carbon emissions in atmosphere and is responsible for environmental degradation.

Carbon emissions is accumulating in Pakistan and the effects of global warming and climate change is marking in form of heat waves, changes in crop pattern, floods and droughts (Govt. of Pakistan, 2017). Although, there are studies that determined different factors of carbon emissions in case of Pakistan such as energy and trade (Nasir and Rehman, 2011; Awan et al. 2018); globalization (Khan and Ullah, 2020), industrialization (Rahman et al. 2021)exports, energy, technological development, and FDI (Haq et al., 2022) and agricultural exports and financial development (Haq et al., 2021). However, the researchers did not find out any empirical study that considered the role of economic structure in carbon emissions in Pakistan. It is important to trigger out the effect of economic structure on carbon emissions as Pakistan's economy is transforming from primary and secondary sectors to tertiary sector. Thus, it is important to examine the effect of economic structure on carbon emissions in Pakistan. The rest of this study is organized in the following manner that literature review is discussed in second section of the study. Data, variables description and methodology are discussed in third section while results and discussion are provided in fourth section. The last section concludes the study.

Table 1: Pakistan's economic structure and carbon emissions

Period	Carbon emissions (per capita)	Agri. sector (% of GDP)	Industrial sector (% of GDP)	Services sector (% of GDP)
1972-1979	0.312	30.32	14.26	40.56
1980-1989	0.43	25.61	14.32	43.21
1990-1999	0.62	23.57	15.05	44.65
2000-2009	0.76	23.04	12.05	52.05
2010-2017	0.810	23.71	13.11	52.15

2. LITERATURE REVIEW

In literature, different determinants of carbon emissions are identified such as energy, economic growth, financial development, trade etc. (Abler et al. 1999; Antweiler et al. 2001; Jalil and Mahmud, 2009; Kwakwa et al., 2014; Asumadu-Sarkodie and Owusu, 2016; Appiah, 2018). In a study conducted by Kwakwa et al. (2014) for Ghana investigated the effect of agriculture and industrial sector on environmental degradation and concluded that both these sectors are significant influences of environmental degradation in Ghana. In a similar fashion, Taghvaee and Parsa (2015) determined the effect of manufacturing and services on environmental degradation for Iran. The study reached to conclusion that Iran experienced growth in manufacturing and service sector that result in increase in energy which consequently leads to high carbon emissions. Likewise, Asumadu-Sarkodie and Owusu (2016) examined the effect of industrialization on carbon emissions along with electricity and economic growth in Benin. This study used time series data and applied autoregressive distributed lag (ARDL) model for short run and long run estimates. Results of this study documented that industrialization positively contributed to carbon emissions in long run henceforth; aggravated environmental degradation in Benin. Appiah (2018) examine the nexus among carbon emissions, energy and economic development in Ghana. The study determined that variables of the study are relationship in long run as results of Johansen cointegration and ARDL test revealed. Moreover, causality results that bidirectional causality is present between energy and carbon emissions thus; recommended that investment in renewable energy and energy efficiency can abstain environmental degradation in Ghana. Likewise, Ali et al. (2020) inspected the link among technical innovation, structural changes, carbon emissions, energy usage, and economic development using the EKC hypothesis in Malaysia. The study included the years 1985 to 2016. The tests were utilized in this study to check for a unit root problem in the variables. The ARDL technique was also used in this study to assess the long and short run relationships among dependent and independent variables in the model. The results showed the presence of

structural breaks, hence the Gregory Hansen test was used in addition to the ARDL model. In the instance of Malaysia, the findings revealed that industrial value added has a negligible effect on carbon emissions. In the long run, the results reveal that carbon emissions are the two ways connected with energy consumption, technological innovation, and structural changes, while the short run results likewise show a bidirectional linkage among energy consumption, structural changes, and carbon emissions.

As discussed earlier that Pakistan is facing challenges due to environmental degradation so, there are several studies conducted in case of Pakistan to examine different factors of environmental degradation. For instance, Nasir and Rehman (2011) examined the effect of energy and trade along with income on environmental degradation in Pakistan. They considered carbon emissions as a proxy for environmental degradation. Time series data has been analyzed through various time series techniques. This study found out that energy, trade and income are cointegrated with carbon emissions thus; concluded that energy, income and trade are significant factors of carbon emissions henceforth of environmental degradation. This study concluded that income, energy and trade are accumulating carbon emissions in long run and argued that as there is a structural change in trade of Pakistan that is why trade is accumulating carbon emissions and is responsible for environmental degradation along with energy and income. In a study, Khan and Ullah (2020) determined the impact of globalization on environmental degradation. Long run relationship and estimates are obtained through ARDL bound testing approach. They considered all three aspects (economic, political and social) of globalization to capture the effect of globalization on environmental degradation. It is concluded in this study that all aspects of globalization are responsible for aggravation of environmental degradation.

Haq et al. (2021) studied the effect of agricultural exports and financial openness on environmental degradation. This study determined long run relationship among variables of the study through ARDL bound technique and also the short run and long run through ARDL bound technique. The reason is that this econometric technique has the ability to capture long run relationship if exists irrespective of the order of integration of the data and also has the ability to capture short run and long run estimates. Results of this study exhibited that agricultural exports are negatively associated with environmental degradation irrespective of the time span thus; increase in agricultural exports of Pakistan will not hurt environmental quality. However, the case is opposite for financial openness as results indicate that it will aggravate environmental degradation. Likewise, in another study for Pakistan, Haq et al. (2022) analyzed the effect of export variety, foreign direct investment (FDI) and technological development on environmental degradation. Time series data is being analyzed in this study and cointegration among variables are determined once the problem of unit root (non-stationarity) is being addressed. Short run estimates of the study documented that export variety is not aggravating environmental degradation while its effect on environmental degradation is not significant in long run. Furthermore, results of this study indicated that FDI and technological development are negatively associated with environmental degradation in long run but had insignificant effect in short run. Additionally, energy consumption in Pakistan is degrading environmental quality in both time spans. Similarly, Arafat et al. (2022) examined the causal nexus among energy, environmental degradation, financial development and health outcome and concluded that environmental degradation is badly affecting the health outcome in Pakistan.

It is deduced from the related literature discussed in this section that the determinants of environmental degradation can be analyzed in time series set up for a single country context such as Pakistan. It is also highlighted from literature that economic structure of an economy can be an influential factor or determinant of environmental degradation and energy and trade also can influence environmental degradation. Thus; this study considered energy and trade as control variables. Besides, it can also be deduced from the literature discussed in this study that so for no study is conducted in this regard for Pakistan and the effect of economic structure on environmental degradation can be analyzed in a time series study by applying appropriate econometric techniques.

3. MATERIALS AND METHODS

This study is designed to investigate the role of economic structure in environmental degradation whereas energy and trade openness as control variable. Henceforth; after discussing literature and following the studies such as (Janicke et al., 1989; Nasir and Rehman, 2011; Raitzer et al., 2015; Asumadu-Sarkodie and Owusu, 2016; Haq et al., 2021). this study developed the Model of study that is depicted in Equation (1) as follows:

$$CE=f(AGRI,IND,SER,TRADE,EC) \quad (1)$$

In Equation (1), CE denotes carbon emissions, *AGRI* denotes agricultural sector, *IND* denotes industrial sector, *SER* denotes service sector, *TRADE* denotes trade openness and *EC* denotes energy consumption. The model of the study in log linear representation is presented in equation (2):

$$ln(CE)_t=\beta_0+\alpha_1\ ln(Agri)_t+\alpha_2 ln\ (Ind)_t+\alpha_3\ ln\ (Ser)_t+\alpha_4\ ln(Trade)_t+\alpha_5\ ln(EC)_t+\epsilon_t \ldots \quad (2)$$

Where *ln* is the natural log of variables. β_0 shows the intercept while α_i represents respective coefficient of the explanatory variables and ϵ_t represents the error term. Time series data from 1972 to 2017 is considered for analysis for mentioned variables in Model. The use of CO_2 emissions as a proxy for environmental degradation is commonly used (Owusu, 2016; Appiah, 2018; Nasir and Rehman, 2011; Haq et al., 2022). Carbon emission and energy consumption are measured in million metric tons obtained from British petroleum online database (2021). The Agriculture, Industrial, and services value added are measure in United States of America dollars (USD) and Trade openness is measured in percentage of GDP and these variables are obtained from World Bank. Table 2 shows description of variables of the study. Before estimating the study's models, the data must be reviewed to see if it fulfills the regression assumptions. One of the requirements of regression is that data must be stationary and there must be

Table 2: Description of variables

Variables	Notation	Description
Dependent variable		
Carbon emissions	*CE*	Measured in million metric tons
Independent variables		
Agriculture Value added	*AGRI*	Measure in current US$
Services Value added	*SER*	Measure in current US$
Industrial Value added	*IND*	Measure in current US$
Trade Openness	*TRADE*	Measured in percentage to GDP
Energy Use	*EC*	Measured in million metric tons

no trend in the data over time, otherwise the regression findings will be unreliable. For this purpose, we employed Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) and Phillips-Perron (PP) tests are used to test the problem of unit root. It is an significant tool to check the unit root problem in the data and identified whether the data is stationary or not. Phillips and Perron (1988) studied that this approach is used as alternative or non-parametric method use to checking the unit root problem in the data. Phillips and Perron (1988) used the equation of DF test and modify the coefficient *t*-test by which research avoids the effect of autocorrelation based on distribution of test statistics. The ARDL model is used to examine the long-term association between the variables under question (Pesaran et al., 2001). This ARDL bound test maybe applied for small sample size and is more reliable and significant approach to inspect the long and short run. The ARDL model is use for examine the short and long run association among given variables; ignoring that the direction of integration whether the variables are integrated of I (0) or I (1) (Ibrahim, 2015; Meo et al., 2018).

The equation of ARDL model is used in this study is portrayed as follows:

$$\Delta lnCE_t = \alpha_0 + \sum_{i=1}^{m}\alpha_i \Delta lnCE_{t-i} + \sum_{i=0}^{m}\alpha_i \Delta lnAgri_{t-i} +$$
$$\sum_{i=0}^{m}\alpha_i \Delta lnInd_{t-i} + \sum_{i=0}^{m}\alpha_i \Delta lnSer_{t-i} + \sum_{i=0}^{m}\alpha_i \Delta lnTrade_{t-i} +$$
$$\sum_{i=0}^{m}\alpha_i \Delta lnEC_{t-i} + \beta_1 lnAgri_{t-1} + \beta_2 lnInd_{t-1} + \beta_3 lnSer_{t-1} +$$
$$\beta_4 lnTrade_{t-1} + \beta_5 lnEC_{t-1} + \beta_6 ECT + \varepsilon_t$$

Equation (3) is an error correction method for estimating a short and long run correlation, where represents the slope of variables in the short run and the term represents the long run coefficients. The error term is denoted by ε_t, whereas the constant term is denoted by β_0.

4. RESULTS AND DISCUSSION

This section elaborate the results obtained, its interpretation and discussion. The basic purpose of descriptive statistics is to display the various features of the given data that are mean, maximum value, minimum value, standard deviation and Jarque-Bera statistics. The classical assumption for the regression is that all series have to be normally distributed. However, for the results of Jarque-Bera statistics, it is observed that the series are not normally distributed. As mentioned earlier that log is considered. In another sense data is to be transformed. So if one looks into Jarque Bera statistics now all the series are normally distributed. The data now fulfilled the classical assumption of normally distributed. Descriptive statistics are displayed in Table 3.

The first step in time series is to check for unit root problem as usually in time series data. if data has unit root as it does not possess constant mean, variance and co-variance over time. Table 4 describes the results of unit root tests (ADF and PP). Results of both unit root tests indicated that variables of the study are combination of I (0) and I (1) integration. However, no variable is integrated of higher order that I (1). These results justify the application of ARDL bound test to analyze the long run cointegration. The results of the ARDL bound test are shown in Table 5. It can concluded from results in Table 5 that variables are cointegrated are in long run relationship as the estimated value of F-stat. is greater than upper limit bound and is significant at 1% level.

The results of the study are provided in Table 6. In long run, all independent variables are significant factors of environmental degradation except series sector. It is found that agriculture sector is abstain environmental degradation in Pakistan in long run as its coefficient is negative and significant. This result is similar to what (Rodriguez et al., 2004) concluded. Industrial sector is aggravating environmental degradation in Pakistan as it has positive and significant effect in environmental degradation. The finding of the study is resembled with (Rahman and Kashem, 2017; Saidi and Hammami, 2015). Services sector has negative and insignificant effect on environmental degradation in long run. Trade openness has negative and significant effect on environmental degradation in long run as the study is opponent to what (Nasir and Rehman, 2011) for the Pakistan but is consistent with popular belief that trade openness has a beneficial influence on carbon emissioms (Jalil and Feridun, 2011; Wang and Zhang, 2021). The energy consumption and carbon emission has positive and significant relationship in long run as. This result is also achieved in studies conducted by Results supported by Farhani et al. (2014), Dogan and Turkekul (2016) and Haq et al. (2021). In short run, the results indicate that only industrial sector and energy have significant effect on carbon emissions however; industrial sector has negative while effect energy has positive effect on carbon emissions in Pakistan. The ECT represents Error correction term in our model; it represents cointegration, and the adjustment of coefficients showing in previous period how much the model is adjusted in case of disequilibrium. The value of the coefficient of the ECT is −0.291 and its statistical significant. This indicated that the model is dynamically stable in long run. It is deduced from the results of the study that model of the study is stable and economic structure, energy and trade are determinants of carbon emissions henceforth; of environmental degradation in Pakistan. Moreover; reduction in share of agriculture in Pakistan's GDP would further aggravate environmental degradation whereas increase in the share of service sector would ensure environmental quality. Besides, if appropriate plocy measure are not taken then industrialization would harm environmental quality and from the effect of energy on

Table 3: Descriptive statistics

Variables	*CE*	*AGRI*	*IND*	*SER*	*TRADE*	*EC*
Mean	82.56	2.11e+10	1.18e+10	4.39e+10	31.94	36.32
Maximum	188.47	6.98e+10	3.65e+10	1.62e+11	38.50	81
Minimum	17.63	2.07e+09	9.42e+08	2.42e+09	15.82	7.50
Std. Dev.	50.63	1.94e+10	1.07e+10	4.48e+10	4.21	21.93
Jarque-Bera	3.46	10.94	9.35	11.5	28.78	3.53
Prob	0.17	0.00	0.01	0.00	5.6	0.17
Observations	46	46	46	46	46	46
Variables	***lnCE***	***lnAGRI***	***lnIND***	***lnSER***	***lnTRADE***	***lnEC***
Mean	4.18	23.37	22.77	23.96	3.45	3.37
Maximum	5.24	24.95	24.32	25.81	3.65	4.39
Minimum	2.87	21.45	20.66	21.60	2.76	2.01
Std. Dev.	0.73	0.94	0.98	1.11	0.15	0.72
JB	3.81	1.40	1.19	1.24	146.9	3.49
Prob	0.14	0.49	0.55	0.54	1.20	0.17
Observations	46	46	46	46	46	46

Table 4: Unit root tests results

Variables	At level		1st difference	
	t-statistics	Prob.	t-statistics	Prob.
lnCE	−2.42	0.14	−3.89	0.00
lnAGRI	−0.22	0.94	−9.76	0.00
lnIND	−0.77	0.83	−8.59	0.00
lnSER	−0.64	0.86	−8.88	0.00
lnTRADE	−6.14	0.00	-	-
lnEC	−3.20	0.02	-	-
Variables	**At level**		**At 1st difference**	
	t-statistics	**Prob.**	**t-statistics**	**Prob.**
lnCE	−2.42	0.14	−5.81	0.00
lnAGRI	−0.2	0.94	-4.84	0.00
lnIND	−0.77	0.82	−6.88	0.00
lnSER	−0.64	0.86	−6.06	0.00
lnTRADE	−6.14	0.00	-	-
lnEC	−3.19	0.02		

Table 5: Bound test results

F statistical=5.40*		
Significance level (%)	**Upper bound**	**Lower bound**
10	3.35	2.26
5	3.79	2.62
1	4.68	3.41

Table 6: Long run and short run results

Repressors	Coefficients	Std. Error	Prob.
Long run			
Constant	1.15	0.31	0.00
lnAGRI	−0.43	0.20	0.04
lnIND	0.36	0.16	0.03
lnSER	−0.01	0.18	0.95
lnTRADE	−0.37	0.14	0.01
LnEC	1.10	0.05	0.00
Short run			
D(lnAGRI)	0.04	0.05	0.38
D(lnIND)	−0.08	0.04	0.03
D(lnSER)	0.07	0.05	0.16
D(lnTRADE)	0.03	0.02	0.21
D(lnEC)	0.39	0.13	0.01
ECT	−0.29	0.77	0.00

environmental degradation it can be concluded that Pakistan has to look and should ensure energy security from renewable resources. Additionally, integration of Pakistan's economy with rest of world would help Pakistan to restrain environmental degradation and as a result to control the effects of climate change.

5. CONCLUSIONS AND POLICY IMPLICATIONS

The prime objective of the study was to explore the role of economic structure of Pakistan's economy in environmental degradation. Time series data on carbon emissions, agriculture, industrial and service sector along with energy and trade openness is analyzed to accomplish the objective of the study for the period of 1972–2017. The econometric techniques are applied in such manner that first, description and normality of all the series are tested. It is followed by unit root tests. Once, it is found that variables of the study are integrated in combination of I (0) and I (0) then, ARDL bound test is applied for cointegration among variables and for the confirmation of long run relationship. It is found that variables are cointegrated in long run and it is concluded that economic structure, energy consumption and trade openness are significant influential determinants of environmental degradation in Pakistan. An advantage of ARDL bound test is that it provides short run and long run estimates and also provides the adjustment process of deviation of model from equilibrium. It is evident from the study that agriculture and service sector has negative effect on environmental degradation but the effect of service sector is insignificant. The negative and positive significant effect of industrial sector on environmental degradation in short run and long run is providing a window for policy makers to come up with different policy implications for lessening environmental degradation and its worse effects. Results indicate that trade openness is abstaining environmental degradation as it is witnessed from long run results that trade openness has negative and significant effect. Energy consumption is deteriorating effect on environmental quality in both time spans as it has positive and significant effect on carbon emissions in long run and short run. The result of error correction term is suggesting that the model of the study will come back to equilibrium within 4 years from any external shock as its coefficient documents that 29 percent adjustment will be done by the model itself per annum.

The findings of the study highlighting several policy implications for alleviating the effects of environmental degradation. First, measures should be taken to prevent deforestation and encourage agricultural sector through credit provision for modern techniques in farming. This will not only ensure food security but also it will help Pakistan's to lessen environmental degradation. Second, it is important to encourage green financing for all sectors of the economy. Third, green technology and green production techniques in industry sector have to be encouraged through different incentives in form of monetary incentives such as lower taxation and exemption from taxes in those areas of industrial sector that is more harmful to environment. Fourth, it has to be ensuring that all industries and manufacturing units are observing ISO and Pakistan Council of Scientific and Industrial Research (PCSIR) standards. Fifth, government has to initiate and ensure that large portion of energy requirements of the economy has to be fulfilled from renewable energy resources.

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REFERENCES

Abler, D.G., Rodriguez, A.G., Shortle, J.S. (1999), Trade liberalization and the environment in Costa Rica. Environment and Development Economics, 4(3), 357-373.

Ahmed, K., Long, W. (2012), Environmental Kuznets curve and Pakistan: An empirical analysis. Procedia Economics and Finance, 1, 4-13.

Al Mamun, M., Sohag, K., Mia, M.A.H., Uddin, G.S., Ozturk, I. (2014), Regional differences in the dynamic linkage between CO2 emissions, sectoral output and economic growth. Renewable and Sustainable Energy Reviews, 38, 1-11.

Ali, W., Rahman, I.U., Zahid, M., Khan, M.A., Kumail, T. (2020), Do technology and structural changes favour environment in Malaysia: An ARDL-based evidence for environmental Kuznets curve. Environment, Development and Sustainability, 22(8), 7927-7950.

Antweiler, W., Copeland, B.R., Taylor, M.S. (2001), Is free trade good for the environment? American Economic Review, 91(4), 877-908.

Appiah, M.O. (2018), Investigating the multivariate Granger causality between energy consumption, economic growth and CO2 emissions in Ghana. Energy Policy, 112, 198-208.

Arafat, M., Gh, W.M., Mehmed, B., Abbas, A., Gamage, S.K.N., Gasimli, O. (2022), The causal nexus among energy consumption, environmental degradation, financial development and health outcome: Empirical study for Pakistan. Energies, 15(5), 1859.

Asumadu-Sarkodie, S., Owusu, P.A. (2016), Carbon dioxide emission, electricity consumption, industrialization, and economic growth nexus: The Beninese case. Energy Sources, Part B: Economics, Planning, and Policy, 11(11), 1089-1096.

Awan, S.A., Meo, M.S., Ghimire, A., Wu, R.Y., Zhuang, P.F. (2018), Is trade openness good or bad for environment in Pakistan; an ARDL bounds testing approach. In: 4th Annual International Conference on Management, Economics and Social Development (ICMESD 2018). Netherlands: Atlantis Press. p822-827.

British Petroleum BP Statistical Review of World Energy. (2021), Data. Available from: http://www.bp.com/statisticalreview.

Can, M., Gozgor, G. (2017), The impact of economic complexity on carbon emissions: Evidence from France. Environmental Science and Pollution Research, 24(19), 16364-16370.

Dickey, D.A., Fuller, W.A. (1979), Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74(366a), 427-431.

Dogan, E., Turkekul, B. (2016), CO2 emissions, real output, energy consumption, trade, urbanization and financial development: Testing the EKC hypothesis for the USA. Environmental Science and Pollution Research, 23(2), 1203-1213.

Esteve, V., Tamarit, C. (2012), Threshold cointegration and nonlinear adjustment between CO2 and income: The environmental Kuznets curve in Spain, 1857-2007. Energy Economics, 34(6), 2148-2156.

Farhani, S., Chaibi, A., Rault, C. (2014), CO2 emissions, output, energy consumption, and trade in Tunisia. Economic Modelling, 38, 426-434.

Govt. of Pakistan. (2017), Pakistan Economic Survey 2017. Islamabad: Ministry of Finance.

Haq, I.U., Khan, D., Taj, H., Allayarov, P., Abbas, A., Khalid, M., Awais, M. (2021), Agricultural exports, financial openness and ecological footprints: An empirical analysis for Pakistan. International Journal of Energy Economics and Policy, 11(6), 256-261.

Haq, I.U., Mehmed, B., Naradda Gamage, S.K., Allayarov, P., Khan, D., Khattak, Z.Z. (2022), Nexus between export variety and carbon emissions in Pakistan: The role of FDI and technological development. PLoS One, 17(1), e0263066.

Ibrahim, M.H. (2015), Oil and food prices in Malaysia: A nonlinear ARDL analysis. Agricultural and Food Economics, 3(1), 1-14.

Jalil, A., Feridun, M. (2011), The impact of growth, energy and financial development on the environment in China: A cointegration analysis. Energy Economics, 33(2), 284-291.

Jalil, A., Mahmud, S.F. (2009), Environment Kuznets curve for CO2 emissions: A cointegration analysis for China. Energy Policy, 37(12), 5167-5172.

Janicke, M., Monch, H., Ranneberg, T., Simonis, U.E. (1989), Structural change and environmental impact. Intereconomics, 24(1), 24-35.

Jaunky, V.C. (2011), The CO2 emissions-income nexus: Evidence from rich countries. Energy Policy, 39(3), 1228-1240.

Khalid, M.H. (2022), Exploring the Impact of Economic Structure on Carbon Emission: A Case Study of Pakistan. Kohat, Pakistan: MPhil Thesis Submitted to Kohat University of Science and Technology.

Khan, D., Ullah, A. (2019), Testing the relationship between globalization and carbon dioxide emissions in Pakistan: Does environmental Kuznets curve exist? Environmental Science and Pollution Research, 26(15), 15194-15208.

Kwakwa, P.A., Arku, F.S., Aboagye, S. (2014), Environmental degradation effect of agricultural and industrial growth in Ghana. Journal of Rural and Industrial Development, 2(2), 22-28.

Nasir, M., Rehman, F.U. (2011), Environmental Kuznets curve for carbon emissions in Pakistan: an empirical investigation. Energy Policy, 39(3), 1857-1864.

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.

Phillips, P.C., Perron, P. (1988), Testing for a unit root in time series regression. Biometrika, 75(2), 335-346.

Rahman, M.M., Kashem, M.A. (2017), Carbon emissions, energy consumption and industrial growth in Bangladesh: Empirical evidence from ARDL cointegration and Granger causality analysis. Energy Policy, 110, 600-608.

Raitzer, D.A., Bosello, F., Tavoni, M., Orecchia, C., Marangoni, G., Samson, J.N.G. (2015), SouthEast Asia and the Economics of Global Climate Stabilization. Mandaluyong, Philippines: Asian Development Bank.

Rehman, A., Ma, H., Ozturk, I. (2021), Do industrialization, energy

importations, and economic progress influence carbon emission in Pakistan. Environmental Science and Pollution Research, 28(33), 45840-45852.

Saidi, K., Hammami, S. (2015), The impact of CO2 emissions and economic growth on energy consumption in 58 countries. Energy Reports, 1, 62-70.

Solarin, S.A., Al-Mulali, U. (2018), Influence of foreign direct investment on indicators of environmental degradation. Environmental Science and Pollution Research, 25(25), 24845-24859.

Taghvaee, V.M., Parsa, H. (2015), Economic growth and environmental pollution in Iran: Evidence from manufacturing and services sectors. Custos E Agronegocio Line, 11(1), 115-127.

Tutulmaz, O. (2015), Environmental Kuznets curve time series application for Turkey: Why controversial results exist for similar models? Renewable and Sustainable Energy Reviews, 50, 73-81.

Ulucak, R., Lin, D. (2017), Persistence of policy shocks to Ecological Footprint of the USA. Ecological Indicators, 80, 337-343.

Wang, Q., Zhang, F. (2021), The effects of trade openness on decoupling carbon emissions from economic growth-evidence from 182 countries. Journal of Cleaner Production, 279, 123838.

World Bank. (2021), World Development Indicators (WDI). Online Database. United States: World Bank.