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RESEARCH ARTICLE

Industrialization, Freight Transport and Environmental Quality: Evidence from Belt and Road Initiative Economies

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Abstract

Belt and Road initiative has been proposed by China to initiate the cooperation among relevant countries in sector of energy and Trade. The study investigate highlighting the relationship between industrial value added per capita, transport freight and CO_2 emission among the partner countries of Belt and Road initiatives by using panel of 33 economies from 1986-2017. Study includes panel autoregressive distributed lag model (ARDL) to estimate the long-run relationship among variables. Estimated results of pool mean group (PMG) indicates that increase in industrial value added per capita and transport freight deteriorates the quality of environment in long-run. However, short-run results of granger causality reveals positive and unidirectional causality running from industrial value added per capita to emission of CO_2 while transport freight and CO_2 emission shows bidirectional causality. The study emphasized to formulate environment friendly policies in industrial and transport sector.

Keywords CO_2 emission, Industrialization · Autoregressive distributed lag model · transport freight, causality

JEL Classification P18 · Q19 · Q20

Introduction

Standard of living has been dramatically increased for the last two decades due to innovation of new technologies among industrial and other sector of the economy but it also affects the quality of environment due to excessive rise in CO_2 emission (Uddin et al. 2016; Maliszewska and Mensbrugghe 2019). President of China "Xi Jinping" started the project of one belt one road (OBOR) in fall 2013. The creation of novel institutional linkages was initiated by developing networks of trade and development among Africa, Europe, Asia and Middle East. It can also enhance regional association and collaboration of economic policy. The realization of Asian Prophecy will step forward after the extension of old "Silk Road", which is initiated in the name of OBOR. The OBOR comprises of various big projects but "Silk Road Economic Belt (SREB)" and "Maritime Silk Road (MSR)" are two major programmes of OBOR. These two programmes were initiated by the Chinese president "Xi Jinping" during the visit of Indonesia and Kazakhstan. The OBOR has various projects for the connection between Baltic Ocean and Pacific Ocean by using sea lanes, roads and railways for free trade. Keeping in view the interest of shared economy; OBOR will not only the game changer for the economy of china but also for partner countries. The approximate cost of OBOR is $21.1 trillion and comprises of more than 65 economies, which is around 80% of population (Hafeez et al. 2019; Klinger 2019).

Figure 1 displays that the program of MSR will be initiated from the origin of Guangzhou, which is situated in Yunan province of South China linked with different sea ports such as Bay of Bengal, Andaman Sea, Arabian Sea, the Persian Gulf and further ended at Baltic Sea. In addition, the next component of OBOR is SREB, which is composed of roads and railways for the connection of trade among countries. The SERB composed of "China-Mongolia-Russia Land", "The China-Central Asia-West Asia Corridor", "China-India-

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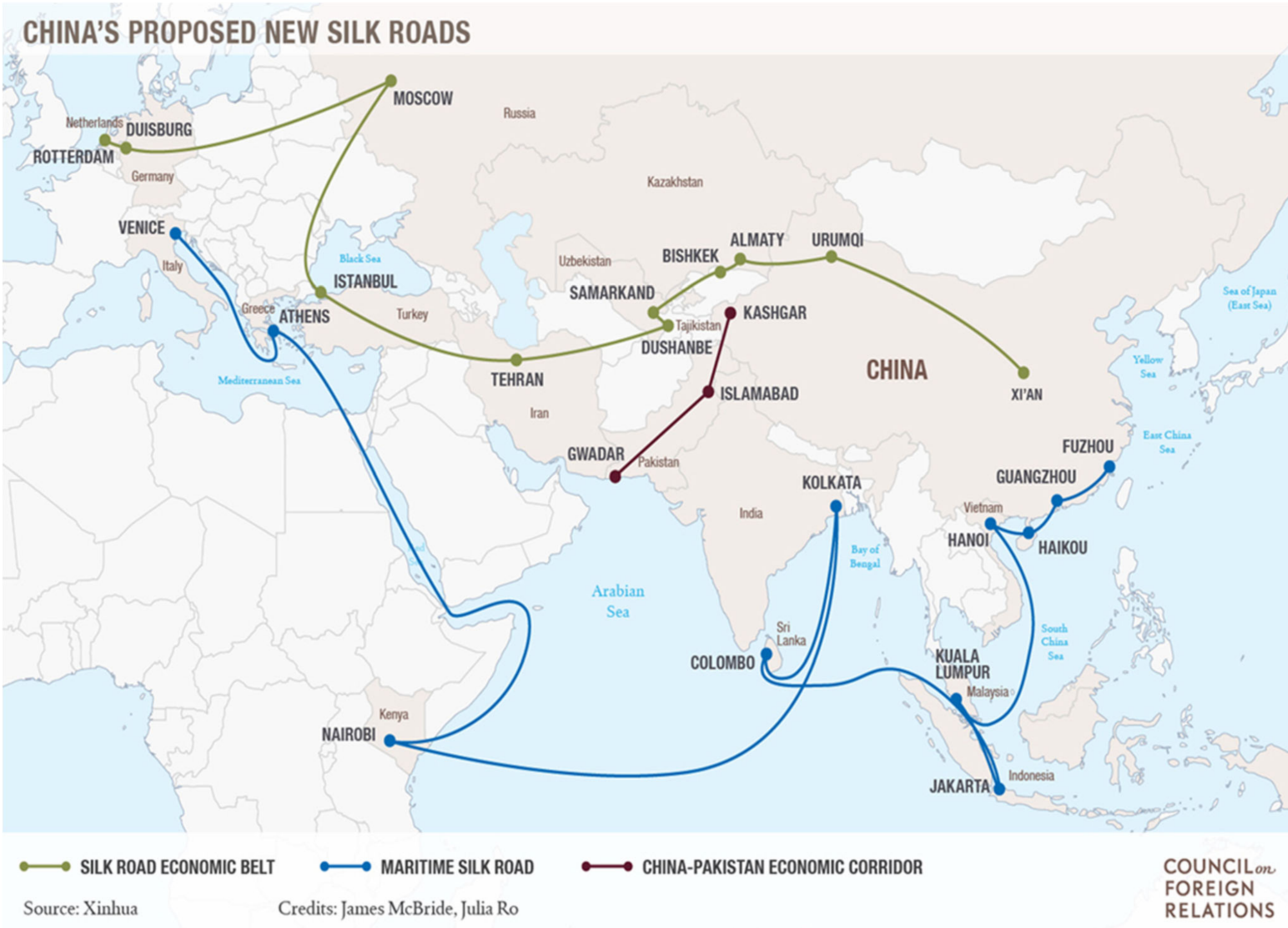

Figure 1: China recommended OBOR project, including three main programmes including "Silk Road Economic Belt, Maritime Silk Road and China-Pakistan Economic Corridor. Source Mc Bride 2015

Bangladesh-Myanmar Corridor" and China-Pakistan Economic Corridor which is discussed in red line. The routes of discussed Corridors can be seen on map. However, the financing of this mega project can be helped by several sources such as "The Asia Infrastructure and Investment Bank (AIIB), New Development Bank and "China-ASEAN Interbank Association" (Saud et al. 2019; Kui and Jiawei 2017; Chen 2016). The project of OBOR can encourage efficient allocation of resources, trade and maintain economic growth across the region but this will damage the environmental quality (Ozturk and Acaravci 2010; Uddin et al. 2016; Maliszewska and Mensbrugghe 2019).

Furthermore, many studies such as (Baum 2000; Baum and Kurte (2002); Akbostancı et al. (2009); Shahbaz et al. 2013 elucidates that industrialization, freight transport and increase in per-capita income plays significant role in deteriorating the quality of environment. However, transportation sector is one of the major consumers of energy. Increase in transportation will lead to increase in economic growth due to building of linkages between production and consumption market by movements of goods and services. Increase in services of transportation will lead to increase in consumption of energy such as fossil fuels, which further depreciate the quality of environment (Léonardi and Baumgartner 2004a). Ecological freight transport was first introduced by China in 2012. Reduction in emission of CO_2, control on air pollution due to commercial use of road transport, energy efficiency and specialized version of cargo management was the main objective of this national program. Moreover, Indonesia has adopted several steps for sustainable system of freight transport and parallel emission of CO_2. The main initiatives includes substitution towards more environmental means of transport such as transport of maritime and rails for short distance (Achour and Belloumi 2016; Adom et al. 2017; Banister and Stead 2002; Chi 2016; UNCTAD 2015). In addition, (United Nation Conference on Trade and Developmen) UNCTAD (2015) elucidates that transport sector consumes approximately 67% of final petroleum consumption of the world in 2012. However, it is forecasted that consumption of global energy will increase by 82% from 2008 to 2035, while demand for energy will rise around the globe by 78% from 2010-2040 due to increase in usage of commercial transportation. Consequences upon these circumstances; the emission of pollutants and greenhouse gases will increase in the atmosphere. In 2012, it is estimated that 25% of CO_2 emission will increase due to combustion of fuels among transportation sector while it is forecasted that CO_2 emission will rise about 1.7% annually by 2030. In addition, it is forecasted that 80% of CO_2 emission will rise among less developing countries due to increase in usage of land transport. However, commercial cargo and international transport will account 3.9% for CO_2 emission by 2050 (Nasreen et al. 2018; Chi and Baek 2013; Fosgerau and Kveiborg 2004).

Furthermore, increase in industrialization will denigrate the environmental quality due to increase in the emission of industrial waste, harmful products, contains heavy metals and increase the level of energy consumption; combined with greenhouse gases. Previous last three decades, south Asian economies are heavily dependent on industrial sector. Therefore, fisheries, factory and agriculture show remarkable increase in their growth. In 1990's manufacturing sector accounts 30% share to GDP in Malaysia and Thailand, while Phillipines and Indonesia accounts more than 20% share in GDP. However, developed countries emit more than 70% of world's CO_2 in 1960's (Brandon 1994; Ekins 1997; Pandya et al. 2003; Akbostancı et al. 2009; WEPA 2010). However, the level of CO_2 emission increased remarkably due to utilization of fossil fuels by the industries, which act as main cause of energy. That's why application fossil fuels among several industries contribute mainly in emission of CO_2 in the atmosphere. However, industries emit 37% of greenhouse gases; out of which total utilization of energy accounts 80%. The consumption of these fossil fuels in excess amount will reduce their natural reserves on earth, which further hurts the environmental quality and climate change. In conclusion of above discussion for the dangerous effects of fossil fuels; societies should adopt alternative sources of energy, which are less harmful to environment such as geothermal energy, solar wind and biomass. These alternate sources of energy can be used domestically and commercially, so that amount of greenhouse gases and other pollutant will reduce in the atmosphere (Zakhidov et al. 2008; Worrell et al. 2009; Wang et al. 2016; Green Industrial Policy 2017; Farhad et al. 2018;).

In addition, 65% of funds used in generation of energy were grounded on coal-based projects while 1% funds will utilize on wind-based energy generation among economies of Belt and Road countries. China is the only country who is responsible for the utilization of 40% their public investment in coal-based projects around the globe from 2007-2013. It is significant to notify that china is invested in 240 plants, which is coal based for energy generation in 25 partner countries of OBOR. These coal based-plants have 251 gigawatts installed capacity. However, several firms of china are aimed to install 92 additional coal-based power projects in 27 several economies. The emission of CO_2 increased by 61.4% among the partner countries of OBOR project including china. Moreover, the proportion of CO_2 emission for energy generation is about 80% among partner countries of OBOR. This indicates that energy sectors contribute in a greater amount for environmental degradation. Therefore it is important to notify from the above discussion that projects of OBOR will increase the level of economic growth among partner countries at the cost of environment (Global Capital 2015; Statistical Review of World Energy 2017).

The motivation to examine the relationship between industrial value added, transport freight and CO_2 emission is that project of OBOR will not increase the real of income of partner countries but also the other countries of the world due to reduction in trade cost. It is forecasted that OBOR will increase the real income of world by 0.7% by 2030. However, the partner economies will get 70% of this gain with subsequent increase in real income of China (World Bank, 2018; Belt and Road Portal 2018). However, OBOR initiative will benefit all the partner countries in terms of economic growth. It is important to know that how the collaboration of these countries contributes for the reduction in CO_2 emission due to increase in economic growth. Furthermore, gross domestic product of partner countries accounts 45% of world's gross domestic product in 2014 while the consumption of energy among partner countries accounts half of the global energy consumption and the emission of CO_2 from partner economies accounts 54% of world's CO_2 emission. Moreover, India, China and Russia are the major emitter of CO_2 in the atmosphere, which accounts 6%, 28% and 5% of global emission of CO_2 in 2014. In addition, the CO_2 emission will increase in the atmosphere from 2000 to 2014 due to OBOR initiative. Therefore, it is concluded that emission of CO_2 is high among partner countries of one belt one road (OBOR) and these countries have rapid economic growth. This will burn a significant issue for the reduction of CO_2 emission (World development Report 2016; Belt and road initiative 2015; International Energy Agency (IEA) 2016). In addition few researchers such as (Rauf et al. 2018; Zhao et al. 2018; Howard and Howard (2016) elucidate that "global shifting wave" for projects of one belt one road (OBOR) will cause adverse effect on ecosystem and indigenous resources. However, relationship between industrialization, transport freight and quality of environment has not been extensively examined among partner countries of OBOR. To our best knowledge, almost all the available studies are for some particular country or region. However, the main objective of the study is to examine the relationship among industrial value added, transport freight and CO_2 emission among partner countries of OBOR project.

Study incorporates (Pesaran et al. 1997; Peseran et al. 2004) panel ARDL to solve the problem of stationarity and slope heterogeneity. Panel ARDL become popular method of estimation in econometrics due to several reasons. First, it is assumed that choice variable is a function of its past values and the current and past values of other discussed independent variables. However, panel ARDL incorporates different lag structure, which captures the dynamic and static effect of the choice variable. General lag structure will be accommodated in the model and can be easily extended to integrate panel data (Peseran et al. 2004; Rafindadi and Yosuf 2013; Asghar et al. 2015). Secondly, (Pesaran et al. 1997 proposed that ARDL estimate the long-run and short-run simultaneously and resolve the problem for variables having different order of integration such as *I(0) or I(1)*[1]. Third the conventional co-integration technique employs several systems of equations for the estimation of long-run relationship while ARDL technique incorporates single reduced form equation for long-run association. However, Panel ARDL produces robust and consistent estimates for long-run and short-run relationship (Eberhardt and Teal 2011; Pesaran et al., 1995; Pesaran et al. 1997; 1999). In addition, the long-run relationship between the variables is estimated by using pool mean group (PMG), mean group (MG), fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS) which indicate the presence of positive and significant long-run relationship between industrialization, freight transport and CO_2 emission. Moreover, study also discourse the policy implication for the partner countries of OBOR. Next, the assessments portray summarized approvals for the government of countries to manage the quality of environment by using environmental friendly techniques in industrial and transport sector.

Literature Review

Grossman and Krueger (1991) initially discussed the relationship between quality of environment and economic growth, which was further named as "Environmental Kuznet Curve" (EKC). Environmental Kuznet Curve (EKC) hypothesis elucidates that rise in economic growth deteriorate the environmental quality at primary stage, however, later on increase in economic growth will improve the environmental quality. However, policy makers initiate policies, which are environment friendly such as treatment plants in industrial sector, renewable consumption of energy and induction of energy-efficient mechanism, which further decrease the emission of CO_2 and greenhouse gasses in the atmosphere. This shows the inverse U shaped relationship between economic growth and quality of environment. There are many economists such as Shahbaz et al. (2013); Nasir and Rehman 2011; Akbostancı et al. 2009; Wagner 2008; Tao et al. (2008); Johansson and Kriström 2007; Stern et al. (1996) who empirically investigate the relationship between above discussed variables.

In addition, Selden and Song (1994) estimate the relationship between economic growth and CO_2 emission among Asian economies and their findings suggested the inverse U shaped relationship between the discussed variables. Consistent with the findings of (Selden and Song 1994; Jaunky (2011) confirmed the presence of Environmental Kuznet Curve (EKC) hypothesis among 36 high-income economies. On contrary to above findings, some economist such as Arouri et al. (2012); Toman and Jemelkova 2003; Smyth 2013 find the absence of Environmental Kuznet Curve (EKC) hypothesis. Many researchers such as (Xu and Lin 2016; Chen and Chen (2015); Shi 2003; Wang et al. 2018 extended the hypothesis of Environmental Kuznet Curve (EKC) by incorporating some additional variables such as urbanization, financial development and industrialization. Their findings suggested the positive relationship between energy consumption, urbanization and CO_2 emission. Moreover, 50% of population lives in urban areas, which are responsible for the major emission of CO_2 in the atmosphere. Qu et al. (2013) elucidates that increase in emission of CO_2 is caused due to increase in family income and size among particular districts of China. However, Zhao et al. (2018) estimate the relationship between efficiency of energy and CO_2 emission among 35 partner countries of one belt one road (OBOR) project. Their findings suggested that less energy efficient economies are more responsible for the emission of CO_2.

Keeping in view the study of Taiwan, Chang and Lin (1999) shows that majority of industries in Taiwan are extensively emitting CO_2 emission in the atmosphere, which further damages the quality of environment. Furthermore, increase in economic growth in advanced economies due to industrialization also deteriorates the environmental quality (Chaitanya 2007). In addition, Tunç et al. (2009) studied three major sectors of Turkish economy; agriculture, industry and services during the period of thirty six years (1970-2006) to examined the factors which take part to alter the emission level of CO2. The study revealed that, for time period taken for analysis, the discharge of CO2 kept on rising due to continuous contribution of industrial sector. So, industrial sector is main reason to elevate emissions level of CO2. Ahmad et al. (2013) estimate the relationship between industrialization and CO_2 emission among South Asian economies for the period of 1980-2008. Their findings suggested that increase in industrialization leads to increase in CO_2 emission in the atmosphere, which further cause a decline in environmental standards. However, Shahbaz et al. (2014) elucidates that increase in industrialization will cause environmental decay at initial stages but after a certain point industrialization will improve the quality of environment in Bangladesh for the period of 1975-210.

In addition, the relationship between agriculture value added and quality of environment has not been properly established. However, Smith, p. (2004) elucidates that

[1] I(1) means variable is non-stationary at level and stationary at first difference. Hence if the variable is I(1) its arithmetic mean and standard deviation is time variant, making simple OLS approach invalid (Enders, 2008).

agriculture plays an important role for the emission of CO_2 in the atmosphere due microbial decay, plant burning and soil organic matter. Moreover, traditional techniques of farming will also damage the environmental quality among developing regions due to strengthening of farm output in different areas and regional meditation of accomplishments, such as livestock farming. Oenema et al. (2005) shows that application of non-renewable energy sources among agriculture sector also emit CO_2 in the atmosphere. Consistent with the findings of Smith, p. 2004; Oenema et al. 2005, many studies such as (Huang et al. 2002; Trewavas 2002; Green et al. 2005 investigates that application of modern farming techniques and renewable energy sources in agriculture sector will decrease the emission of CO_2. Ben Jebli and Ben Youssef (2017) empirically investigate the relationship between economic activity, agriculture value added, renewable energy consumption and emission of CO_2 in the atmosphere for the case of North African regions. The estimated results reveal the negative relationship between agriculture value added and CO_2 emission in long-run while economic activity, energy consumption and emission of CO_2 exhibits positive and significant relationship in long-run. Furthermore, Reynolds and Wenzlau (2012) discuss that using of farm equipment's, which run by fuel for irrigation, indoor activities of live-stock farming and application of nitrogen rich fertilizer in fields will increase the level of CO_2 emission in the atmosphere. There are many agricultural activities, which can be run by applying renewable energy sources such as solar energy can be used for farm field irrigation and drying of product. Modern biofuels, such as biogas and bioethanol can be used for different residues of agriculture while wind energy can also be utilized for the irrigation of crops, generation of electricity and crops can be grind (Bayrakcı and Kocar 2012; Alvarez et al. 2012; Chebbi 2010; Mushtaq et al. 2007).

Furthermore, Rafaa, and Riadh, h. (2014) empirically investigate the relationship between road freight transport and quality of environment in case of Tunisia. The estimated results show that Tunisian authority of transport utilizes different instruments such as economic and fiscal regulatory to reduce the emission of CO_2. Transport authority should give incentive for the utilization of clean vehicle with unpolluted fuel for the reduction of CO_2 emission. However, the intensity of CO_2 emission can be reduced by reducing the intensity of freight transport by using technological (such as clean fuel and vehicle) and functional (such as economic and fiscal) tools (Vanek and Morlok 2000; Leonardi and Zafirakis 2004). Increase in transportation will have positive impact on the economy but it damages the quality of environment with the passage of time. The scale of road safety has been recognized around the globe for the past few decades. Correspondingly, many studies such as (Peden et al. 2004; Pan et al. 2009; Refaat 2010; Várhelyi (2002) discuss the relationship between road transportation and quality of environment. Currently, the transportation is composed for combustion of fuels, which is the major source of CO_2 emission and air pollution. Moreover, there are other environmental aspects for the increase in transportation such as usage of land, reduction in open space and noise pollution. However, increase in transportation is important for mobility of people and goods for trade, social and economic development. It also increases the employment and educational opportunities but sustainable mobility is a need of an hour. In order to meet the challenges of environment and road safety, several measures have been designed and implemented such as electric vehicle and public transport. (United Nations 2010; Victoria Transport Policy Institute 2010).

Moreover, transport sector and use of land are the major source to deteriorate the environmental quality. Directly, the change in pattern of land use such as from flora to urban is an important reason for the change in climate. However, the behaviour of travelling from one place to other affects the CO_2 emission in the atmosphere (Dhakal 2010; Handy 2005). Many studies such as (Watson et al. 2000; Pena et al. 2007; Dale 1997; Shaw 1992 elucidates that many people lives in area which has great deal of employment and residential density, good connection among several streets and diverse usage of land (e.g mixture of recreational, residential and commercial). These areas are the major source of CO_2 emission in the atmosphere. People living in this type of area did not use car more frequently due to compact neighbourhood while most of the people use transit service. Although public transit service also emits carbon dioxide but CO_2 emission per passenger is very high in personal car in comparison with public transit service. That's why such compact neighbourhood will reduce travelling on personal car and facilitate people to travel by foot or by public transit system. This process will further enhance the quality of environment. In conclusion to the above discussion, linkages among behaviour of travel and urban form forces more passenger to support public transit service. However, connectivity of streets will reduce the walking time from destination to relevant opportunities (McCormack and Edwards 2011; Cervero and Sullivan 2011; Li 2011; Lin and Gau 2006; Cervero 1996)

Many factors such as changes in ecological system and industrial growth, which occur in result of higher economic activities, will deteriorate the quality of environment. Increase in contribution of industrial sector in gross domestic product (GDP) is the main indication for advancement in industrialization. Since the time of its revolution, to surge production's level through constructing and encouraging more factories, the industries had taken unavoidable changes in terms of structure. The one side of the picture demonstrates an eye opening reality regarding industrial outcomes, economies and countries are facing environmental decay which is escalated by huge production of industries, while better and brighter side of picture indicates that industries play outstanding role in assisting to decrease in unemployment as well as poverty level and enriching the economy paving way to ensure higher growth (Shiyi 2009; Shahbaz et al. 2011; Shahbaz et al. 2013).

Data Description and Estimation Technique

Annual data has been collected for the time period of 1986-2017 of selected 33 BRI (Belt Road Initiative) countries. The selection of 33 panel economies is based on the availability of dataset from World Development Indicators (WDI) for variables included in the model. In order to articulate the famous "Going Global through Bilateral Relationship", the project of BRI was introduced by the government of china. More than 68 countries are involved in the project of BRI in order to deeply understand the demand and supply of energy in project operation, ecological sustainability, development of infrastructure, collaboration of trade and business and sustainable development. Therefore, it is important to study the outlook and challenges observed for the success of BRI initiatives[2].

Keeping in view the model of Liu and Bae (2018), which can be extended to test the effect of industrial growth and transportation along with other controlled variables on quality of environment, the general form of model is given below.

$$co_2 = f(ind, ava, ataf, tra, gdp) \quad (1)$$

This study has converted all the variables in to natural logarithm due to linear specification. However, this will give us efficient and reliable estimates as compare to other specification (Waheed et al. 2018; Shahbaz and Lean 2012; Shahbaz et al. 2017). In addition, estimates will convert in to elasticities of standardized units and this will make variables more comparable with each other. The transmuted empirical equation can be written as follows.

$$lco_2 = \beta_0 + \beta_1 lind + \beta_2 lava + \beta_3 lataf + \beta_4 ltra + \beta_5 lgdp \quad (2)$$

Furthermore, lco_2,*lind*, *lava*, *lataf*, *ltra* and lg*dp* are represented as the natural logarithm of CO_2 emission as proxy for the quality of environment[3] (metric tons per capita), industrial value added per capita and agriculture value added per capita (constant 2010 US$). However,*lataf*, *ltra*and lg*dp* measures freight transport (million tons per KM)[4], trade as percentage of GDP (Gross Domestic Product) and GDP per capita (constant 2010 US$). Table 1 shows the description of each variable.

[2] Confirmed by (Belt and road initiative 2015)

[3] (Ferguson 2007; Adamantiades and Kessides 2009; Anwar et al. 2019 incorporate CO_2 emission as proxy of environmental quality

[4] "Freight transport refers to the total movement of goods using inland transport on a given network. Data are expressed in million tonne-kilometres, which represent the transport of one tonne over one kilometre. Components for road and rail are available".

However, industrial value added calculates from the net total production after varying the entire output with intermediate inputs and fundamentally inspects the share of industry in total GDP. It is concluded from several literatures that increase in industrialization leads more environmental degradation (Anees et al., 2011; Gokmenoglu et al., 2016; Jamel & Derbali, 2016; Azam & Khan, 2016). The transport activities emit million tons of numerous gases, such as Carbon dioxide (CO_2), carbon monoxide (CO), Methane (CH_4), chlorofluorocarbons (CFCs) and Nitrous oxide (N_2O). Especially Nitrous oxide (N_2O) plays an important role in depleting Ozone (O_3) layer. Emissions of these gases from vehicles are the major contributor of pollution in the air, especially the areas of busy roads and corridors. In New Zealand, 44% of Carbon dioxide is emitted by the transport, which is 16% of total greenhouse gases. In modern cities, infrastructure of transports acquires 25% to 30 % of land, which can be utilized for agricultural expansion and natural habitats (Stead 2001; Banister and Stead 2002; Léonardi and Baumgartner 2004a; Tanczos and Torok 2007; Sharma and Kumar 2012; Saidi and Hammami 2016).

Furthermore, increase in productivity of agriculture sector makes environment less polluting because agriculture sector is less polluting as compare to the other sectors of the economy like industry and transport. However, agriculture sector has a huge potential to restrain the greenhouse gases in the atmosphere. Keeping in view the study of India, it is investigated that greenhouse gases will reduce by 50% due to substitution of fossil fuel with renewable energy sources by 2030 (Rafiq et al. 2016; Ben Jebli and Ben Youssef 2016; Waheed et al. 2018; Holly 2015). In addition, the Hecksher-Ohlin elucidates that developing countries will specialize in the production of labour and natural resources intensive commodities, while developed economies specialize in human capital and creates capital intensive products. The movement of commodities from one country to another and their production and consumption will deteriorate the quality of environment. However, countries which are more liberalized in terms of trade will experience low level of pollution in the atmosphere. Trade liberalization will push countries for the adaptation of new and efficient technologies due to higher level of Competition (Grossman and Krueger 1991; Stern et al. 1996; Cole and Neumayer 2004; Lean and Smyth 2010; Kohler 2013; Kivyiro and Aminen 2014).

Estimation Technique

In this study, we examine the relationship between industrial growth, transport freight and environmental quality for the period of 1986-2016 by using panel co-integration and panel ARDL methods (Pedroni 1999; Bildirici et al. 2012; Bildirici and Kayıkc 2013). Study also incorporates the results of fully modified ordinary least square (FMOLS) and pool mean

Table 1 Description of Variables

Variables	Elaboration	Data Source
co_2	Metric tons of CO2 equivalent per capita	WDI
ind	industrial value added per capita (constant 2010US$)	WDI
ava	agriculture value added per capita (constant 2010US$)	WDI
ataf	Freight transport refers to the total movement of goods using inland transport on a given network. Data are expressed in million tonne/kilometres	WDI
tra	trade as percentage of GDP (Gross Domestic Product)	WDI
gdp	GDP per capita (constant 2010 US$).	WDI

group (PMG). The sample size is large enough to apply these methodologies.

Unit root tests

Empirical results of (Levin et al. 2002; Im et al. 2003 unit root test has been incorporated in panel studies. However, unit root test of (Levin et al. 2002; Im et al. 2003 depends on the nature of data, which is mean and pooled of ADF (Augmented Dickey Fuller). The equation for Levin et al. (2002) unit root test can be represented as follows

$$X_{it} = \gamma_i X_{i,t-1} + V_{it}^{'}\lambda + e_{it} \quad i = 1,2,3....,n; t = 1,T \tag{3}$$

In addition,$e_{it,}V_{it}^{'}$ is represented as stationary process and deterministic component. However, the assumption of Levin et al. (2002) unit root test exhibits that residual should be independent and identically distributed with constant variance (δ_e^2) and zero mean. For all values of (i = 1, ..., n); $\gamma_i = \gamma$. All series across each panel exhibits the problem of unit root is embodied as null hypothesis ($H_0 : \gamma = 1$) while all series across each panel does not displays the problem of unit root is shown as alternative hypothesis ($H_1 : \gamma < 1$).

Furthermore, problem of heterogeneity is allowed in intercept for the case of Levin et al. (2002) unit root test while the problem of heterogeneity can be discussed in both slope and intercept across each panel for the case of Im et al. (2003) unit root test. The mathematical equation of Im et al. (2003) unit root test can be symbolized as follows

$$X_{it} = \gamma_i X_{i,t-1} + \sum_{j=1}^{\nu_i}\phi_{ij}\Delta X_{i,t-j} + V_{it}^{'}\lambda + u_{it} \tag{4}$$

All series across each panel exhibits the problem of non-stationary is represented as null hypothesis ($H_0 : \gamma_i = 1$) while all series across each panel are stationary is shown as alternative hypothesis ($H_1 : \gamma_i < 1$). The main difference between statistics of stationarity is that the following test will depend on previous one.

Statistics for the problem of unit root among all cross sections is given by Im et al. (2003) test. However, if ($T \to \propto$) and ($n \to \propto$), the " t " statistics can be written as follows

$$t_{ips} = \frac{\sqrt{n}\left(t - \frac{1}{n}E[t_{iT}/\gamma_i = 1]\right)}{\sqrt{\frac{1}{n}\text{var}[t_{iT}/\gamma_i = 1]}} \quad n(0,1) \tag{5}$$

In addition, the problem of cross-sectional dependence prevails due to interdependence of countless residuals and unobserved mutual features across different panels of the study. Im et al. (2003) unit root test does not capture the problem of non-stationary due to macroeconomic linkages among all discussed panel. In these circumstances, (Pesaran 2007; Bildirici and Kayıkc (2013) unit test is applied which are cross-sectionally augmented. Pesaran (2007) apply ordinary least square (OLS) for the regression of cross sectionally augmented dickey fuller for the estimation units of each cross section in the panel.

$$\Delta X_{it} = \alpha_i + \gamma_i X_{i,t-1} + \nu_i \overline{X}_{t-1} + \sum_{j=0}^{k}\tau_{ij}\Delta\overline{X}_{t-j} + \sum_{j=1}^{k}\sigma_{ij}\Delta X_{i,t-j} + u_{it} \tag{6}$$

The CIPS statistics is represented by the mean of discrete CADF

$$CIPS = \frac{1}{n}\sum_{i=1}^{n} t_i(n,T) \tag{7}$$

$t_i(n, T)$ represents the statistics of " t " for the approximations of γ_i

Panel Co-integration test

Pedroni (1995) introduce the test of panel co-integration, which is very famous among test of panel co-integration. However, permission of variation in parameters across individual panel, Pedroni (1995) includes precise parameter, which addresses the problem of heterogeneity across each panel. Permission of interdependence between cross-sections of numerous separate effects in panel co-integration can be represented as follows

$$\Delta \ell_{it} = \alpha_i + \phi_{it} + \Delta \ell_{i,t-p} + u \quad (8)$$

Pedroni (1995) suggests seven different statistics for the evaluation of panel data by means of panel co-integration. Within dimension is represented by using first four statistics, which is grounded on pooling while between dimension is characterized by rest of three statistics, which is also based on pooling. No c-integrationexists among the discussed variables is the null hypothesis, which is grounded on above discussed two discrete test while the presence of co-integration is documented as alternative hypothesis. If critical value is larger as compare to estimated value of test statistics, we will reject the null hypothesis.

Group of heterogeneous panel and heterogeneous panel across each panel is estimated by Pedroni (1995) by using panel co-integration. In addition, the null hypothesis be contingent with panel and group statistics. Null hypothesis can be discussed as ($H_0 : \gamma_i = 1$) for all the debated values of *i*. The coefficient of autoregressive residual term of i^{th} unit is discussed as γ_i. The methodology of Pedroni (1995) is operated to check the presence long-run relationship among debated variables. However, the estimation of coefficients of debated exogenous variables, Pedroni (1995) introduces dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS). In comparison with ordinary least square (OLS); fully modified ordinary least square (FMOLS) gives us better estimate during estimation of non-stationary series of heterogeneous panel. Fully modified ordinary least square (FMOLS) exhibits unbiased distribution. Furthermore, FMOLS provide consistent *t* values and residuals in the presence of heterogeneous countries (Bildirici 2004; Purna and Pravakar 2007). Pedroni (1995) starts with traditional ordinary least square (OLS) regression, given as follows

$$\ell_{it} = \alpha_{it} + \beta_i y_{it} + e_{it} \quad (9)$$

Taking account of each cross-section, the slope of co-integrated vectors is represented byβ_i, while number of cross-section and time period is shown as $i = 1, 2.....n$ and $t = 1, 2, 3.....T$. Vector of Δy_{it} is assumed that it does not have problem of unit root if $u_{it} = e_{it}$ and discussed model comprise of estimated error term and take difference in *y*. Let

$$\Omega_{it} = \lim_{T\to\infty} \left[T^{-1} \left(\sum_{t=1}^{T} u_{iT} \right) \left(\sum_{t=1}^{T} u_{iT} \right)' \right) \right] \quad (10)$$

Covariance of above discussed vector in the long-run is disintegrated as follows

$$\Omega_i = \Omega_i^0 + \tau_i + \tau_i' \quad (11)$$

Ω_i^0 is represented as Contemporaneous covariance. However, τ_i represents the sum of auto-covariance, which is biased in nature. The value of coefficient for FMOLS is given as follows

$$\delta^* = n^{-1} \sum_{1}^{n} \left(\sum_{t=1}^{T} \left(y_{it} - \overline{y}_i \right)^2 \right)^{-1} \left(\sum_{t=1}^{T} \left(y_{it} - \overline{y}_i \right) X_{it}^* - T\nu_i \right) \quad (12)$$

Where

$$X_{it}^* = \left(X_{it} - \overline{X}_i \right) - \frac{\Omega_{21i}}{\Omega_{22i}} \Delta y_{it} \quad (13)$$

$$\nu_i = \tau_{21i} + \Omega_{22i}^0 - \frac{\Omega_{21i}}{\Omega_{22i}} \left(\tau_{22i} + \Omega_{22i}^0 \right) \quad (14)$$

$\delta^* = n^{-1} \sum_{i=1}^{n} \delta_i^*$ represent the estimator between the dimensions. However, δ^* show the estimator of FMOLS, which is applicable to the *ith* country across the discussed panel.

The prerequisite of pedroni (1995) co-integration is the hypothesis of mutual factor restriction. Moreover, cross-country dependence did not capture by the pedroni (1995) co-integration technique. In addition, the value of short-run estimators, which does not contain unit root at first difference *I(1)* must equal to the value of long-run coefficients, which is stationary at level *I(0)*. This kind of situation is accepted for the application of overhead quoted hypothesis. The restriction for influence of residual-based cointegration test is reduced due to above discussed serious concerns. Keeping in view, these limitations, Panel ARDL is more efficient as compare to Pedroni (1995) co-integration test.

Panel Auto Regressive Distributed Lag (ARDL) Test

(Pesaran et al. 1997; Peseran et al. (2004) introduces autoregressive distributed lag model (ARDL), which is used for the model of single equation in order to estimate co-integration. Two step estimations are used in panel ARDL to co-integration to estimate the long-run association among variables. The existence of long-run relationship among the variables has been checked empirically in first step while the long-run coefficients have been estimated empirically by using ARDL model in second step. Restrictions on the long-run estimates in the model of panel data have been applied by the maximum likelihood estimation (Peseran et al. 2004). However, Hausman (1978) test has been used for the validity of restriction. Pool mean group (PMG) has been used for the estimation of long-run coefficients. The estimates of unrestricted individual economy and its mean are known as pool mean group (PMG). For the estimation of panel data model, pool mean group (PMG) gives us efficient estimates as compare to dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS). Long-run relationship between CO_2 emission, industrialization and transport freight gives us important conclusions. That's why, we incorporate panel ARDL in our study.

Paseran et al. (1997) extend the traditional ARDL model (p, q) to panel ARDL model. The generalized form of ARDL-VECM (Vector error correction model), which depicts the long-run association among the variables is discussed as follows

$$\Delta\ell_{it} = \Phi_i + \sum_{K=1}^{P} \nu_{ij}\Delta\ell_{i,t-j} + \sum_{K=0}^{q} e_{ij}\Delta y_{i,t-j} + \varphi_{1ij}\ell_{i,t-1} + \varphi_{2ij}y_{i,t-1} + u_{it} \quad (15)$$

Where

$$\varphi_{1i} = -\left(1 - \sum_{j=1}^{q} \tau_{ij}\right), \quad \varphi_{2i} = \sum_{j=0}^{q} \Upsilon_{ij},$$

$$\nu_{ij} = -\sum_{M=j+1}^{P} \tau_{iM}, e_{ij} = -\sum_{M=j+1}^{q} \Upsilon_{iM}$$

$t = 1, 2, ...T$ and $i = 1, 2....n$ represent the number of time period and cross sections. Moreover, Φ_i represent the intercept of group specific. Υ_{ij} and τ_{ij} represents the vector $k \times 1$ of explanatory variables. The above discussed model is similar to the model of (Pesaran et al. 1997; Peseran et al. 2004). The absence of long-run relationship among the variables is represented as null hypothesis ($H_0 : \varphi_{1i} = \varphi_{2i} = 0$), while the presence of long-run relationship between the variables is shown as alternative hypothesis ($H_1 : \varphi_{1i} \neq \varphi_{2i} \neq 0$). The null hypothesis and alternative hypothesis are also represented as ($H_0 : \Upsilon_{ij} = 0$) and ($H_1 : \Upsilon_{ij} \neq 0$). It is supposed that some of the variables becomes stationary at level *I(0)* at one set of critical value, while all variables becomes stationary at first difference *I(1)* on the other set of critical values. If estimated value of test statistics is larger than upper critical bound value; we will reject null hypothesis. However, if estimated test statistics is smaller than critical upper bound value; we will accept null hypothesis, which shows the absence of co-integration between the variables.

Study incorporates smaller amount of countries to estimate the coefficients long-run, which handles the problem of heterogeneity in the model. Binder and Offermanns (2007) also discuss the similar form of long-run relationship

$$\ell_{it} = -\left(\frac{\varphi_{2i}}{\varphi_{1i}}\right)' y_{it} - \frac{\phi_i}{\varphi_{1i}} = \eta_i' y_{it} + e_{it} \quad (16)$$

$\Omega_i = \eta\nu_i$ represent the assumption of discussed associations. The validity of restriction has been tested by (Hausman 1978); discussed as follows

$$h = T'\omega(\ )^{-1} \quad (17)$$

In addition, the difference between controlled PMG and uncontrolled mean group (MG) can be discussed as follows $\ = \eta_u - \eta_r$. Hausman (1978) introduce the estimation of consistant variance, which is shown as follows $(W(q) = \omega(\eta_u) - \omega(\eta_r))$. The consistency of homogeneity under controlled estimation is represented by null hypothesis $(\mathrm{cov}(\eta_r,\ ) = 0\ )$.

In addition, if co-integration presents among the variables, we will estimate the long-run estimates by using conditional ARDL model.

$$\ell_{it} = \phi_i + \sum_{k=1}^{P} \tau_{ij}\ell_{i,t-j} + \sum_{k=0}^{q} \Upsilon_{ij}y_{i,t-j} + u_{it} \quad (18)$$

Order of ARDL (p, q) model is estimated by using AIC and SBC standards. Study incorporates the error correction model (ECM) for the estimation of short-run coefficients, which is more related with the coefficients of long-run variables

$$\Delta\ell_{it} = \alpha_i + \sum_{k=1}^{P} \nu_{ij}\Delta\ell_{i,t-j} + \sum_{k=0}^{q} e_{ij}\Delta y_{i,t-j} + \phi_{ij}ect_{t-i} + u_{it} \quad (19)$$

u_{it}shows error term, which is independently and identically distributed with zero mean and constant variance. ect_{t-i} represent the error correction term. ecm_{t-i}. The speed of adjustment towards the long-run equilibrium after a shock is denoted byϕ_{ij}. The sign of coefficients should be significant and negative. ecm_{t-i} shows the convergence towards long-run equilibrium after shock which is represented byϕ_{ij}.

Granger Causalities

Engle and Granger's (1987) causality test has been applied in initial stages. However, the estimator of PMG composed of pooling and averages, that's why PMG estimator is more appropriate as compare to three stage least square (3SLS) and general method of moment (GMM). In addition, the differences in country in the short-run also sheltered by PMG estimator. That's why PMG is more useful as compare to ordinary least square (OLS) and dynamic ordinary least square (DOLS). Furthermore, if all variables become stationary, PMG technique can be used for granger causality. Vector error correction model (VECM) can be discussed as follows in order to find the short-run relationship among the variables.

$$\Delta\ell_{it} = \alpha_0 + \sum_{i=1}^{M} \beta_{ik}\Delta\ell_{j,t-i} + \sum_{i=1}^{N} \phi_{ik}\Delta y_{j,t-i} + \phi_1 ecm_{t-1} + \varepsilon_{1t} \quad (20)$$

$$\Delta y_{it} = \alpha_0 + \sum_{i=1}^{P} \rho_{ik}\Delta y_{j,t-i} + \sum_{i=1}^{q} \theta_{ik}\Delta\ell_{j,t-i} + \phi_2 ecm_{t-1} + \varepsilon_{2t} \quad (21)$$

ε_{1t} shows the value of residual, which is independent and identically distributed with zero mean and constant variance. The relationship of long-run equilibrium is represented byecm_{t-1}, which is derived from error correction model (ECM). Convergence towards equilibrium after a certain shock is characterized byϕ, which is known as speed of adjustment. Estimator of mean group of (MG) and pool mean group (PMG) incorporated for the estimation of error correction model (ECM). In addition, cross country heterogeneity is allowed for short-run in case of PMG while cross country heterogeneity is allowed for both short-run and long-run in case of mean group (MG). $H_0: \phi_i = 0$ shows the null hypothesis of granger causality in short-run while $H_0: \phi_i \neq 0$ represents the alternative hypothesis of granger causality in case of short-run, keeping in view the values of *i* and *k*. The short-run causality is measured by the difference of lagged independent variable.

Results and Interpretation

Estimated results of cross-sectional dependence are represented by Table 2. Keeping in view the cross-sectional dependence tests of Pesaran (2007), Peseran et al. (2004), Breush Pagan LM and Friedman shows that all variables are cross-sectionally independent based on their probability values. The absence of cross-sectional autocorrelation nullifies the application of second generation unit root and cointegration tests in panel data. The study incorporates the results of unit root tests, introduced by Im et al. (2003) and Levin et al. (2002).

In addition, if the data has large sample size (t >20), the implication of human error learning becomes significant. In above debated situation, the discussed variable does not have constant mean and variance in time. This phenomena will violates the assumption of (OLS) ordinary lest square (Pedroni 2008; Gujarati 2009; Eberhardt and Teal 2011). Panel unit root test is used to confirm the existence of above mentioned property in panel data. Table 3 explains the results of unit root test familiarized by Im et al. (2003) and Levin et al. (2002). Mean and variance of the discussed variable are not independent of time (non-stationary) is the Null hypothesis, while variable is stationary is the alternative hypothesis, which confirms that all variables are not stationary at first difference. However, trade as percentage of GDP (Gross Domestic Product) and freight transport are stationary at level *I(0)*. Specification of both “without trend” and “with trend” in Im et al. (2003) and Levin et al. (2002) tests confirms that mean and variance of all variables are independent of time at first difference *I(1)*, except trade as percentage of GDP (Gross Domestic Product) and freight transport. In addition, stationarity of variables at *I(0)* and *I(1)* shifts our analysis towards panel ARDL (Auto Regressive Distributed Lag). Panel ARDL is similar to time series ARDL whereby there must be solid indications that mean value of residuals must approaches to zero for every random shock in long-run. Using AIC and BIC criteria, we will find the optimal lag length for each unit or group per variable. Now, we will find the most common lag across the panel for each variable in order to represent the optimal lag of the model for each variable. The optimal lag length of equation 1 is ARDL (2 0 1 1 0 0).

Table 4 debates the results of panel cointegration introduced by Pedroni (1995) and Westerlund (2007), which confirms the presence of cointegration among variables. Keeping in view, robust probability values of Westerlund (2007), we will reject the null hypothesis of no cointegration among the discussed variables. This confirms the presence of long-run relationship among CO_2 emission, industrial value added, trade, GDP per capita, transport freight and agriculture value added; covering the period of 1986-2017 among selected 33 BRI (Belt Road Initiative) countries.

Furthermore, Table 5, 6 and 7 incorporates the estimated results of dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS), mean group (MG), pool mean group (PMG) and dynamic fixed effect model to ensure the robustness of estimates after confirming the presence of long-run relationship among

Table 2 Pesaran (2007) cross sectional dependence

Variables	lco_2	*lind*	*ltra*	l*gdp*	*latf*	*lava*
CDF	1.75	0.34	25.62	17.33	1.86	3.27
Tests	Peseran et al. (2004)		Breush-Pagan (LM)		Friedman CD	
Statistics	0.85		156.56		74.169	

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

Table 3 Unit root test

Variables	Im et al. (2003)				Levin et al. (2002)			
	Without trend		With Trend		Without trend		With Trend	
	Level	First Difference	Level	First Difference	Level	First Difference	Level	First Difference
lco$_2$	5.41	-13.25***	-1.22	-11.31***	1.84	-11.39***	-2.62	-9.95***
lind	-1.11	-11.09***	1.03	-9.62***	-1.87	-9.68***	-2.90	-8.81***
ltra	-4.22***	-15.55***	-1.82**	-14.02***	-4.51**	-13.56***	-3.71***	-12.19***
l*gdp*	0.48	5.11***	3.78	-4.64***	0.39	-9.67**	-7.21	-8.67***
latf	-2.77**	-14.52***	4.67**	-13.76***	-4.13***	-10.91***	-1.60*	-10.52***
lava	2.12	-12.80***	0.20	-10.31***	-2.02	-10.44***	-2.11	-8.46***

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

studied variables. We also applied Hausman Test to confirm the efficient estimates among above discussed econometric techniques. Table 5 incorporates the results of long-run estimates by using dynamic ordinary least square (DOLS) and fully modified ordinary least square (FMOLS), which confirms that majority of variables shows positive and significant relationship with CO_2 emission except GDP per capita and agriculture value added among selected 33 BRI (Belt Road Initiative) countries. The estimates of these two techniques contain similar results in terms of sign and statistical significance.

In addition, Table 6 shows the consequences of long-run estimates by using pool mean group (PMG) and mean group (MG). However, Table 6 confirms that industrial value added per capita and transport freight significantly increase the CO_2 emission in the atmosphere while increase in agriculture value added per capita significantly decreases the level of CO_2 emission. The estimates of mean group (MG) and pool mean group (PMG) are similar in terms of significance and direction except GDP per capita, which significantly decrease the level of CO_2 emission in the atmosphere in case of pool mean group (PMG). The result of Hausman (1978) confirms the refusal of alternative hypothesis for efficient estimates of mean group because probability value of Hausman (1978) test is 0.52. Furthermore, Table 7 incorporates the results of dynamic fixed effect model and pool mean group (PMG). Long-run estimates of dynamic fixed effect model indicate that industrialization and transport freight significantly increase the level of CO_2 emission in the atmosphere in case of 33 BRI (Belt Road Initiative) countries. However, probability value of Hausman (1978) test is 0.54, which confirms the rejection of alternate hypothesis for efficient estimates of dynamic fixed effect model.

Results of short-run causality for heterogeneous panel have been incorporated in the study across the 33 economies of Belt and Road initiatives. Table 8 shows empirical results of panel causality. Industrial value added per capita shows unidirectional causality in short-run, running from industrial value added per capita to CO_2 emission. In addition, transport freight and GDP per capita exhibit bidirectional causality with CO_2 emission in short-run. Moreover, the value of error correction term, ecm_{t-1} is negative and significant; which shows the convergence towards long-run equilibrium, which occurs due to occurrence of any economic shock.

Furthermore, Table 9 incorporates the results of speed of convergence across each panel. Table 9 exhibits the negative and least value of error correction term across china, which shows

Table 4 Pedroni & westerlund Cointegration.

	Within-Dimension Statistics		Between-Dimension Statistics	
V statistics	-4.64**	V statistics	-7.34*	
Rho statistics	2.54*	Rho statistics	5.81**	
Pp statistics	-0.56**	Pp statistics	3.25*	
ADF-statistics	-5.36	ADF-statistics	-8.46*	
Westerlund Cointegration				
	G_t	G_a	p_a	p_t
P Value	0.64	0.63	0.87	0.54
Robust P Value	0.00**	0.01**	0.00***	0.23

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

Table 5 FMOLS & DOLS estimation results

	Fully Modified ordinary Least Square (FMOLS)		Dynamic Ordinary Least Square (DOLS)	
Variables	Coefficient	probability	Coefficient	probability
lind	0.345***	0.02	0.25***	0.00
ltra	1.562***	0.00	1.354***	0.00
l*gdp*	0.842	0.74	0.987	0.94
latf	0.325***	0.05	0.425***	0.00
lava	-0.216	0.84	-0.879	0.23

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

that 11% of adjustment takes place in each time for the occurrence of any shock. However, Ukraine shows the negative and significant value of error correction term, which shows that 82% of adjustment takes place in each time for the occurrence of any shock.

Discussion

There are several advantages for the establishment of OBOR project such as increase in economic growth through globalization and trade. However, it has some severe repercussion for the quality of environment due to increase in energy consumption, industrialization, transportation, urbanization and removing of trees for building of roads and railways, which further decrease the forest area. The relationship between industrialization and emission of CO_2 is different among several economies due to energy mix, infrastructure and means of transportation. In addition, China is the fastest and second largest emerging economy around the globe which initiates the project of OBOR among 68 different countries. China is the biggest consumer of energy and emits 30% of CO_2 emission of the world in the atmosphere (International energy outlook 2014). Rauf et al. (2018) empirically investigate the relationship between industrialization, energy consumption and quality of environment among OBOR countries for the period of 1971-2016. The estimated results indicate the positive and significant relationship between industrialization and CO_2 emission in case of long-run. It was suggested that China should reduce the environmental degradation by addressing the solution for industrial waste. This will generate the operative consequences for the project of OBOR and further increase the sustainable economic growth of China in long-run. Moreover, Xu and Lin (2016) states that rapid increase in industrialization and economic growths are two main reasons for the deterioration of environmental quality in case of china. In the meantime the project of OBOR will shift many polluted industries to overseas, which will increase the level of CO_2 emission among host countries (Xu and Lin 2016; Howard and Howard 2016; Rauf et al. 2018; Zhao et al. 2018). Furthermore, increase in industrialization will deteriorate the quality of environment because during production process, these industries emit enormous level of by-products, materials and smokes, which are the main cause of atmospheric calamity; carried by industrialization. These by-products contain dangerous toxic elements that can devastate the quality of environment. There are many factors, which can be controlled by the industries such as standard raw

Table 6 Mean Group & Pooled Mean Group estimation results

	Mean Group Estimation ARDL (2 0 1 1 0 0)		Pooled Mean Group Estimation ARDL (2 0 1 1 0 0)	
Variables	Coefficient	probability	Coefficient	probability
lind	0.478***	0.00	0.254***	0.00
ltra	0.321	0.34	0.682	0.85
l*gdp*	-1.83	0.54	-0.458***	0.00
latf	0.675***	0.00	0.362***	0.00
lava	-0.512***	0.00	-0.562***	0.00
Hausman Test				
Statistics		Probability		
8.432		0.528		

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

Table 7 Dynamic Fixed Effect & Pooled Mean Group estimation results

	Dynamic Fixed Effect ARDL (2 0 1 1 0 0)		Pooled Mean Group Estimation ARDL (2 0 1 1 0 0)	
Variables	Coefficient	probability	Coefficient	Probability
lind	0.364***	0.00	0.254***	0.00
ltra	0.542	0.89	0.682	0.85
l*gdp*	-0.245	0.42	-0.458***	0.00
latf	0.316***	0.00	0.362***	0.00
lava	0.258	0.85	-0.562***	0.00
Hausman Test				
Statistics		Probability		
-23.43		0.54		

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

Table 8 Pool Mean group Causality

	Δlco_2	$\Delta lind$	$\Delta ltra$	$\Delta \lg dp$	$\Delta latf$	$\Delta lava$	ecm_{t-1}
Δlco_2	1.00	0.645	0.324	-0.193***	0.423***	-0.364**	-0.364**
$\Delta lind$	0.452***	1.00	-0.234	0.614**	-0.364	0.754	-0.485***
$\Delta ltra$	0.452	0.362	1.00	-0.678	0.236*	0.257	-0.256***
$\Delta \lg dp$	0.452**	0.564**	0.421	1.00	0.132**	-0.236***	-0.671***
$\Delta latf$	0.246***	0.256	0.462**	1.452	1.00	0.672	-0.362***
$\Delta lava$	-0.348	-0.524***	0.362	0.514	-0.542**	1.00	-0.512***

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

material, manufacturing, safety laws and technology to curtail CO_2 emission in the atmosphere. Every year several economies has to bear massive loss in production, labour productivity and welfare to cope up with the quality of environment (Cole and Neumayer 2004; Bernauer and Koubi 2006; Shahbaz et al. 2011; Hossain 2011).

Many researchers such as (Klyashtorin and Lyubushin 2003; Paul and Bhattacharya 2004) have shifted their interest towards the impact of energy consumption on environmental degradation with spread of sustainable development. However, majority of energy is consumed by transport activity, which subsidizes to economic growth directly or indirectly by bridging production markets to the markets of consumption and fulfils the movements of goods and services. The increase in the freight transport will lead to increase in consumption of energy such as fossil fuels, which further deteriorates the quality of environment by emitting CO_2 in the atmosphere (SPRITE 2000; HEI 2010). Moreover, the transport activity is considered to be the most important birthplace for the consumption of fossil fuel and emission of CO_2. Increase in the services of transport will cause many societal and environmental problems, especially when economic growth is heavily dependent on freight transport. The activity of transport is considered to be the aggregate indicator, which is used as sustainable literature in order to measure the transport demand and investigate the relationship between transport activity, economic growth and environmental quality. However, keeping in view the above context; energy intensity, freight transport and CO_2 emission are the most relevant indicators (Lise 2006; Lee and Oh 2006; Saikku et al. 2008). However, the share of transport for the emission of CO_2 will increase 21% to 23% from 1991 to 2007 and it will approximately increase to 23.2% by 2030. In addition, road transport will contribute 70% in CO_2 emission among total transport sector from 1990 to 2007. In addition, increase in economic activity demand significantly increases the transport freight, which further leads to increase the CO_2 emission. Higher energy consumption leads by higher economic growth. This phenomenon will further deteriorate the quality of environment. Transport sector is the major consumer of energy sector in case of Hungary[5], which further deteriorates the environmental quality. However, 64% of petroleum is consumed by transport sector in the world in 2012. This will cause the energy consumption to increase approximately by 82% globally from 2008 to 2035. Keeping in view usage of commercial transportation the demand for energy will increase by 70% from 2010 to 2040. (Murtishaw and Schipper 2001; Song et al. 2014; Léonardi and Baumgartner 2004b; Tanczos and Torok 2007; Omri et al. 2014; Farhani and Ozturk 2015; Kyophilavong et al. 2015; Shahbaz et al. 2015; Charfeddine and Ben Khediri 2016; Sulaiman and Abdul-Rahim 2017; Saboori et al. 2017).

Estimated results of the study show the negative and significant relationship between agriculture value added and CO_2 emission in case of OBOR countries. The adaptation of renewable energy sources such as organic seeds and modern farming techniques in agriculture sector will reduce the emission of CO_2 in the atmosphere. However, many countries such as Russia, Kazakhstan, Uzbekistan and Tajikistan[6] will reduce the adaptation of nitrogen rich fertilizer and pesticide by 10%. These countries also utilize quality of natural water which will further reduce the greenhouse gas emission. Moreover, the rate of soil erosion will also decrease due application of new farming techniques among above discussed countries (Huang et al. 2002; Trewavas 2002). In addition, Rafiq et al. (2016) shows that increase agriculture value added will reduce the emission of CO_2 because agriculture sector is less polluting as compare to the other sector of the economy. Consistent with above discussion (Ben Jebli and Ben Youssef 2017; Anwar et al. 2019 elucidates that increase in agriculture value added will decrease the emission of CO_2 in the atmosphere.

Empirical investigation clarifies the significant positive and negative relationships with CO_2 emission among selected partner countries of OBOR. Moreover, study proves that increase in industrial value added and freight transport will increase the level of CO_2 emission which further deteriorates the quality of environment while increase in agriculture value added will decrease

[5] Partner country of OBOR

[6] Partner countries of OBOR

Table 9 ECM for each country

Country	China	Mongolia	Russia	Pakistan	Bangladesh	Sri Lanka	Nepal	Indonesia
ecm_{t-1}	-0.115**	-0.456***	-0.1.25***	-0.364***	-0.524***	-0.124**	-0.152***	-0.362***
Country	Thailand	Malaysia	Vietnam	Singapore	Philippine	Brunei	Kazakhstan	Uzbekistan
ecm_{t-1}	-0.152**	-0.364***	-0.254***	-0.542***	-0.135***	-0.124*	-0.584***	-0.245*
Country	Kyrgyz	Tajikistan	Saudi-Arabia	Iran	Turkey	Israel	Egypt	Jordan
ecm_{t-1}	-0.236**	-0.254**	-0.342***	-0.354**	-0.751***	-0.362**	-0.851*	-0.823*
Country	Lebanon	Poland	Romania	Czech	Bulgaria	Hungary	Ukraine	Azerbaijan
ecm_{t-1}	-0.362**	-0.541***	-0.398***	-0.198***	-0.325***	-0.674**	-0.823***	-0.214*
Country	Belarus							
ecm_{t-1}	-0.374**							

*, ** and *** denotes the significance level of 0.10, 0.05 and 0.01 level

the CO_2 emission among OBOR countries. Majority countries of OBOR will increase the level of industrialization to sustain the level of economic growth which further increases the intensity of CO_2 in the atmosphere. However, these findings are consistent with (Rauf et al. 2018; ; Klinger 2019; Hafeez et al. 2019; Teo et al. 2019

Conclusion and Policy Implication

Study debates the novel empirical understanding of the association among industrial value added; transport freight and quality of environment for the sample of partner countries of OBOR project introduced by Chinese president “Xi Jinping” in 2013. OBOR connects 68 countries, which represents 65% of world population. OBOR helps countries to share their labour, technologies and resources to modernize the industrial infrastructure. This will lead to increase the economic growth of each country. The major portion of OBOR is composed of developing countries to increase the pace of their development. We incorporate Panel Autoregressive distributed lag (ARDL) model because variables have different order of integration such as *I(0) or I(1)*[7] to estimate long-run relationship between the variables. Granger causality has been used to estimate short-run relationship among discussed variables. However, fully modified ordinary least square (FMOLS), dynamic ordinary least square (DOLS), Mean group (MG), Pool mean group (PMG) and dynamic fixed effect model has been applied to estimate the long-run coefficients. The findings are robust within the included variables among selected BRI (Belt Road Initiative) countries.

Estimated results show the positive relationship between industrial value added per capita and CO_2 emission while increase agriculture value added per capita will decrease the emission of CO_2 among partner countries of OBOR project. However, increase in transport freight leads to increase in emission of CO_2. Furthermore, it is important that the direction of short-run causality changes for different time horizon. Short-run causality indicates positive and unidirectional causality running from industrial value added per capita and CO_2 emission while transport freight exhibits positive and bidirectional causality with CO_2 emission among selected BRI (Belt road initiative) countries. In addition, value of error correction term is negative and significant which shows the convergence and towards long-run equilibrium due to any shock. The value of error correction term is negative and significant across each panel.

It is deducted from the above discussion that government should slow down the pace of rapid industrialization, especially for those industries which emit high level of CO_2 in the atmosphere. This will help to curtail the increasing hazardous results of industrialization on quality of environment. However, introducing better transport facility such as fuel efficient domestic and commercial vehicle will decrease the externalities of environment. This will create positive social, environmental and economic consequences. Keeping in view the econometric results; we recommend that transport and industrial sector should adopt environment friendly technologies such as electric transport for commercial and domestic use and energy efficient techniques for production and recycling of several commodities to curtail the emission of harmful gases. This will increase the industrial production and decrease the emission of CO_2 in the atmosphere.

[7] I(1) means variable is non-stationary at level and stationary at first difference. Hence if the variable is I(1) its arithmetic mean and standard deviation is time variant, making simple OLS approach invalid (Enders, 2008).

Appendix

Table 10 A List of selected countries

China	Mongolia	Russia	Pakistan	Bangladesh	Sri Lanka	Nepal	Indonesia
Thailand	Malaysia	Vietnam	Singapore	Philippine	Brunei	Kazakhstan	Uzbekistan
Kyrgyz	Tajikistan	Saudi-Arabia	Iran	Turkey	Israel	Egypt	Jordan
Lebanon	Poland	Romania	Czech	Bulgaria	Hungary	Ukraine	Azerbaijan
Belarus							

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