Foreign Direct Investment, Trade Openness, CO2Emission and Economic Growth in Pakistan: Bi-variate Co-integration

Adeela[1], Asma[1], Kanwal[2]

ARTICLE DETAILS	ABSTRACT
History **Revised format:** Nov, 2018 **Available Online:** Dec, 2018 **Keywords** CO2 emission, GDP, FDI, Trade openness, Labor Force, Domestic investment, Pakistan.	The current study is designed to investigate the relationship between CO2emission and various economic indicators such as economic growth, foreign direct investment, trade openness, domestic investment and labor force in Pakistan. The study covers the period for 1972-2017.To achieve the objective of consistency in the estimation results, the study applies different estimation techniques such as Augmented Dickey fuller Test (ADF) was used to test the unit root and Johansson co-integration test (JCT) used to test the long run relationship among the variables. The results of the study show that CO2emission has long run relation with FDI, DI and TO. CO2emission has causality with DI. Results of the study suggest that government would pay attention to increase the industrialization in the country that become the cause to increase domestic investment and also attract the foreign investment in the country which increase the productivity and produce the skilled labor.

[1]M. Phil Economics, National College of Business Administration & Economics Multan Campus
[2]District Health Authority, Multan

1 Introduction

There has been a growing concern on the global warming mainly arising from the huge amount of world-wide carbon dioxide emissions. A number of developed countries have committed to reduce their domestic CO_2emissions to a certain level. In 1965 CO_2 emission is 20.17M in Pakistan. Carbon Dioxide Emissions is at a current level of 189.19M, up from 176.71M one year ago. This is a change of 7.06% from one year ago. There is 11 million metric tons of CO_2 was produced worldwide in 1751. But in 1960s the level of CO_2 was around about 1,000 times greater than in 1751. In 2017 36.2 billion metric tons of CO_2 was produced universally.

Heavy use of energy is motivated by the economic development of developing countries and, as a result, further residues and waste are thrown away by default, which could cause environmental pollution. The primary cause of the greenhouse effect is known to be CO2 emissions, which have drawn significant attention in recent years. The majority of CO2 emissions arise from the use of fossil fuels such as coal, the automotive

industry 's key power source which is directly related to economic development and growth (Saidi & Hammami, 2015).

In short-run and long-run correlation is originating among growth and CO_2 emissions. Stimulatingly create that trade maintenance the atmosphere absolutely and population pays to conservational deprivation in Pakistan. The vitality consumption and development are the main descriptive variables which subsidize to ecological contamination in Pakistan (Ahmed & Long, 2012).

The observed indication confirms the co integration among the variables and indicate to electrical energy expenditure have an optimistic product on economic development. The decision suggests that implementation of power maintenance policy to protect power income might unconsciously waste monetary expansion and the subordinate enlargement pace determination within rotate promote reduce the demand for electrical energy (Shahbaz & Lean, 2012).

The energy expenditure, CO_2 emission and economic expansion contain appear in the direction of exist co incorporated. The results identify so as to China's CO_2 emission resolve not reduce in an extensive illustration of point with falling CO_2 emission could obstacle China's cost-effective increase to several position (Wang, Zhou, Zhou & Wang; 2011).

The bidirectional causality among the monetary development with power use in short run and long run we find unidirectional causality since trade then industry escalation in the direction of power use. Power expenditure do not guide to monetary development within the extensive sprint as advanced power price (grease price) raise the cost of production mostly significant to a harmful outcome on profitable intensification (Hye & Riaz, 2008).

Get expose to the point of agreement through energy plan target influence linkage connecting economic growth and energy consumption. Result display that fundamental relationships in the group of countries with the superlative decrease of greenhouse gas emissions, the maximum decline of energy power and the peak share of renewable energy expenditure in total energy expenditure (Smiech & Papiez, 2014).

In the long term a 100% raise in electrical energy power consumption resolve cause real gross domestic product per capita to increase by more or less 52%. The purpose of unidirectional causality runs beginning electricity consumption to economic growth intellect that some policy events in use to change the smooth consumption of electricity in Ghana determination absolutely concern her gross domestic product per capita. So the existing load shedding policy owed to low supplier of electricity force positively change the Ghanaian economy unenthusiastically, to be subordinate construction level, high inflation, and high rates of joblessness and lower ordinary of income (Enu & Havi, 2014).

Explained conduct by diverse econometric methodologies, different information set and singular countries' individuality. While new and extra complicated econometric method for classification and considerate of causality be industrial above the years, an increasing quantity of available observed studies concerning interconnectedness of energy consumption and gross domestic product motionless have contradictory consequences. Result indicates that a contributory relationship essentially exists in insufficient performance of suitable economic and energy plan (Jakovac, 2018).

2 Literature Review

Shahbaz and Lean (2012) depicted electricity consumption and economic growth in Pakistan. Empirically result shows that the electrical energy consumption, wealth and industry contain constructive plus important force on economic. There is fundamental rapport among voltage consumption and economic growing in the short run and long-run periods for Pakistan. Finding explains to electrical energy protection policy can inversely change the rate of economic growth. Result identify that is it significant to appreciate the association among voltage consumption and earnings which is the indicator of winning environmental and growth strategy.

Hye and Riaz (2008) tried to indicate the association between energy consumption (EC) and economic growth (EG) by applying the time series data of 1971 to 2007 in Pakistan. "The co-integration and an augmented form of the Granger causality test" are used to check the connection of EC and EG. The study results indicate that EG and EC have a bidirectional causality relationship in the short term, whereas it has a long-term unidirectional causality from EG to EC.

Saidi and Hammami (2015) cited the impact of both energy consumption and CO_2 emissions on economic development indication from dynamic equations models terminated the analysis data duration 1990 to 2012. Our exact outcomes demonstrate that vitality utilization positively affects monetary development. This suggests vitality utilization assumed an essential job in the expansion of monetary development in the examined economies however with the outcome of high contamination. Since vitality is a vital element for financial development, solid vitality arrangements are required to acknowledge monetary development. Then again, the CO_2 emissionshave a negative effect on financial development.

Wang et al. (2011) cited the CO_2 emissions and economic development in China. The fundamental goal of the investigation was to discover the connection between vitality proficiency and monetary development. Discovering demonstrates vitality power as an intermediary for vitality proficiency. Results demonstrate the Vector Error Correction model to tests the presence of a long haul connection between the vitality force and GDP, while utilizing this model to catch the Granger causality between factors. Discoveries demonstrates that vitality force is relied upon to increment if the offers of industry and administrations to GDP increment. These outcomes have various ramifications. The businesses are driver of monetary development in creating nations. In this way, vitality anticipating mechanical utilize must be given most extreme significance. There is a need to conduce a more itemized examination to make projection for future vitality prerequisites keeping in mind the end goal to be better educated for making dependable arrangements for the vitality area. Result demonstrates vitality utilization has developed more quickly than GDP. This investigation found that 1% expansion in monetary development requires over 1% expansion in vitality utilization in poor economies.

Smiech and Papiez (2014) examined energy consumption and economic development the bootstrap panel on the Granger Causality Method in the data from 1993 to 2011 is used to collect energy policy boards in the EU. The outcomes acquired uncover that the dimension of consistence with vitality approach targets impacts linkages between vitality utilization and financial development. The outcomes show causal relations in the gathering of nations with the best decrease of ozone harming substance outflows, the most astounding decrease of vitality force and the most astounding offer of sustainable power source utilization in complete vitality utilization. In the rest of the gatherings the outcomes for the most part affirm the lack of bias speculation.

Shahbaz et al. (2017) explored trade Openness Carbon Emissions Nexus and the value to country panels of turning points of trade openness. Exchange transparency blocks ecological quality for the worldwide, high pay, center and low pay boards yet the effect changes in these differing gatherings of nations. The board

VECM causality results features a criticism impact between exchange transparency and carbon emanations at the worldwide dimension and the center pay nations however exchange receptiveness Granger causes CO_2 discharges for the high pay and low salary nations. Approach suggestions are likewise given.

Hassan and Haq, (2017) investigated he effect of economic development, openness to trade and energy use on carbon emissions in the Pakistan EKC nexus. The results showed that per capita GDP has a positive and substantially enormous relationship with CO2 emissions. By applying Granger causality and unit root tests, the findings examined the relation between spills in the United States for the period from 1960 to 2004. Finding watched that Granger does not cause carbon outflows in the US over the long haul pay, but rather use vitality does. There does not seem to be a tradeoff among salary growth and discharge reduction.

Jakovac, (2018) depicted An empirical study of the relationship between economic growth and energy use in Croatia. Findings demonstrate that there is a bidirectional short-run causality and a unidirectional long-run causality in the primary sub-test, which runs from adding to the use of vitality to financial growth, indicating that the use of vitality is a key factor in the economy. The positive effect that vitality utilization had on financial development around then recommends that vitality utilization prodded monetary development in Croatia and assumed a critical part in the development procedure as an irreplaceable generation contribution and a supplement to work and capital.

3 Methodology

The study covers the period for 1972-2017. The research uses various estimation techniques to achieve the objective of accuracy in the predicted results, such as the Augmented Dickey Fuller Test (ADF) used to test the unit root and the Johansson co-integration test (JCT) used to test the long-term relationship between the variables. The data is collected from the World Bank. The following are estimated variables and their impact on model explained. Mathematical model of the study is,

Model: GDP = f (CO2_EMISSION, FDI, TO, LF, DI)

It can be written in econometrics form,

$GDP_t = \alpha o + \alpha 1 CO2_t + \alpha 2 FDI_t + \alpha 3 TO_t + \alpha 4 LF_t + \alpha 5 DI_t + \varepsilon$

Where:

GDP = Gross domestic product per capita (current US$)

CO2_emission = Carbon dioxide emission (metric tons per capita)

FDI = Foreign direct investment, net inflows (current US$)

TO = Trade openness (current US$)

DI= Domestic investment (current US$)

LF= Labor Force (total)

E= Error Term

Table: 1 Variables Measurement

Variables	Measurements
Dependent Variable	
Gross Domestic Product	GDP at the price of the buyer is the amount of the total value added by all resident producers in the economy, including any taxes on the goods and minus any incentives which are not included in the value of the products.
Independent Variables	
CO_2–emission	The emissions of carbon dioxide are those arising from the combustion of fossil fuels and cement manufacturing.
Trade Openness	The value of all products and other business services offered to the rest of the world is measured by exports of goods and services.
Foreign Direct Investment	International direct investment in the reporting economy relates to direct investment equity flows. It is the amount of equity capital, earnings reinvestment, and other capital.
Domestic Investment	Gross domestic investment comprises of spending on additions to the economy's fixed assets, plus net improvements in inventory levels.
Labor Force	The labor force is the sum of employed and unemployed persons.

Source: World Bank, 2018

4 Results and discussion

Unit Root Test

The first and most significant aspect is to explore the follow-up and presence of unit root in the time series data unit root process. Test series submitted by econometrics over various time periods, but one of the best constructive tests for unit root is the test developed by Dickey and Fuller. The unit root test is a test of stationarity (or non-stationarity) which has become popular over the past few years. A significant assumption of the DF test is that there is an independent and equivalent distribution of the error termsTo keep hold of the serial correlation in the error terms without including lagged differential terms, Phillips and Perron use nonparametric statistical techniques. Since the PP test's asymptotic distribution is the same as the ADF test statistic, (Gujarati, 2004). The basic assumption of the Augmented Dickey Fuller Tests is to fit and freely distribute data. Another assumption is that even the variance value should also be constant. In addition, stationarity was tested at the level however the result was non-stationary, the necessary results for stationarity were obtained after taking the first difference (Gujarati, 2004).

Table 2: Unit Root Test

	Level	First Difference

Variables		t-Statistic	P.Value	t-Statistic	P.Value
GDP	ADF	-0.8187	0.804	-8.6651	0
FDI	ADF	-1.5604	0.4942	-11.815	0
CO2	ADF	-1.3325	0.6063	-6.904	0
DI	ADF	-1.2672	0.6366	-7.0064	0
LF	ADF	0.20137	0.9697	-8.3996	0
TO	ADF	-1.6703	0.4391	-6.9729	0

Source: Software E-Views09

All the variables are stationary at the first difference in the unit root test in this model.

Co-integration analysis

Inherently, co-integration analysis is multivariate, since a single time series could not ultimately be co-integrated, considering a number of associated variables. Nevertheless, co-integration implies little about the course of causality (Hendry and Juselius, 2001).

Table 2: Unrestricted Co-integration Rank Test (Trace)

Co-integration: Unrestricted Cointegration Rank Test (Trace)					
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**	
None *	0.750849	131.9975	95.75366	0	Co-integration
At most 1 *	0.53187	70.85085	69.81889	0.0413	Co-integration
At most 2	0.351866	37.45441	47.85613	0.3264	No Co-integration
At most 3	0.27698	18.37348	29.79707	0.5386	No Co-integration
At most 4	0.088105	4.103457	15.49471	0.895	No Co-integration
At most 5	0.001029	0.045296	3.841466	0.8314	No Co-integration

Source: Software E-Views09

 Note: * shows the significant of the variable.

The result for multivariate co-integration analysis is presented in this table for all the series. The results show that two variables are co-integrated with GDP in long run.

Table: 3 Unrestricted Cointegration Rank Test (Maximum Eigen value)

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)					
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**	
None *	0.750849	61.14669	40.07757	0.0001	Co-integration
At most 1	0.53187	33.39644	33.87687	0.057	No Co-integration
At most 2	0.351866	19.08093	27.58434	0.4083	No Co-integration
At most 3	0.27698	14.27002	21.13162	0.3433	No Co-integration
At most 4	0.088105	4.058161	14.2646	0.8532	No Co-integration

| At most 5 | 0.001029 | 0.045296 | 3.841466 | 0.8314 | No Co-integration |

Source: Software E-Views09

Note: * shows the significant of the variable.

The consequence of the study of multivariate co-integration for all the series. The findings of the current study show that a long-term relationship is seen between GDP, CO2 emissions, openness to trade, domestic investment, labour force, and foreign direct investment. The linear blend of all of these series reveals long-term relationships according to the outcome.

Table 4: Bi-variate Co-integration

Variables	Eigenvalue	Trace Statistic	0.5 Critical Value	
GDP				
CO2	0.266316	14.54593	15.49471	No Co-integration
	0.020696	0.920164	3.841466	
GDP FDI	0.27795	17.94597	15.49471	Co-integration
	0.078914	3.616881	3.841466	
GDP DI	0.296653	18.37588	15.49471	Co-integration
	0.063616	2.892087	3.841466	
GDP LF	0.378888	21.33221	15.49471	Co-integration
	0.008542	0.377466	3.841466	
GDP TO	0.171827	10.67373	15.49471	No Co-integration
	0.052617	2.378276	3.841466	
CO2 FDI	0.624478	46.11576	15.49471	Co-integration
	0.066343	3.020429	3.841466	
CO2 DI	0.387379	23.54611	15.49471	Co-integration
	0.044127	1.985721	3.841466	
CO2 LF	0.047861	2.425314	15.49471	No Co-integration
	0.006058	0.267381	3.841466	
CO2 TO	0.255574	16.02026	15.49471	Co-integration
	0.066632	3.034046	3.841466	
FDI DI	0.3454	23.29543	15.49471	Co-integration
	0.100315	4.651276	3.841466	
FDI LF	0.37651	20.89251	15.49471	Co-integration
	0.002405	0.105933	3.841466	
FDI TO	0.422006	33.35834	15.49471	Co-integration
	0.189377	9.23791	3.841466	
DI LF	0.540704	34.70485	15.49471	Co-integration
	0.010629	0.470173	3.841466	
DI TO	0.352213	27.9855	15.49471	Co-integration
	0.182775	8.880983	3.841466	
LF TO	0.197793	10.09844	15.49471	No Co-integration
	0.00908	0.40133	3.841466	

> *Source*: Software E-Views09

The results for Bi-variate relationship of GDP, FDI, TO, LF, DI and CO_2 emissions are shown in the above table. When the trace value is greater than the critical value it shows that presence of the long run relationship of the Bi-variate co-integration exists among the variables. GDP is integrated with FDI, DI and LF while GDP is not integrated with Co_2 and TO in the long run. Co_2 is integrated with FDI, DI and TO but it is not integrated with LF in the long run. Similarly, FDI is integrated with DI, LF and TO and DI is integrated with LF and TO in the long run. Whereas Lf is not integrated with TO.

Table 4: Granger Causality

Null Hypothesis:	Obs	F-Statistic	Prob.
CO2 does not Granger Cause GDP	44	2.87311	0.0686
GDP does not Granger Cause CO2		0.54349	0.5851
FDI does not Granger Cause GDP	44	0.01051	0.9895
GDP does not Granger Cause FDI		1.35738	0.2692
DI does not Granger Cause GDP	44	0.55886	0.5764
GDP does not Granger Cause DI		2.04395	0.1432
LF does not Granger Cause GDP	44	7.07224	0.0024
GDP does not Granger Cause LF		0.78788	0.4619
TO does not Granger Cause GDP	44	2.24038	0.1199
GDP does not Granger Cause TO		2.81055	0.0724
FDI does not Granger Cause CO2	44	0.84997	0.4352
CO2 does not Granger Cause FDI		12.8133	5.0005
DI does not Granger Cause CO2	44	0.31222	0.7336
CO2 does not Granger Cause DI		5.63176	0.0071
LF does not Granger Cause CO2	44	0.7487	0.4797
CO2 does not Granger Cause LF		0.29011	0.7498
TO does not Granger Cause CO2	44	2.05023	0.1424
CO2 does not Granger Cause TO		2.59948	0.0871
DI does not Granger Cause FDI	44	2.36123	0.1077

FDI does not Granger Cause DI		0.25809	0.7738
LF does not Granger Cause FDI	44	4.45599	0.0181
FDI does not Granger Cause LF		0.62418	0.541
TO does not Granger Cause FDI	44	6.23031	0.0045
FDI does not Granger Cause TO		1.39278	0.2605
LF does not Granger Cause DI	44	13.5579	3.0005
DI does not Granger Cause LF		0.66802	0.5185
TO does not Granger Cause DI	44	4.63669	0.0156
DI does not Granger Cause TO		2.90974	0.0664
TO does not Granger Cause LF	44	2.70973	0.8373
LF does not Granger Cause TO		0.85083	0.4348

Source: Software E-Views09

The earliest column in the above table shows the null hypothesis for potential rejection at various levels of significance. Whereas the second shows F statistics and the third column shows the value of probability. The argument that has a probability value less than or equal to 0.10 can be rejected as a null hypothesis according to the probability values stated in the table. After observing the LF does not Granger Because GDP is 0.0024. It means that LF has positive impact on economic growth, when the labor force increases then the economy of the country also rises. LF has a unidirectional relation with the GDP and FDI. The P. Value CO_2 does not Granger Because DI is 0.0071 which show CO_2 has unidirectional relation with DI. Similarly, TO also has unidirectional relation with the FDI and DI.

5 Conclusion and Future Work

The basic study objective is to investigate the relationship between the CO2 emissions and economic growth of the Pakistan. The study covers the period for 1972-2017. The research uses various estimation techniques to achieve the objective of accuracy in the estimation results, like the Augmented Dickey Fuller Test (ADF) used to test the unit root and the Johansson co-integration test (JCT) used to test the long-term association between the factors. The data is collected from the World Bank. GDP (Gross Domestic Product) is dependent variable while the Domestic Investment (DI), Labor Force (LF), Foreign direct investment (FDI), Trade openness (TO) and CO2 (carbon dioxide emissions) are the independent variables.

The outcomes of Bi-variate co-integration analysis show that GDP is integrated with FDI, DI and LF while GDP is not integrated with Co2 and TO in the long run. Co2 is integrated with FDI, DI and TO but it is not integrated with LF in the long run. Similarly, FDI is integrated with DI, LF and TO and DI is integrated with LF and TO in the long run. Whereas Lf is not integrated with TO. Results of the Granger Causality analysis indicate that the LF does not Granger Cause GDP that means LF has positive impact on economic growth,

when the labor force increases then the economy of the country also rises. LF has a unidirectional relation with the GDP and FDI. The CO_2 has unidirectional relation with DI. Similarly, TO also has unidirectional relation with the FDI and DI. Results of the study suggest that government would pay attention to increase the industrialization in the country that become the cause of Domestic investment and also attract the foreigner investment in the country which increase the productivity and produce the skilled labor. So, there is need to pay more attention by the government administration to use them properly and efficiently to get more benefits which take the proper part in the development and growth of the economy of Pakistan.

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