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Is Trade Liberalization, Economic Growth, Energy Consumption Good for the Environment? Time Series Evidence from Pakistan

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ABSTRACT

The study attempts to identify the dynamic relationship between trade, income growth, energy consumption and CO_2 emissions for Pakistan. Johansen's Cointegration procedure has been employed to estimate the coefficients of the Cointegrated Vector Autoregressive model. The results reveal that trade has a favorable effect on environmental quality for Pakistan economy, while income growth, energy consumption tends to worsen the environmental quality thus supporting the existence of Environmental Kuznet Curve for Pakistan.

Key words: Trade, Energy consumption, Economic growth, Environment quality, Cointegrated VAR

JEL Classification: F1, N7, O4.

1. Introduction

Trade is considered to be a catalyst for economic development. Trade has become a progressively significant global economic activity, apparent from the fact that yearly trade volume is incrementing sixteen folds over the course of last fifty years and in addition to this, degree of world exports to GDP is reaching twenty percent (Azhar et al, 2007). Trade enhances living standards of nations by reducing their cost of living thus ultimately leading towards economic growth. These are monetary paybacks associated with trade liberalization. While considering the monetary payoffs we often neglect the "social payoffs", here by social payoffs we mean environmental contemplations. The impacts of international trade have been in writing for decades. Keeping in view the goal to capture changes in environmental conditions several indicators have been developed with the sole purpose to grasp environmental impacts in the national account (Abdulai and Ramcke, 2009).

Various research has been undertaken to test the relationship between trade liberalization and environmental quality. Some of these studies postulate positive relationship between trade liberalization and environmental quality (e.g. Shafik 1994, Porter and van der Linde, 1995, Stoessel, 2001), the basic theme of these studies is that trade liberalization has potential economic gains. In particular, the effect of free trade is an increase in the income generated as the countries produce and trade those goods for which they have relative comparative advantage to produce but trade not only have this straightforward effect. At higher income levels, these countries likely to invest in cleaner technologies for the improvement in air and water as the citizens of these countries demand for environmental quality. Similarly, trade also results in adopting effective environmental cleaner technologies by developing countries.

On the other hand trade liberalization can negatively relate with environmental quality since trade liberalization enhance production intensity in developing countries and this may prompt more industrial contamination and environmental degradation (Alam et. al 2011). Moreover as liberalized trade regimes provide incentives for export; it will lead to a greater misuse of natural resources resulting in environmental degradation (Mukhopadhyay & Chakraborty, 2005).

In the case of environment-growth-nexus the relationship between environmental quality and economic growth can be explained through Environmental Kuznets Curve (EKC). Environmental Kuznets Curve states that initially pollution seems to be worse off but as income grows pollution tends to decrease.

According to Grossman & Krueger (1995) and Copeland & Taylor (2004) environment quality is affected by economic growth through three justifications which in turns shape the Environmental Kuznets Curve. These justifications are provided by scale effect, composition effect, and technique effect. The scale effect indicates as economic growth occurs it leads to increase in pollution which affects the environmental quality. The composition effect implies structural changes within an economy resulting in various environmental pressures in long run. The technique effect indicates the practice of cleaner production techniques as a result of trade liberalization. It can be explained through income perspective as incomes increases, income-induced demand results in more strict environmental regulations, environmental protection, higher environmental standards and access to environment friendly production techniques.

The main strand of the study is the relationship between environmental quality and energy consumption. Most of the research has linked this relationship with economic development because energy consumption is closely related to economic growth as greater economic growth requires additional energy consumption. Similarly, more proficient energy use requires a higher level of economic growth (Halicioglu, 2009). Examples of this line of research include Masih and Masih (1997), Wolde-Rufael (2009) and Narayan et al. (2009).

After the general overview of the environmental quality with different economic indicators, the study is now steered to a specific case of Pakistan showing a rapid economic growth for the past 5 years (SBP, 2011). According to Economic Survey (2013) undertaken by State Bank of Pakistan, the growth rates have climbed from 1.8 percent in 2000-01 to an average of 6-7 percent per year. Pakistan's trade liberalization reforms have been praised by international organizations and multilateral financial institutions. As indicated by a World Bank study, Pakistan has the least applied average tariff rates of the three large South Asian economies India, Pakistan and Bangladesh. Pakistan arrived as this position by lessening the number of tariff band to 25 percent. The velocity with which trade liberalization has occurred in the mid of the last decade is quite impressive. The tariff rate has been lessened to 25 percent from 80 percent in 1995 with an average rate of 15 percent as compared to 51 percent in 1995.

Moreover the energy consumption is also at its peak in Pakistan according to Pakistan Energy Outlook (2010/2011, PP: 1):.

"Primary energy consumption in Pakistan has grown by almost 80% over the past 15 years, from 34 million tons oil equivalent (TOEs) in 1994/95 to 61 million TOEs in 2009/10 and has supported an average GDP growth rate in the country of about 4.5% per annum".

But it seems that with trade liberalization, rapid economic growth and high level of energy consumption, the country is facing serious environmental issues. According to Human Development Report (UNDP, 2011) South Asia has the world's maximum levels of urban air pollution, with urban areas in Bangladesh and Pakistan experiencing critical air contamination. Hence the above discussion provides significant evidence for the existence of interconnections between environmental quality, trade liberalization, economic growth and energy consumption. The basic purpose of this study is to test the relationship between environmental quality, trade liberalization, economic growth and energy consumption in case of Pakistan by using secondary data from 1980-2013.

The study is arranged as follows: after introduction provided in Section 1 above, review of relevant studies is carried out in Section 2. Data source and methodological structure is explained in Section 3. The estimations and results discussion are given in Section 4. Finally, Section 5 concludes the study

2. Literature Review

The variables like trade liberalization, economic growth, energy consumption and the environment have been of great concern to the analysts. In the above mentioned variables a lot of work has been done in finding the relationship between trade liberalization and the environmental degradation (mostly on emission of CO_2) both in Pakistan and on international level but the study of finding the relations CO_2 hip among all variables mentioned above at the same time still needs further studies and much of exploration. For finding the relationship among the variables mentioned above, here the study presents review of the previous work done.

2.1. Environment and Economic Growth Nexus

Panayotou (2003) in a historical perspective for Mauritius analyzed the relationship between carbon dioxide emissions and GDP. The results suggest the existence of close relationship between carbon dioxide emissions path and GDP time path. The results also showed that there exists a direct relationship between GDP growth and environmental degradation.

Arcelus and Arocena (2005) applied panel cointegration methods, panel unit root tests and panel causality test for investigating the relationship between GDP, economic consumption (EC) and Carbon dioxide (CO_2) for 15 MENA countries covering the annual period from 1973 to 2008. The findings revealed that in the long-run, there is a unidirectional causality running from GDP and CO_2 emissions to EC. However in the short-run there is no causal relationship between GDP and EC; and between CO_2 emissions and EC.

Hosein (2006) on the premise of wide variety of international data gathered in the Environmental Sustainability Index (ESI) project reconsidered the policy-relevance of the Environmental Kuznet Curve (EKC), which shows the relationship between environment and economic growth. The author also tested the theoretical arguments that EKC links are unlikely to hold for environmental issues which are across national boundaries intergeneration in time. The results showed that for environmental policy formulation around the world the EKC idea is an incomplete and inadequate guide.

2.2. Environment and Economic Growth Nexus

Devine (1987) during the years 1980-2008 using panel of ten Asian developing countries analyzed the causal relationship between economic growth and energy consumption. For investigating bivariate model of energy consumption and real GDP a panel-VECM frame work is employed. The results confirmed the indications of bidirectional causality relationship between energy consumption and economic growth by the panel causality test, and that long-run relationship between variables is supported by panel cointegration test.

Edwards (1993) investigated the magnitude of impact and causal relationship between energy consumption (EC) and the economic growth (GDP growth). For the empirical analysis quarterly data spanning a period of 39 years is used. The granger causality test shows that there exists unidirectional causal relationship between economic growth and energy consumption. Further that all things being equal 2% growth in the electric energy is explained by 1% growth in the GDP.

Brack (1995) over the period of 1971-2006 for five South Asian countries examines the causal link between energy consumption and economic growth for the long-run and short-run estimates. Panel cointegration, ECM and FMOLS were applied. The results found unidirectional causality from per capita GDP to Per capita energy consumption in the short-run. On the other hand there is a decrease of 0.13 percent per capita GDP because of one percent increase in per capita energy in the long-run. Due to increased energy use coupled with insufficient energy supply there are indications of energy shortage crises in South Asia as indicated by the long-run relationship.

Antweiler et al. (2001) over the period 1970-2003 for Turkey examined energy consumption economic growth relationship using oil and electricity consumption. For cointegration relationship Bounds testing approach by Pesaran et al (2001) is employed. The cointegration results showed that oil consumption has positive effect on economic growth while electricity consumption has negative effect in the long-run, however, both oil consumption and electricity consumption has positive and statistically significant effect on economic growth in the short-run.

Tornell et al. (2003) identified the long-run equilibrium relationship between economic growth and electricity consumption (EC) by using the Autoregressive Distributed Lag (ARDL) bound testing procedure. In the case of Pakistan the data from the period between 1971 and 2008 is used. The direction of the causal relationship between these two variables is identified through Toda Yamamoto and Wald-test. For handling the problems of integrating order of variables Clement-Montanes-Reyes and Ng-Perron unit root tests are used. The results suggested that there is a long-run equilibrium relationship between the two variables and that economic growth leads to electricity consumption.

Kuik and Gerlagh (2003) empirically analyzed and implemented a bound testing approach and an augmented form of granger causality test for the identification of the directions of relationship between the energy consumption (EC) and economic growth (GDP) both in the short-run and in the long-run. Their finding suggested unidirectional causality from GDP to EC in the long-run and bidirectional causality between GDP and EC in the short-run.

Raymond (2004) using panel data from 1971 to 2008 for 95 countries studied the relationship between energy consumption (EC) and economic growth (GDP). The 95 countries are divided into four income groups of countries with the help of World Bank classifications i.e. Lower middle income group, High income group, Low income group and Upper-middle income group countries. The empirical results revealed that there is a unidirectional long-run granger causality running from GDP to EC for low and high income countries and bi-directional granger causality between GDP and EC for the lower-middle and upper-middle income countries.

Copeland et al. (2004) over the period 1981 to 2005 for 12 Middle East and North African countries (MENA) investigated the relationship between energy consumption, carbon dioxide emissions and real GDP by implementing cointegration techniques and bootstrap panel unit root tests. The results concluded that energy consumption has a positive significant impact on CO_2 emissions in the long-run. Interestingly for the region as a whole a quadrate relationship with CO_2 is established by the real GDP. Also in the support of the EKC hypothesis poor evidence was found. The conclusion of the finding is that it is not required for all MENA countries to sacrifice economic growth for decreasing their emissions.

Frankel and Rose (2005) investigated the energy consumption and economic growth relationship/nexus in Vietnam. Vector error correction and threshold cointegration model for granger causality test were applied for period 1976 to 2010 using Logarithm of per capita energy consumption (LPCEC) and Logarithm of per capita GDP (LPCGDP). The results indicate that there is a strong unidirectional causality running from LPCGDP to LPCEC and that the LPCEC and LPCGDP are co integrated for Vietnam. They also found time-varying effect (greater variation before and after the structural breakpoint, 1992) in Vietnam of LPCGDP on LPCEC

2.3. CO_2 Emission and Trade Nexus

Mukhopadhyay and Chakraborty (2005) investigated empirically the long run relationship among environmental degradation, trade liberalization and substantial economic development along with industrialization, urbanization, fertilizer consumption and human development in Pakistan, which are important socio-economic factors. The results conclude that there is a high impact on environmental degradation in Pakistan by trade liberalization, urbanization, human development, fertilizers consumption and industrialization. The study also found that the economic growth is also effected by trade liberalization along with all other demographic and socio economic factors (mentioned above) and that for sustainable economic development persistent increase in trade liberalization and in industrial and agriculture activities are fruitful and on the path of sustainable development for Pakistan a big hurdle is fast growing urbanization.

Shunsuke et al. (2008) by using a cross-country dataset of 3 countries (People's Republic of China, Thailand and Vietnam) for the period 1980 to 2006 studied the relationship between environmental degradation and trade liberalization. Carbon dioxide emissions from the consumption of energy and primary energy consumptions have been used as two environmental indicators for the analysis. For describing the interrelations between the environment quality and per capita income, the presence of an Environment Kuznet Curve (EKC) was investigated. The results concluded that for the existence of an EKC for the relation between environmental indicator and per capita income no evidence was found.

Badinger (2005) examined effects on carbon leakage because of trade liberalization. In the Uruguay Round of multilateral trade negotiations under the Kyoto Protocol with and without free trade by means of import tariff reductions agreed quantitative estimates of carbon dioxide leakage is presented. The study revealed that the overall rate of leakage increases as a result of the implementation of the import tariff reductions.

McCarney and Adamowicz (2006) suggested that trade openness makes environmental quality better depending on government policies. Similarly, Managi et al. (2008) found that foreign trade also improved quality of environment if environmental regulation effect is stronger than capital labour effect through the technological effect.

Abdulai and Ramcke (2009) empirically investigated the impact of trade liberalization on air and water pollution in Pakistan. For examining the long run and short run dynamics the error correction model technique and Johnson co-integration method has been used. Overall finding suggest that Pakistan must minimize the environmental cost associated with industrial development, to maximize the gains from liberalization and high-quality growth path.

Amin et al. (2009) studied trade openness, economic growth and the environment. For studying possible effects of trade openness on the environment pooled personal data on Chinese water pollution have been used. The results suggested that free trade aggravates environmental damage, but income growth mitigates it. It is suggested that the net effect of free trade for China was beneficial.

Alam et al. (2011) both theoretically and empirically explored the interrelation between economic growth, international trade and environmental degradation from developing and developed countries by using panel data for the period of 1980 to 2003. The results indicate that there exist an Environmental Kuznets Curve (EKC) for most pollutants, however with a few reservations. Along with this the results reveals that trade liberalization might be harmful for the poor ones, but beneficial for the rich countries in the regard of sustainable development.

Shahbaz et al. (2011) explored the relationship between CO_2 emissions, energy consumption, economic growth and trade openness for Pakistan for period 1971- 2009. By employing ARDL cointegration model, the results suggest long run relationship among the variables. The positive sign of linear and negative sign of non-linear GDP support the EKC hypothesis. The Granger Causality test showed one-way causal relationship running from income to CO_2 emissions. Energy consumption also increases CO_2 emissions both in short and the long run. Besides, trade openness reduces CO_2 emissions in long run.

Baek and Kim (2011) used simple endogenous growth model showing that through implementing policies that effectively generate competitive advantage in favourable sectors economic growth can be stimulated. Data supports the model. Including technological change and a proxy for trade specialization a series of growth regressions is run. The results indicate that in their impact on economic performance sectors are not indistinguishable.

Choma (2012) studied India's trade during the 1990 with European Union (15) and the rest of the world for testing Pollution Heaven Hypothesis (PHH) and Factor Endowment Hypothesis (FEH). Three pollutants; Carbon dioxide, Sulfur dioxide and Nitrogen dioxide (CO_2, SO_2 and NO_2) and suitably modified input-output method are used for testing both the hypothesis. The results show that the export-related pollution for India is much lesser than the import related pollution.

3. Data and Methodological Framework

The study has compiled yearly time series data on carbon dioxide (CO_2 2) emissions, income, trade openness and energy consumption for Pakistan for the time span 1980-2013. The per capita CO_2 emissions (measured in metric tons) are taken as a measure of environmental quality and are gathered from the World Development Indicators (WDI) provided by the World Bank. The per capita real GDP is used as a proxy for income and is collected from the Economic Survey of Pakistan compiled by the Ministry of Finance. The energy per capita data (measured in kg of oil equivalent per capita) is used as a proxy for energy consumption and is taken from the WDI. The degree of openness of an economy is used a proxy for trade liberalization and is also obtained from the Economic Survey of Pakistan.

3.1. Unit Root Test

The time series data normally exhibits non-stationarity at level as a result, the estimations generally give erroneous results (Granger, 1981). Subsequently, the beginning step in any empirical analysis of time series data is to check the presence of unit root to uproot the issue of spurious estimates. The following imperative step taken is to check the order of integration of every variable in the model to build up how often it should be differenced to pick up stationarity (Yousaf et al 2008).

The ADF equation are defined mathematically as follows, given a time series $Y_1, Y_{2,\dots,} Y_n$ Dickey and Fuller consider following three differential auto regressive mathematical equations to recognize that the unit root is present:

$$\Delta Y_t = \gamma \times Y_{t-1} + \sum \rho_j \times \Delta Y_{t-j} + \varepsilon_t \quad (1)$$

$$\Delta Y_t = \alpha + \gamma \times Y_{t-1} + \sum \rho_j \times \Delta Y_{t-j} + \varepsilon_t \quad (2)$$

$$\Delta Y_t = \alpha + \beta \times t + \gamma \times Y_{t-1} + \sum \rho_j \times \Delta Y_{t-j} + \varepsilon_t \quad (3)$$

Where : *t* stands for time index;

α is an intercept constant;

β is the coefficient of time pattern;

γ is the coefficient representing process root, i.e., the focus of testing;

ρ is the lag order of the first-differences autoregressive process;

ε is the residual term.

These three equations are different on the basis of the presence of the deterministic elements α (a drift term) and $\beta \times t$ (a linear time trend).

The core of testing in each case is that the coefficient γ equivalents to zero, which implies that the null hypothesis that there is a unit root is accepted.

3.2. Co-integration Test: The Johansen-Juselius (JJ) Method

Johansen (1988, 1991, 1992) and Johansen-Juselius (1990, 1992) put forward another technique that helps in finding more than one co integration vectors if we have variables number more than two. Such technique is used because sometimes variables might form several equilibrium relationships in the model. So Johansen approach is used for multiple equations.

A VAR representation of the N-dimensional data vector:

$$X_t = \Pi_J X_{i-j} +_{....} + \Pi_\phi X_{i-\phi} + \delta + \mu_i, \quad i = 1,2,..., T \tag{4}$$

Where $\mu_1, \mu_1, ..., \mu_t$ are N-dimension variables

X_t is a vector which shows all endogenous variables in the model and δ shows a vector of constant.

By using the information $\Delta = 1 - L$ (where L stands for lag operation) the VAR system can be rewritten as Error Correction Model (ECM) as follows:

$$X_t = \Pi_J X_{i-j} + \Phi_j \Delta X_{i-\phi} +_{....} + \Phi_{k-j} \Delta X_{i-k+1} + \delta + \mu_i, \quad i = 1,2,..., T \tag{5}$$

The central attention is on the parameter matrix Π of the Johansen-Juselius method. The number of co integration vectors is the VAR system can be determined the rank γ of this matrix $\Upsilon(\Pi)$, where ($0 < \gamma < N$).There are γ linear combinations of the variables in the framework if the rank of this matrix is found to be γ.

The matrix Π can be supplanted as $\Pi = \alpha \times \beta$, where β is the cointegration vector and α is the rate of speed adjustment vector. The maximum eignvalue test ($\lambda_{\max}$) and the trace test (λ_{trace})are employed to test for the estimation of γ on the premise of the number of maximum eigenvalues of Π. The aforementioned test insights are disseminated as X_2 with the degrees of freedom (n-k) where γ is the value of rank and N speaks to the number of endogenous variables. On the off chance that if the values calculated are less than the critical values at the proper degree of freedom and the level of significance than the alternative hypothesis is rejected.

4. Results and Discussion

The study adopts the time series regression to investigate the interrelationship between trade, income growth, energy consumption and CO_2 emissions. Logarithmically transformed variables shall be used in order to remove trends. Thus the variables become:

LGDP=Logarithm of GDP used as a proxy for economic growth;

L CO_2 = Logarithm of carbon dioxide emission;

LENCAP= Logarithm of energy per capita;

LTO=Logarithm of trade openness;

All the data series are tested for stationarity to avoid the likelihood of drawing erroneous conclusions. In this connection Augmented Dickey Fuller (ADF) unit root test has been used and test results are presented in Table 4.1.

Table 1 Results of ADF Test

Variable	Level			First difference			Level of integration
	Intercept	Trend	None	Intercept	Trend	None	
GDP	-0.3432 (-2.6210)	-1.9655 (-3.218)	2.8766 (-1.610)	-3.8524 (-2.621)	-3.7662 (-3.218)	-2.2704 (-1.6102)	I(1)
CO_2	-2.7902 (-2.6210)	-2.2220 (-3.215)	5.8263 (-1.610)	-2.2220 (-3.215)	5.8263 (-1.610)	-7.3860 (-2.6210)	I(1)
NCAP	-3.9081 (-2.6191)	-1.4794 (-3.215)	6.5802 (-1.610)	-3.8133 (-2.621)	-5.0137 (-3.218)	-2.1996 (-1.610)	I(1)
TO	0.7897 (-3.650)	-8.0796 (-4.261)	-9.5268 (-2.607)	-14.415 (-4.6503)	-14.254 (-4.268)	-1.4201 (-2.606)	I(1)

Note:Critical values at 10% level of significance has been shown in parenthesis.

Table 1 suggests that we could not reject the null hypothesis which shows the presence of unit root in the variables at level. At 10% level of significance, this indicates that the variables are non-stationary at levels. However, when the variables are first differenced the null hypothesis is rejected at 10% significance level. Therefore it can be suggested that all the variables are integrated of order one, i.e., I (1).

Since it is recognized that the variables are integrated of the similar order, cointegration tests are carried out in order to determine the presence of a long-run equilibrium relationship between the variables. One lag was selected using the lag order selection criteria

The ARDL approach establishes $(k+1)^p$ p number of regressions to get ideal lag length for every variable, where k is the maximum of lag to be taken and p is the aggregate number of variables incorporated in the regression. The number of structural lags is chosen on the premise of minimum value of AIC (Akaike Information Criteria).

Table 2 Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	213.7508	NA	3.66e-12	-14.98220	-14.79188*	-14.92402
1	256.6794	29.42408*	1.84e-12*	-15.76282*	-14.04998	-15.23919*

Note: indicate lag order selected by the criterion LR: sequential modified LR test statistic at 5% level) FPE: Final prediction error AIC: Akaike information criterion SC: Schwarz information criterion HQ: Hannan-Quinn information criterion.*

Null Hypothesis: H_0 There is no cointegration in the data

Alternate Hypothesis: H_1 There is cointegration in the data

Both the Johansen trace (Table 3) and maximum eigenvalue (Table 4) cointegration rank tests reflected that cointegrating equations exist at 5% significance level.

Table 3 Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob**
None*	0.623533	48.57248	47.85613	0.0427
At most 1	0.415225	22.19553	29.79707	0.2878
At most 2	0.217581	7.709274	15.49471	0.4970
At most 3	0.039368	1.084414	3.841466	0.2977

*Note:Trace test indicates 1 cointegrating eq. at the 5% level * denotes rejection of the hypothesis at the 5% level**MacKinnon-Haug-Michelis (1999) p-values.*

Table 4 Cointegration Rank Test (Maximum Eigen value)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob**
None*	0.623533	26.37694	27.58434	0.0707
At most 1	0.415225	14.48626	21.13162	0.3265
At most 2	0.217581	6.624860	14.26460	0.5344
At most 3	0.039368	1.084414	3.841466	0.2977

*Max-eigenvalue test indicates 1 cointegrating eq. at 5% level * denotes rejection of the hypothesis at the 5% level **MacKinnon-Haug-Michelis (1999) p-values.*

Using the same explanation, the alternative hypothesis that there is at most 1 cointegrating vector is accepted. Accordingly, it can be inferred that there is a significant long run relationship among the variables. Now Vector Error Correction model (VECM) is used to disaggregate these effects. The VECM identifies the degree of impact that the economic (explanatory) variables have on environmental quality. The long run influence of the economic variables on environmental quality in Pakistan is as shown in Table 5.

Table 5 Normalized Cointegration Equation

Variable	Coefficient	Standard error
GDP(-1)	0.059869	0.43688
ENCAP(-1)	0.320157	0.36208
TO(-1)	-0.231780	0.31014

$$CO_2 emission = 0.0598 \times GDP + 0.3201 \times Enper - 0.2317 \times TO \quad (6)$$

The long run relationship between the variables as explained by equation shows that income growth and energy consumption causes significant environmental degradation; while TO have a negative long run relationship with environmental quality. The VECM results suggest that in the long run, a unit increase in GDP increases CO_2 emission by approximately 5.9%. Deterioration in CO_2 emission can be interpreted as, since the economy of Pakistan has not reached the EKC turning point, CO_2 emission increases as the income rises. It is so because Pakistan is placed in the category of developing countries based on the World Bank's criterion and appear to have not arrived income levels sufficiently high to determine the EKC point of inflection so that emission level has a tendency to increase with higher income growth. In other words, the emission intensities in Pakistan provide evidence to support the existence of the Environmental Kuznets Curve (EKC) in the sense that in initial stages of economic development, environmental quality starts deteriorating before a threshold level of income has been crossed.

On the other hand, a unit increase in ENCAP decreases the environmental quality by approximately 32%. The positive long-run relationship between CO_2 emissions and energy consumption indicates that air contamination tends to increase as a country's energy consumption increases. This suggests that energy consumption has been a significant detrimental effect on environmental quality. This result thus can be interpreted to support the argument that among various greenhouse gases, CO_2 emissions through the combustion of fossil fuels such as coal, petroleum and natural gas seems to be the major contributor of global warming. The long run cointegrating coefficient of TO is also found to be statistically significance but having negative sign. The results show that, trade liberalization has a favorable effect on environmental quality; negative long-run relationship between CO_2 emissions and trade openness, indicating that trade liberalization tends to improve environmental quality. This finding is similar to Shahbaz et al. (2011) who explored that foreign trade reduces CO_2 emissions due to technological effects in Pakistan. Our finding also supports the view by Managi et al. (2008) and McCarney and Adamowicz (2006). The finding thus, supports the gains-from-trade hypothesis with trade induced income growth, countries become more willing to channelize their resources into environment protected production technologies through the enforcement of clean environment rules and regulations, thereby improving environmental quality. Specifically, when confronted with international competition, developing countries have strong incentives to set environmental standards in order to attract foreign direct investment and multinational firms, particularly those engaged in tight environmental protecting activities.

Table 6 Error Correction Results

Variable	Coefficient	Standard error	t-statistics
CointEq1	0.24418	10.1799083	2.48573**
D(CO_2 emission)	-16.52529	22.6937	-0.72819
D(ENCAP)	0.255363	0.45742	0.558268
D(TO)	0.582413	0.45742	1.273257

Note:*and**indicates significance at 5% and 1% level respectively

The coefficient of the dependent variable (-0.24418) is found to be negative and statistically significant at t-value of 2.48. The numerical value shows that the adjustment speed is approximately 25%; this implies that if there is any divergence from the long run equilibrium path, approximately 25% of the equilibrium is restored in a year. For that reason, that there is no strong pressure on environment quality to move towards long run equilibrium path whenever there is a disturbance.

5. Concluding Remarks

Though numerous studies have analyzed the interrelationship between environmental quality, income growth and energy consumption but relatively little work has been done for environmental consequences due to trade liberalization. This study examined the dynamic effects of income, energy consumption as well as trade on CO_2 emissions in Pakistan in a cointegration framework. For this purpose, the Johansen multivariate cointegration method is used. The results of the cointegration analysis revealed that there is a long-run relationship between environmental quality that is, CO_2 emissions, trade openness, income and energy consumption. The results of long-run coefficients showed that CO_2 emissions have a positive relationship with income growth and energy consumption which shows that they have detrimental impacts on environmental quality. It is though because a CO_2 emission increases due to the combustion of fossil fuels which is a major contributor of global warming. While trade liberalization plays a positive role in improving environmental quality for the developing country like Pakistan.

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