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CPEC in the Perspective of Pakistan Economy: A Comprehensive Analysis

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ABSTRACT

China Pakistan Economic Corridor (CPEC) is a part of multidimensional infrastructural initiative known as 'Belt and Road Initiative (BRI) which attempts to bond economies, regimes and societies in Europe and Asia. In this background, objective of this study is to analyze CPEC in the light of Pakistan economy. Vector Autoregressive (VAR) model, Vector Error Correction Mechanism (VECM) and Granger Causality are applied to data from 1980 to 2016 for discovering interactions of infrastructure and sustainable development. In the long run, causality runs from economic and social component of sustainable development to infrastructure. However, in the short run, energy infrastructure has a causal connection with sustainable development and its economic component. Short run associations of past is found to have the force to enlarge future responses. The statistical context of this study, as a constraint, is not sufficient to highlight any association between infrastructure and environment.

1. Introduction

China Pakistan Economic Corridor (CPEC) is termed as a game changer not only for Pakistan but also for the region. For Pakistan, it is hoped that CPEC would be helpful in fortifying its infrastructure which will consequently build up its collaborations with China and Arab states, increase indigenous and international trade, enhance foreign direct investment (FDI) and consolidate economic growth and development. For China, it is initially designed to complement Belt (Silk Route) with Road (maritime Silk Route) in Belt and Road Initiative (BRI) to develop westernmost China region by minimization of costs accruing in maritime journey along Indian and North Pacific oceans. Iran, Afghanistan, India and United States of America (USA) are paramount skeptic of this initiative on account of different grounds for example be like East India Company, agenda to increase Chinese influence on globe through trading conspiracies, saddled financial strategy of China, unnecessary wattage to Gwadar as deep Sea Port, danger to New World Order and many more. Future is nothing more than predictions but CPEC has already been proved as a game changer in global rhetoric forums.

In Pakistan there is also a clear divide among proponent and opponents of CPEC. Supporters of CPEC are optimist about bright future of Pakistan whereas contenders are skeptical on grounds already taken by opponents in international community by adding domestic justifications that is excessive civil, military and cultural influence of China, needless financial burden due to outrageous financial terms, non-participation of indigenous resources, proportionately more focus on agriculture in comparison to industry, institutional and governance set up of Pakistan etcetera. In these circumstances, it is imperative to explore the costs and benefits of the CPEC initiative for Pakistan in the light of the facts. However, scope of the topic is broader but limitations restrain this study to focus on economic issues only. Apparently, CPEC initiative is an investment in infrastructure; hence, infrastructure could be a handy area to be investigated.

Major objective of this study is to evaluate CPEC initiative in background of Pakistan economy. For this purpose, three types of analyses are utilized in Sections 2 to 4 of the study. In Section 2, CPEC is introduced with the help of descriptive analysis. In Section 3, the study takes into consideration the past data and attempts to explore the relationship between infrastructure and development comprehensively from 1980 to 2013 by using causality analysis. Infrastructure is measured in three different dimensions; economic, social and energy. Concept of development has evolution over time from economic growth to sustainable development. In this study development is measured by sustainable development through its core components i.e. economic, social and environmental. Then in Section 4 the estimated associations between infrastructure and sustainable development are utilized to explore the performance of Pakistan's economy with the help of forecasting technique. Thereafter, conclusion of the study is presented.

2. Descriptive Analysis of CPEC

An attempt has been made to demonstrate introductory awareness about CPEC on the basis of most recent available information. There is growing international reflection towards CPEC, as a game changer, which lacks comprehensiveness. It looks that little is known to the World and well-informed corners are being ignored by the World. In these circumstances an attempt on the basis of possible available information is reiterated here.

2.1 Belt and Road Initiative: BRI

Origin of CPEC is BRI, up to 30 trillion-dollar project (estimated) of China for infrastructure development, coordination expansion, integration, trade enhancement and socialization of Asia and Europe known as Eurasia. BRI is a combination of two routes; the old Silk Road Economic *Belt* (SREB) and the new 21st Century Maritime Silk *Road* (MSR). Silk Road Economic Belt comprises of six overland corridors: China Pakistan Economic Corridor (CPEC), Bangladesh China India Myanmar Economic Corridor (BCIMEC), China-Central and West Asia Economic Corridor (CCWAEC), China Indochina Peninsula Economic Corridor (CICPEC), China Mongolia Russia Economic Corridor (CMREC), and New Eurasian Land Bridge Economic Corridor (NELBEC). Countries involved in these corridors are China, Pakistan, Bangladesh, India, Myanmar, Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan, Iran, Turkey, Cambodia, Malaysia, Thailand, Vietnam, Russia, Belarus, Czech Republic, Poland, and Germany. [ACCA, 2017].

Maritime Silk Road has two components; first is the trajectory of sea ports starting from China and encompassing South China Sea, Indian Ocean, and Pacific Ocean with targeting South and South East Asia, Europe and East Africa for the purpose of trade, and second is the inclusiveness of infrastructural development programs over the sea ports designed for the route. Europe is the target of MSR in one direction passing through Fuzhou and Malacca Strait Major and in other direction includes the sea ports of Sittwe (Myanmar), Gwadar (Pakistan), Hanbantota (Sri Lanka), and Chittagong (Bangladesh). Along with this some projects are under consideration for example Kra canal (Thailand), Coastal Axis comprises of 30 ports (Indonesia) and Colombo Port City (Sri Lanka). Some programs are still in future expansionary vision of MSR that is Coast of Africa and Suez Canal in Egypt. China's global investments are also a witness of its target to Europe as destination for example Port of Piraeus (Greece), COSCO Pacific Ltd, Multi Port Gateway and North Adriatic Port Association etcetera. [Koboevic et al., 2018].

CPEC is the most important corridor out of six corridors because it has the uniqueness of linking SREB with MSR. It could be imagined as a corridor of trade, energy, technology and development.

2.2 China Pakistan Economic Corridor: CPEC

China Pakistan Economic Corridor is outcome of all-weather affiliation of Pakistan with China since 1950 after Pakistan officially initiated pioneering diplomatic relationships with her. CPEC is originally a network of roads, railways, energy production units, industrial parks and metropolitan transit and surveillance projects planned for trade enhancement, energy pathways, collaborations and socio-economic development. Its core zone starts from Kshghar in Xinjiang province of China and reaches Gwadar through Atushi, Tumshuq, Akto, Gilgit, Peshawar, Islamabad, Lahore, Multan, Dera Ismail Khan, Quetta, Sukkur, Hyderabad and Karachi. Its jurisdictional territory is Xinjiang's autonomous region (China) and Pakistan. It comprises of one belt, three axes and several passages. Here belt is meant to core zone of CPEC as explained earlier. Three axes are road linkages between Lahore-Peshawar, Sukkur-Quetta, and Karachi Gwadar. Several passages are interlinking routs intersecting these axes. Core zone is composed of five subzones i.e. Xinjiang (China), northern border of Pakistan (Gilgit-Baltistan and Azad Jammu & Kashmir), eastern & central plain in Pakistan (Punjab), western zone (Balochistan & Khyber Pakhtunkhwa) and southern coastal areas (Sindh) [GoP & PRC, 2017].

As depicted in Table: 1, in total 75 projects of infrastructure are to be initiated under CPEC. Proportion of energy, Gwadar, special economic zones, and transportation are 32, 17, 14 and 12 percent respectively. This information is analyzed on the basis of number of projects because yet sufficient information is not available on estimated costs. It is quite likely that on the basis of estimated costs the importance of different sectors of the economy may vary in comparison to the number of projects but the limitations of availability of data restrain this study to analyze present information on the basis of number of projects. According to the available information as mentioned in Table 1, 64 percent of total estimated cost belongs to energy sector however the scenario of proportional share remains the same.

Table 1

CPEC Projects Financed by China

Sector	Total (No)	Proportional Share (%)	Status (No)			Estimated*	
			Operational	Approved ECOD	Under Review	Capacity	Cost (US $ M)
Energy	21	32	6	9	6	13805 MW	25221
Infrastructure (Roads & Railway)	8	12	-	2.5	5.5	2796 KM	13577
Gwadar	12	17	-	2	10	-	796
Rail Based Mass Transit	4	6	-	1	3	2712 K M	-

Provincial Projects	6	9	-	-	6	-	-
Special Economic Zones	9	14	-	-	9	-	-
Social Sector Development	4	6	-	-	4	-	-
Others	3	4	1	-	2	-	44
Total	67	100	7	14.5	45.5	-	-
Percentage	100	-	10	22	68	-	-
CPEC Projects Financed by Pakistan							
Western Route	6	75	2	1	3	1899 KM	-
PSDP	2	25	-	2	-		
Total	8	100	2	3	3	-	-
Percentage	100	-	25	37.5	37.5	-	-

* Based on available information which is yet partial on account of review process of some projects

ECOD: Expected Commercial Operation Date. Source: CPEC Official Website: www.cpec.gov.pk

Around 90 percent of the projects will be financed by China and the rest by Pakistan. Finance options adopted by China are multi-channeled. Some of the projects are financed by the Central Republic of China, some projects are financed by banking sectors of China and some projects would be the foreign direct investment of multinationals of China. Financial burden of the investments is yet not known certainly on account of paucity of information available in this regard. The Pakistan's share is financed by the government of Pakistan and allocations in PSDP (Table 2) is the good indicator of this fact. Ten percent of the projects financed by China are fully operational and of Pakistan are 25 percent. Twenty two percent of the projects financed by China will be completed and operational in future up to 2025 and of Pakistan are 37.5 percent. The projects financed by China which are still under consideration and planned to be completed by 2030 are 68 percent and of Pakistan are 37.5 percent. Most of the projects in this analysis are related to the energy production which on their completion would be able to produce more than 13000 MW of electricity which is almost equivalent to prevalent electricity generation capacity of Pakistan by thermal resources.

Table: 2

PSDP Related Allocations for CPEC Projects (Million Rs)

Year	**No. of Head**	**Cost**		**Expenditures up to June**	**Through Forward**	**Allocations**		
		Total	**Foreign**			**Foreign**	**Indigenous**	**Total**
2016-17	38	1151699	282317	179848	971850	43350	86508	129858
2017-18	42	1357516	365509	300851	1056665	68041	119237	187278

Available at CPEC official Website: www.cpec.gov.pk

Table 2 is about PSDP allocations from Pakistan side on CPEC. Most obvious fact traced out of the table is that sufficient amount is allocated in annual budgets to finance projects of CPEC. This will prove very helpful for completion of the projects well on time.

2.3 CPEC: A Critical Assessment

A number of studies are available which critically analyze CPEC. Some of the studies are reviewed and major lessons and challenges perceived out of the analysis are mentioned here:

a) Expectations from CPEC are not realistic and are divorced of the ground realities

b) Implicitly China's vision is to strongly influence the region economically, politically and militaristically

c) Interweaved fabric of the society in Pakistan is not capable of extracting potential benefits from CPEC

d) Governance structure of the country is the major bottleneck in the process of CPEC implementation

e) It may become a fundamental cause of rivalry among Pakistan and its neighboring countries

f) Financial obligations involved in CPEC are not competitive

Lessons emerged out of the reviewed literature are very important and due attention should be paid by the concerned quarters involved in CPEC initiative. However, general observation of the literature also portrays that some certain voids and impartiality holes are present in the analyses and Indian's concerns are focused overwhelmingly. Observations are as under:

a) Yet comprehensive factual information is not observed in the literature on account of the reason that real erudite of the fields are still unknown

b) Analyses produced in the literature are influenced by globally commanding media houses

c) Explorations occupied are based on personage exposures which may or may not be proved factual in future

d) Contributions are majorly produced in the field of political science and yet empirical economic analysis is rare

[Calabrese (2015); (Rakisists, 2015); (Pitlo III & Karambelkar, 2015); (Wolf, 2017); (Jacob, 2017); (Dadwal & Purushothaman, 2017); (Panneerselvam, 2017) (Garlick, 2018); (Golley & Ingle, 2018); (Deepak, 2018)]

3. Infrastructure and Sustainable Development in Pakistan: The Skeleton of CPEC

This section of the study has tried to explore past performance of Pakistan economy in the perspective of CPEC investments. It is evident from Section 2 that on the whole CPEC is an investment in infrastructure to collaborate resources, people, information and development process etcetera. Therefore, it looks realistic to analyze developmental issues in Pakistan economy in relation to infrastructure. This study intends to explore the relationship extensively; hence, attempts to measure developmental process and infrastructure in a bit more details. Recent scenario suggests sustainable development as the most important dimension of development on the basis of its simultaneous focus on economic, social and environmental aspects of the economy (UN, Realizing The Future We Want for All. Report to the Secretary-General, 2012). This study also considers the sustainable development as a measure of development for Pakistan economy. For measuring infrastructure this study uses 26 variables and constructs four indexes for overall, economic, energy and social aspects of the economy.

Thereafter, on the basis of short-run and long-run causality analysis, it has been endeavored to highlight the relationship between infrastructure, as basic skeleton of CPEC, and sustainable development in Pakistan.

Infrastructure for sustainable development is the key component which emphasizes efficiency in governance in relation to mega infrastructural investments (Edgar et al., 2018). Keeping in view market-friendly approach the role of infrastructure in sustainable development of India, is explored by Nilesh and Boeing (2017) who found that cautiousness is necessary when invested in infrastructure. Importance of infrastructure for connectivity and urbanizations is also evident in case of African countries (Simone, 2014). Association of infrastructure with sustainable development is crystal clear in Fernandez-Sanches and Rodriguez-Lopez (2010) whereby reliability of sustainable development indicators is checked over infrastructure projects in Spain. Be cautious about sustainable development whenever a mega project of infrastructure is launched (Daniel et al., 2011). Urbanization affects growth positively in presence of rural-urban interconnecting infrastructure (Turok & McGranahan, 2013). Infrastructural investment is a key element for sustainable growth, foreign trade and human development (Mirza, 2006). Productivity of infrastructure is evident in Chile (Albaba-Bertrand & Emmanuel, 2004). Consensus exists in literature related to infrastructure and economic growth that infrastructure has the force to enhance economic growth through productivity enhancement, capital formation, deliver abilities regarding human development (Gramlich, 1994; Romp & de Haan, 2005; and Ahmad & Malik, 2012). Along with enhancing economic growth, infrastructural investment is also useful in poverty reduction (Fay et al., 2005; Calderon & Serven, 2011, and Ahmad et al., 2016). However, serious concerns are raised over environmental effects of infrastructure because in case of infrastructural investment in transportation the energy consumption and industrialization may increase which consequently leads to harmful and injurious emissions for health of living beings and careful public policy is necessary in public sector development programs (Lecocq & Shalizi, 2014; and Shalizi & Lecocq, 2010). In this scenario, it looks that whenever developmental effects of infrastructure are explored, the best measure is sustainable development instead of economic growth or economic development.

3.1 Data and Methodology

Causality analysis in Vector Autoregressive framework is utilized in this study for the purpose of finding out the associations between infrastructure and sustainable development. Both these important variables of the study are measured by using indexation methodology as explained below.

For measuring infrastructure index twenty six variables are used in this study and data from 1980 to 2016 is collected to construct the infrastructure index (INF) with the help of principal component analysis. Data is collected from Economic Surveys of Pakistan published annually. Thereafter, infrastructural index is also decomposed into economic infrastructure index (ECINF), energy infrastructure index (ENINF) and social infrastructure index (SINF). For economic infrastructure index eight variables are exploited: length of road, cargo handled, number of locomotives, number of freight wagons, number of vessels, PIA fleet in number, number of post offices and number of telephones. For energy infrastructure index five variables are used: crude oil extraction, petroleum production, gas production, coal production and installed capacity of electricity. Social infrastructure index comprises of thirteen variables: primary, middle, and high schools, vocational centers, higher secondary schools, degree colleges, and universities in numbers for education and for health number of hospitals, dispensaries, basic health units, rural health centers, maternity and child care centers, and tuberculosis centers. Thereafter four index variables are included in the causality analysis to explore the causal connection from infrastructure to sustainable development.

Similarly an index of sustainable development is exploited in this study for the purpose of analysis. Theoretical foundation of sustainable development comprises of three core components; economic, social and environmental. Hence a good measure of sustainable development should include all of the three components. Following UN (2014), thirteen variables are selected for this purpose out of which five are related to economic performance, five are related to social development, and three captures environmental aspects of Pakistan economy. The variables which are included in construction of sustainable development index (SDI) are GDP growth rate, employment to population ratio, gross capital formation, gross national expenditures, energy usage [economic], life expectancy at birth, government expenditures on education, final consumption expenditures, merchandise imports from low and middle income countries, net official development assistance and aid received [social], fossil fuel energy consumption, total greenhouse gas emissions, and other greenhouse gas emissions [environmental]. Data on these variables is collected from 1980 to 2016 and utilized data source is World Development Indicators disseminated by the World Bank. For construction of index all these variables are firstly normalized to the value between 0 to 1. Economic and social indicators are treated positively and environmental indicators are treated negatively on account of their relationship with sustainable development. Then averaging is used for the purpose of constructing an index of sustainable development. After construction the index (SDI) is decomposed into economic component of sustainable development (ECSD), social component of sustainable development (SSD) and environmental component of sustainable development (ENSD). Some of values in data were missing which were filled by appropriate statistical techniques. Afterward, these indexes are used in causality analysis.

On the basis of Vector Autoregrssion (VAR) model, Cointegration, Vector Error Correction Mechanism (VECM) and Granger Causality methods, this study performed causality analysis. As per procedure followed in this study, first of all the unit root hypothesis is checked for all the variables and if integration order is one then the variable is considered for analysis. In the next step cointegration between variables of the model is estimated. In case of no cointegration, granger causality is applied whereas in case of cointegration among the variables the movement to the next step of VECM is carried. Residual diagnostics in each case are also estimated for checking consistency of the results.

Sixteen different model are estimated. There are four variables of sustainable development that is SDI, ECSD, SSD and ENSD and for each of these variables causality is found out for four variables of infrastructure that is INF, ECINF, ENINF and SINF. Hence causality analysis is applied over sixteen models.

3.2 Results and Discussion

First of all, in Table 3, ADF unit root tests are presented. Unit root tests are applied not only in levels but also in first differences and for each of these scenarios the models of ‘intercept’, ‘intercept and trend’, and ‘none’ are utilized. Thereafter, decision regarding integration order is made on the basis of overwhelming evidence of rejection of unit root hypothesis. It could be observed in the table that all of the variables possess unit root in levels and are found to be stationary at first difference.

Table 3

ADF Unit Roots Test

Variable	Statistic	Level			First Difference			Integration Order
		Intercept	Intercept and trend	None	Intercept	Intercept and trend	None	
INF	ADF	-5.869	-2.366	-0.156	-3.452	-6.512	-2.834	I(1)
	Prob	0.000	0.389	0.621	0.016	0.000	0.006	
ECINF	ADF	0.423	-2.106	-0.363	-5.304	-5.346	-4.094	I(1)
	Prob	0.981	0.524	0.546	0.000	0.001	0.000	
SINF	ADF	-0.222	-4.379	-0.962	-5.314	-5.234	-2.791	I(1)
	Prob	0.926	0.010	0.293	0.000	0.001	0.007	
ENINF	ADF	-2.342	-2.675	-2.459	-7.387	-7.524	-7.363	I(1)
	Prob	0.166	0.253	0.016	0.000	0.000	0.000	
SDI	ADF	-1.8967	-1.7441	-0.4635	-5.3877	-5.3110	-5.4751	I(1)
	Prob	0.3297	0.7085	0.5068	0.0001	0.0008	0	
ECSD	ADF	-2.3940	-2.3465	-0.2660	-5.8044	-5.7005	-5.8924	I(1)
	Prob	0.1511	0.399	0.5826	0.0000	0.0003	0.0000	
SSD	ADF	-0.8954	-2.0838	0.44819	-5.3237	-5.4941	-5.1678	I(1)
	Prob	0.7771	0.5354	0.8056	0.0001	0.0005	0.0000	
ENSD	ADF	-1.2877	-4.2425	0.71382	-5.4173	-5.3186	-5.1952	I(1)
	Prob	0.6234	0.0108	0.8645	0.0001	0.0008	0.0000	

Results are estimated by authors

Table: 4

Models for Sustainable Development

Trend Assumption	**Intercept No Trend**										
Variables For VAR (Model)	**Cointegration Analysis**		**VECM**			**Granger Causality**		**Residual Diagnostics on VAR/VECM**			
	Trace	**Eigenvalue**	**Dependent Variable**	**Coefficient**		**Dependent**	**Chi Square**	**Auto Correlation**		**Normality**	**Heteroscedasticity**
				Adjustment	**Independent**			**Lags**	**LM**	**JB**	**Chi Sq.**
SDI and INF	15.337	12.00625	SDI	-	-	SDI	4.25157	1	1.657695	5.40277	30.0979
			INF	-	-	INF	1.01722	2	0.454073		
SDI and ECINF	13.997	13.27059	SDI	-	-	SDI	2.53254	1	3.961034	18.97732*	30.57711
			ECINF	-	-	ECINF	18.2171*	2	4.094547		
SDI and ENINF	12.853	9.377697	SDI	-	-	SDI	12.0792*	1	8.225565	5.401467	34.35005
			ENINF	-	-	ENINF	2.7262	2	3.245112		
SDI and SINF	4.2307	4.199708	SDI	-	-	SDI	2.57375	1	2.328505	3.247511	22.61389
			SINF	-	-	SINF	5.76138	2	2.7526		

INF: Infrastructure Index, ECINF: Economic Infrastructure Index, ENINF: Energy Infrastructure Index, SINF: Social Infrastructure Index

* Significant at 1 %, **Significant at 5%

Estimated by Authors

After unit root testing, now in Table 4, causality analysis is exhibited for sustainable development index with four components of infrastructure index. In this way it has been tried to explore the causality connection between sustainable development and infrastructure comprehensively. Lag length of all the models presented in this study are selected on the basis of 'Akaike Information Criterion'. In this model lag length is found to be 2, thereafter, using the lag length Johansen test of cointegration is applied. It looks that both the trace test and eigenvalue test are not significant, so there exists no cointegration among sustainable development index and infrastructure index.

In the next step granger causality test is employed and it is found out that causality among the variables does not exist in either direction. Therefore, in case of overall infrastructure it looks that the infrastructure simultaneously has no causal connection with sustainable development. Whether these results are robust or not? Answer to this question lie in the results of diagnostic testing. The autocorrelation, normality and heteroscedasticity tests are taken up over VAR estimation and results show that there exists no such problem in the analysis. In these circumstances the results of no causality connection among sustainable development and infrastructure is found to be significant and robust.

Next is the analysis between sustainable development and economic component of infrastructure index. No cointegration among the variables is obvious from trace and eigenvalue tests. Causality is found to be only existed from sustainable development to economic infrastructure and there exists no causal connection running from economic infrastructure to sustainable development. So far as stability of the analysis is concerned it comes to the surface from three tests of residuals (autocorrelation, normality and heteroscedasticity) over VAR estimation that normality of the sample to be analyzed is not established. Therefore, estimated results could not be termed as robust and significant instead highlights spuriousness.

Further, it is apparent that there is no cointegration among the variables of sustainable development and energy infrastructure. This fact is evident from trace test statistics and eigenvalue test statistics and the hypothesis that there exists no cointegration equation is accepted. However, causality analysis shows that causal connection is only to be existed from energy infrastructure to sustainable development and reverse causality from sustainable development to energy infrastructure is not confirmed because the hypothesis of no causality is accepted on the ground that chi-square statistics is higher than the critical value. Stability tests of VAR analysis shows that there is no problem of autocorrelation and heteroscedasticity among the variables of the model and the sample tested here is normally distributed.

In investigating the causality connection between sustainable development and social infrastructure no cointegration is scrutinized between the variables of the model; hence, model lacks long-run relationship among the variables. In this situation, the granger causality is used and it is found out that causality connection is not established in either direction. Neither sustainable development cause social infrastructure nor social infrastructure cause sustainable development. When residual diagnostics of the model are assessed it is found out that there is no problem of autocorrelation, non-normality and heteroscedasticity in the sample under analysis.

Table: 5

Models for Economic Component of Sustainable Development (ECSD)

Trend Assumption	**Intercept No Trend**										
Variables For VAR (Model)	**Cointegration Analysis**		**VECM**			**Causality Analysis**		**Residual Diagnostics on VAR/VECM**			
	Trace	**Eigenvalue**	**Dependent Variable**	**Coefficient**		**Dependent**	**Chi Square**	**Auto Correlation**		**Normality**	**Heterosc-edasticity**
				Adjustment	**Independent**			**Lags**	**LM**	**JB**	**Chi Sq.**
ECSD and INF	47.617*	40.26111*	ECSD	-0.020242	-0.201547	ECSD	-	1	2.399745	4.429131	15.37109
			INF	-0.103508*	-0.159531	INF	-	2	-		
ECSD and ECINF	10.18413	10.13704	ECSD	-	-	ECSD	0.068174	1	8.877623	43.45956*	22.8862
			ECINF	-	-	ECINF	7.730706**	2	-		
ECSD and ENINF	15.36761	10.04261	ECSD	-	-	ECSD	8.702923**	1	7.11118	4.551472	29.87173
			ENINF	-	-	ENINF	2.055085	2	5.957451		
ECSD and SINF	9.428852	9.226153	ECSD	-	-	ECSD	4.186231	1	3.247121	4.381449	28.13974
			SINF	-	-	SINF	1.911506	2	-		

INF: Infrastructure Index, EFINF: Economic Infrastructure Index, ENINF: Energy Infrastructure Index, SINF: Social Infrastructure Index

* Significant at 1 %, **Significant at 5%; Estimated by Authors

Next, in Table 5, the case of economic component of sustainable development establishes that cointegration among the variables is confirmed which highlights long run relationship between the two. On application of VECM to the model the results show that adjustment term, in equation of economic component of sustainable development as dependent variable, is found to be negative but not significant. This means that in the long run the variables are even converging towards equilibrium but same fact is not statistically significant.

In these circumstances it could be inferred that in the long run there is no causality running from infrastructure to economic component of sustainable development. In the same scenario, the coefficient of infrastructure with lag one is found to be insignificant which points out that causality from infrastructure to economic component of sustainable development is also not to be proved in the short run. On the same parameters when causal connection from economic component of sustainable development to infrastructure is analyzed in the equation considering infrastructure as dependent variable, it is noticed that causal connection from economic component of sustainable development to infrastructure is established in the long run but same is not confirmed in the short run. Stability tests of the VECM also confirm that the analysis is free from the problems of autocorrelation, non-normality and heteroscedasticity. Therefore, these long run and short run causality connections are not found to be spurious.

When causality analysis between economic component of sustainable development and economic infrastructure is evaluated then it is found that cointegration among the variables of the model does not exist which poses no long run relationship among them. Granger causality is showing causality connection only from economic component of sustainable development to economic infrastructure. Stability tests are also not considered to be fine because the sample analyzed is not distributed normally.

Causality analysis between economic component of sustainable development and energy infrastructure is represented in the next row where cointegration does not exist. Causality runs only from energy infrastructure to economic component of sustainable development. Stability tests are posing no problem of autocorrelation, non-normality, and heteroscedasticity.

In next step the causality of economic component of sustainable development and social infrastructure is analyzed. No cointegration is observed in Trace and Eigenvalue tests. Granger causality tests show that there is no causality connection between economic component of sustainable development and social infrastructure. Stability tests are also found to be sufficient to show no autocorrelation, normally distributed sample and no heteroscedasticity.

Then analysis turns to the causality connection between social component of sustainable development and infrastructure. As earlier discussed, when there is cointegration between variables then long run relationship is established and VECM modeling is utilized. For this purpose, sign and statistical significance of adjustment term along with independent variables in each equation of structural set of VEC is checked to find out long run and short run causality. For long run causality the adjustment term is important and for short run causality independent variables, in each equation of VECM structural system, are focused.

Table: 6

Models for Social Component of Sustainable Development (SSD)

Trend Assumption	**Intercept No Trend**										
Variables For VAR (Model)	**Cointegration Analysis**		**VECM**			**Causality Analysis**		**Residual Diagnostics on VAR/VECM**			
	Trace	**Eigenvalue**	**Dependent Variable**	**Coefficient**		**Dependent**	**Chi Square**	**Auto Correlation**		**Normality**	**Heteroscedasticity**
				Adjustment	**Independent**			**Lags**	**LM**	**JB**	**Chi Sq.**
SSD and INF	40.9624*	38.8642*	SSD	-0.000176	-0.133112	SSD	-	1	3.706562	7.164325	21.51547
			INF	-0.002203*	-0.091786	INF	-	2	-		
SSD and ECINF	13.26184	0.800231	SSD	-	-	SSD	14.01492*	1	3.70339	41.87853*	23.47592
			ECINF	-	-	ECINF	12.12307*	2	7.300712		
SSD and ENINF	7.089908	4.266064	SSD	-	-	SSD	2.935545	1	5.852059	3.433488	25.715
			ENINF	-	-	ENINF	2.818905	2	-		
SSD and SINF	4.949366	4.949004	SSD	-	-	SSD	4.424418	1	3.400792	8.449172	29.16547
			SINF	-	-	SINF	1.691404	2	-		

INF: Infrastructure Index, EFINF: Economic Infrastructure Index, ENINF: Energy Infrastructure Index, SINF: Social Infrastructure Index

* Significant at 1 %, **Significant at 5%

Estimated by Authors

In Table 6, it is apparent that long run causality is established only from social component of sustainable development to infrastructure. And no other causality connection is observed either in long run or short run. Sample is also found to be fit for stability tests. There is no auto-correlation, sample is normally distributed, and there is no heteroscedasticity.

Thereafter analysis regarding causality related to social component of sustainable development is decomposed for three components of infrastructure i.e. economic, energy and social and results are presented.

In the analysis for causality relationship of social component of sustainable development with economic infrastructure it is perceived that there is no long run relationship between these two variables because Trace and Eigenvalue tests of cointegration are not significant and rejects the hypothesis that there exists at least one cointegration equation. Granger causality analysis demonstrates that causality is bidirectional among these variables and not only social component of sustainable development causes economic infrastructure but reverse causal connection is also verified. However, when autocorrelation, normal distribution and heteroscedasticity is checked for the sample analyzed it is found out that there is no problem of autocorrelation and heteroscedasticity but the sample is not distributed normally. Therefore, it could be inferred that the analysis is not trustworthy and reliable.

In next row of the table the model of social component of sustainable development and energy infrastructure is presented. First section of the table shows cointegration analysis and it is found out by the inspection of Trace and Eigenvalue tests that there is no evidence of cointegration and long run relationship among the variables of the model. This leads the analysis for Granger causality test which illustrates that these two variables are independent and there is no causal connection in any direction. The stability of the tests conducted on VAR model could be established by the residual diagnostic tests as mentioned in stability section and it is found out that the sample is stable enough to believe the causality analysis accomplished here because no evidence of autocorrelation, non-normality and heteroscedasticity is observed in results.

Concise evidence in next row proves that variables of the model exploring causality between social component of sustainable development and social infrastructure, are independent and causality does not run in any direction. So far as reliability of the results is concerned it could be examined in stability part of the table that no major problem of heteroscedasticity, non-normality and autocorrelation are mined in sample diagnostic tests. Hence, overall the causality analysis is reliable and trustworthy.

Table: 7

Models for Environmental Component of Sustainable Development (ENSD)

Trend Assumption	**Intercept No Trend**										
Variables For VAR (Model)	**Cointegration Analysis**		**VECM**			**Causality Analysis**		**Residual Diagnostics on VAR/VECM**			
	Trace	**Eigenvalue**	**Dependent Variable**	**Coefficient**		**Dependent**	**Chi Square**	**Auto Correlation**		**Normality**	**Heterosc-edasticity**
				Adjustment	**Independent**			**Lags**	**LM**	**JB**	**Chi Sq.**
ENSD and INF	49.4502*	41.4535*	ENSD	-0.007454	0.102289	ENSD	-	1	3.021997	180.5711*	14.51005
			INF	0.081339*	0.007	INF	-	2	-		
ENSD and ECINF	13.21072	13.19093	ENSD	-	-	ENSD	7.0979**	1	2.375627	711.003*	33.64869
			ECINF	-	-	ECINF	6.9571**	2	-		
ENSD and ENINF	11.03526	7.178881	ENSD	-	-	ENSD	3.937474	1	5.23997	145.659*	21.97045
			ENINF	-	-	ENINF	0.452003	2	-		
ENSD and SINF	15.787**	15.620**	ENSD	-0.7651*	0.146667	ENSD	-	1	5.732067	281.782*	18.72933
			SINF	-0.181775	-0.231268	SINF	-	2	-		

INF: Infrastructure Index, EFINF: Economic Infrastructure Index, ENINF: Energy Infrastructure Index, SINF: Social Infrastructure Index

* Significant at 1 %, **Significant at 5%

Estimated by Authors

Table 7 presents the causality analysis of environmental component of sustainable development for overall infrastructure and its three components. Succinct facts out of analysis in top rows clearly mention that causality is not observed in any direction or in any time format for overall infrastructure and environmental component of sustainable development. Even it is manifested that there is a long run relationship between the environmental degradation and infrastructure but when specifically, the causality is checked by the adjustment term and independent variables then it is noticed that adjustment term and independent variable of environmental component of sustainable development are not significant. Hence no evidence of long run or short run causality from infrastructure to environmental component of sustainable development. However, in case of adjustment term in infrastructure equation the adjustment term is positive and significant which highlights the situation that in the long run model is not converging towards equilibrium. This is why causality does not find to be existed from environmental component to infrastructure. This fact is also close to the theoretical aspects of the role of environmental degradation in infrastructural development. Independent variable is not significant which negates short run causality. One more fact is worth mentioning here that sample observed for this purpose is not confirming stability. Assumption of the normal distribution of the sample analyzed for VAR is not established because hypothesis of 'residuals are multivariate normal' is rejected.

Table: 7 also elaborates the causality between environmental component of sustainable development and economic infrastructure. Cointegration does not exist and bidirectional causality is concluded on account of granger causality results. Stability is known to be weak because sample is not found to be distributed normally and lacks the assumption of normal distribution.

4. Conclusions and Recommendations

In this study, bearing in mind that infrastructure is the main investment of CPEC, it has been tried to analyze the CPEC initiative in the light of performance of Pakistan economy comprehensively. Association of infrastructure with sustainable development is the core analyzing tool and causality analysis and forecasting analyses are employed for this purpose. In this way if infrastructure has such past associations which could lead to future forecasts then it could be concluded that there is a positive hope with the CPEC initiative. Firstly, analysis-based conclusions of the study are presented in following paragraphs and then recommendations are mentioned in the last.

Descriptive Analysis

Available information as discussed in Section 2 of this study highlights that in total there are 75 projects included in CPEC. Out of which largest number of projects relates to energy projects which are 32 percent out of total projects. Other projects included are infrastructure, mass transit, Gwadar port, special economic zones and others. List of completed projects show that twelve percent projects are operational till yet and twenty three percent projects will be completed up to 2025 while remaining sixty five percent projects are long term and are still under consideration. Long term projects pose different phases just like some projects are still on the table, some are in feasibility stage and some are even near to be implemented on ground. Pakistan's financial contribution in total projects is 10 percent and remaining finance will be initialized by China.

Association between infrastructure and sustainable development

The data from 1980 to 2013 after causality analysis depicts that in the long run infrastructure has no causal connection with sustainable development. However, major conclusion of this study highlights that causality in the long run actually runs from economic and social components of sustainable development to overall infrastructure. The result in the long run is near to reality because Pakistan is a developing country and lacks finances for infrastructural investments therefore; no major investment in infrastructure is occurred that could improve the economic and social impact over the economy. However, the phenomenon for investment in infrastructure remains dependent mainly on economic growth and economic development. This is why in the long run reverse causality from economic and social components of sustainable development to infrastructure is not surprising. The evidence is supported by Yu, Qian, and Liu (2019). However, as far as short run horizon of the study is concerned, it is evident that energy infrastructure plays its role effectively. Energy infrastructure not only associates in a causal connection with economic component of sustainable development but also with the overall sustainable development. Energy resources have the force to augment economic activity in the short run only which in turn associates with development of the country. Energy problems of the country are not resolved in the long run. After every decade country is facing the same problem of energy shortage, hence, impact is observed in the short run only.

Performance of Pakistan Economy in the Perspective of CPEC Investment

Causality from infrastructure to sustainable development is only observed in the short run scenario and only from energy infrastructure to sustainable development and for its economic component. After analysis it comes to the surface that energy infrastructure has the force to affect the behaviors of economic component of sustainable development and sustainable development. However, it is noteworthy conclusion that on the basis of available information and in bounded rationality the strength of the energy infrastructure could not be measured accurately. Hence, the positive response of sustainable development in future on the basis of energy infrastructure is concluded.

It is also necessary to highlight that this study faces the constraints of data collection and overall data used is not sufficient to pose the evidence about association between infrastructure and environmental status of Pakistan economy. On account of reasons mentioned below this study is very hopeful that CPEC initiative could prove very helpful for Pakistan economy if investments in infrastructure are pro-environment [The evidence is in line with Zhai (2018) and Liang & Zhang (2019)]:

a) Major investment in CPEC is on energy projects

b) Energy infrastructure has the short run causality with sustainable development

c) In future also, energy infrastructure has the force to enhance sustainable development

In these circumstances this study suggests that infrastructural investments, in case of CPEC, should be utilized in the perspective of environmental degradation while keeping keen interest on international standards thereof.

References

ACCA. (2017). *The Belt and Road Initiative: Reshaping the Global Value Chain.* London: Shanghai Stock Exchange and The Association of Chartered Certified Accountants.

Ahmad, I., & Malik, S. (2012). Rural Infrastructural Development and Economic Growth: A Time-Series Evidence from Pakistan (1981-2010). *Australian Journal of Business and Management Research, 2*(1), 51-57.

Ahmad, I., Azam, A., & Aziz, B. (2016). Rural Infrastructural Development and Its Role in Poverty Reduction: Evidence from Pakistan. *Pakistan Journal of Applied Economics, Special Issue*, 185-204.

Albaba-Bertrand, J., & Emmanuel, M. (2004). The Impact of Infrastructure on the Productivity of the Chilean Economy. *Review of Development Economics, 8*(2), 266-278.

Calabrese, J. (2015). Balancing on 'The Fulcrum of Asia':China's Pakistan Strategy. *Indian Journal of Asian Affairs, 27/28*(1/2), 1-20.

Calderon, C., & Serven, L. (2011). Infrastructure in Latin America. In J. A. Ocampo, & J. Ros, *The Oxford Handbook of Latin American Economics* (pp. 659-691). Oxford University Press.

Dadwal, S. R., & Purushothaman, C. (2017). CPEC in Pakistan's Quest for Energy Security. *Strategic Analysis, 41*(5), 515-524.

Daniel, G., David, B., Les, B., & Fergus, W. (2011). Sustainable Development for Major Infrastructure Projects. *Proceedings of teh Institution of Civil Engineers, 164*(1), 15-24.

Deepak, B. R. (2018). *China's Global Rebalancing and The New Silk Road.* Singapore: Springer.

Edgar, P., Parnell, S., & Haysom, G. (2018). African Dreams: Locating Urban Infrastructure in the 2030 Sustainable Developmental Agenda. *Area Development and Policy, 3*(2), 149-169.

Fay, M., Leipziger, D., Wodon, Q., & Yepes, T. (2005). Achieving Child-Health-Related Millennium Development Goals: The Role of Infrastructure. *World Development, 33*(8), 1267-1284.

Fernandez-Sanches, G., & Rodriguez-Lopez, F. (2010). A Methodology to Identify Sustainability Indicators in Construction Project Management-Application to Infrastructure Projects in Spain. *Ecological Indicators, 10*(6), 1193-1201.

Garlick, J. (2018). Deconstructing the China-Pakistan Economic Corridor: Pipe Dreams Versus Geopolitical Realities. *Journal of Contemporary China, 27*(112), 519-533.

Golley, J., & Ingle, A. (2018). The Belt and The Road Initiative: How to Win Friends and Influence People. In J. Golley, & L. Taivin, *Prosperity* (pp. 42-61). ANU Press.

GoP, & PRC. (2017). *Long Term Plan for China Pakistan Economic Corriodor (2017-2013).* Ministry of Planning, Government of Pakistan (GoP) & National Development & Reform Commission, Peoples Republic of China (PRC).

Gramlich, E. M. (1994). Infrastructure Investment: A Review Essay. *Journal of Economic Literature, 32*(3), 1176-1196.

Guo, H., Liu, J., Qiu, Y., Menenti, M., Chen, F., Uhlir, P. F., . . . Liu, J. (2018). The Digital Belt and Road Program in Support of Regional Sustainability. *International Journal of Digital Earth, 11*(7), 657-669.

Jacob, J. T. (2017). China's Belt and Road Initiative: Perspectives from India. *China and World Economy, 25*(5), 78-100.

Koboevic, Z., Kurtela, Z., & Vujicic, S. (2018). The Maritime Silk Road and China's Belt and Road Initiative. *Znanstveni casopis za more i pomorstvo (Journal of Marine Sciences), 65*(2), 113-122.

Lecocq, F., & Shalizi, Z. (2014). The Economics of Targeted Mitigation in Infrastructure. *Climate Policy, 14*, 187-208.

Liang, H., & Zhang, Y. (2019). Digital Trade: The Innovation Network of Belt and Road. In H. Liang, & Y. Zhang, *The Theoretical System of Belt and Road Initiative* (pp. 111-115). Singapore: Springer.

Mirza, S. (2006). Durability and Sustainability of Infrastructure- A State of the Art Report. *Canadian Journal of Civil Engineering, 33*(6), 639-649.

Nilesh, A., & Boeing, L. (2017). Sustainable Infrastructure Development Challenges through PPP Procurement Process: Indian Perspective. *Internationale Journal of Managing Projects in Business, 10*(3), 642-662.

Panneerselvam, P. (2017). Maritime Component of China-Pakistan Economic Corridor (CPEC): India-China Competition in the Arabian Sea. *Maritime Affairs: Journal of the National Maritime Foundation of India, 13*(2), 37-49.

Pitlo III, L. B., & Karambelkar, A. (2015). India's Perception and Response to China's "One Belt, One Road" Initiative: Views from Indian Mainstream Media. *Asain Politics and Policy, 7*(4), 667-671.

Rakisists, C. (2015). A Path to the Sea: China's Pakistan Plan. *World Affairs, 178*(3), 67-74.

Romp, W. E., & de Haan, J. (2005). Public Capital and Economic Growth: A Critical Survey. *EIB Papers, 10*(1), 41-70.

Shalizi, Z., & Lecocq, F. (2010). To Mitigate or to Adapt: Is That the Question? Observations on an Appropriate Response to the Climate Change Challenge to Development Strategies. *The World Bank Research Observer, 25*(2), 295-321.

Simone, A. M. (2014). Infrastructure, Real Economies and Social Transformation: Assembling the Components for Regional Urban Development in Africa. In S. Parnel, & E. Pieterse, *Africa's Urban Revolution* (pp. 221-236). London: Zed Books.

Thurer, M., Tomasevic, I., Stevenson, M., Blome, C., Melnyk, S., Chan, H. K., & Huang, G. Q. (2019). A Systematic Review of China's Belt and Road Initiative: Implications for Global Supply Chain Management. *International Journal of Production Research*, 1-18.

Tian, X., Hu, Y., Yin, H., Geng, Y., & Bleischwitz, R. (2019). Trade Impacts of China's Belt and Road Initiative: From Resource and Environmental Perspectives. *Resource, Conservation & Recycling, 150*, 1-8.

Turok, I., & McGranahan, G. (2013). Urbanization and Economic Growth: The Arguments and Evidence for Africa and Asia. *Environment and Urbanization, 25*(2), 465-482.

UN. (2012). *Realizing The Future We Want for All. Report to the Secretary-General.* New York: United Nations.

UN. (2014). *CES Recommendations on Measuring Sustainable Development*". New York and Geneva: United Nations Economic Commission for Europe, United Nations.

Wolf, S. O. (2017). China Pakistan Economic Corridor and its Impact on Regionalisation in South Asia. In S. Bandyopadhyay, A. Torre, P. Casaca, & T. Dentinho, *Regional Cooperation in South Asis: Socio-Economic, Spatial, Ecological and Institutional Aspects.* Cham: Springer.

Wu, Y., Wang, J., Ji, S., & Song, Z. (2019). Renewable Energy Risk Assessment for Nations along China's Belt and Road Initiative: An ANP-Cloud Model Method. *Energy, 30*, 1-19.

Yu, S., Qian, X., & Liu, T. (2019). Belt and Road Initiative and Chinese Firms' Outward Foreign Direct Investment. *Emerging Markets Review*, 1-22.

Zhai, F. (2018). China's Belt and Road Initiative: A Preliminary Quantitative Assessment. *Journal of Asian Economies, 30*, 1-9.