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Green supply chain management, economic growth and environment: A GMM based evidence

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ABSTRACT

The aim of this research is to examine the relationship between green logistics operations and energy demand, economic growth and environmental sustainability need to make factors for relationship clearer in a panel data of 43 different countries around the globe. The study employed panel Generalized Method of Moments (GMM) estimates for robust inferences. The results have revealed that logistics operations consume energy and fossil fuel, while the amount of fossil fuel and non-green energy sources create significant harmful effect on the environmental sustainability and also have negative effect on economic growth. In addition, poor transport-related infrastructure and logistics service are a major contributor of CO2 and total greenhouse gas emissions. However, carbon emission damages fauna and flora, and reduces economic growth. The findings suggest that renewable energy sources and green practices can mitigate harmful effect of logistics operations on environmental sustainability and spur economic activities with greatly export opportunities in a region.

1. Introduction

Logistics is a significant part of a supply chain. Logistics management is a set of integrated actions to improve the following aspects including inventory storage, material handling, freight transport and information processing that are required to move products through proficient supply chain process (Martel and Klibi, 2016). During 1990s the concept of green supply chain management widely realized by several firms and logisticians (structure is missing and also add reference). There is no doubt that logistics is a significant contributor of air pollution, and also affects countries economic growth. Khan et al. (2017a) conducted the research to analyze the relationship between green logistics and economic indicators. The findings show that manufacturing, per capita income, and service share to GDP is greatly affected by carbon emissions. As the awareness is becoming stronger, customers are more conscious regarding green products and sustainability, with governments more aggressive to implement environmental policies.

Since industrial revolutions, many firms are using global sourcing as a corporate level strategy. The phase of globalization started growing countries economic and firms also cater global sourcing as competitive edge. But on the other side, global sourcing seriously affects environmental sustainability; due to huge involvement of transportation and long lead-time (Khan et al., 2016a). In the similar line United Nation (2014) shows some significant facts about transportation, i.e., it results in almost 22% of worldwide carbon dioxide emissions and around 19% black carbon that deliberate highly negative environmental externality on

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humans' life and causes the several diseases including ischemic heart disease and lung cancer etc. Hutchins and Sutherland (2008) emphasized the need of CSS (corporate social sustainability) under the premises of the SC system for competitive gains.

Logistics management is an integral part of a supply chain management. Customer pressure motivates firms to adopt green supply chain management (GSCM) practices in their logistics operations. The adoption of GSCM practices and investment in cleaner technologies not only enhance the environmental sustainability but also increase the firms' profitability in long-run and create competitive edge (Rao and Holt, 2005). The idea of green corridors was recently developed to control the environmental related factors affecting fuel consumption (Demir et al., 2014; Khan et al., 2016a,b). The new concept of green corridors will control and significantly reduce CO2emissions and fuel consumption in the future to improve the environmental performance of goods transport. European Commission report identifies that around 10 million people are working in transport related industry, which is 4.5% approximately of total employment and yields almost 4.6% in GDP. Transport industry is mainly dependent on oil and the industry consumes approximately 96% of its energy needs. Therefore, its contribution to GHG (greenhouse gas) emissions is around 35% during 1990–2008 (European Commission, 2011).

Undeniably, the adoption of green practices in logistics activities the first step towards sustainability. In addition, GSCM (Green Supply Chain Management) is also providing opportunity to build a competitive advantage in the region. As customers aware the environmental issues, firms are facing pressure from customers' side to implement GSCM practices (Green et al., 2012; Zelbst et al., 2010). Governments' strict policies are influencing firms to adopt more sustainable practices in their logistics activities, which shows governments' great concern on environmental issues. Nevertheless, the scarcity of research on how to incorporate these problems makes this task more challenging.

During in-depth literature review, we found that mostly researchers conducted studies on GSCM by using case studies and/or firm-level surveys. But this research's objective is far greater than previous researches. This study is on macro level and to evaluate the relationships between logistics performance indexes with the environmental and economic factors in a panel of 43 top ranked global logistics countries for the period of 2007–2016.

1.1. Literature review

Sustainable logistics is one of the main sub-components of GSCM process, which is a very hot topic in last couple of decades fueled by globalization, customers' demand, market competition, and exploration of new markets (Isaksson et al., 2011). In the following sub-sections, the detailed literature review has been presented.

The relationship between Green Logistics and Energy Demand.

The relationship between logistics and energy demand is a largely discussed area under SCM process, while sustainability in the perspective of logistics indicators needs renewable sources of energy to reduce the harmful effect of global logistics activities on the environment. (Abdul and Khan, 2017). explained green logistics is a set of practices to improve environmental sustainability, while GLP (green logistics performance) has been calculated by efficiency of customs clearance process to reduce carbon emissions, Quality of trade and transport-related infrastructure, and competence and quality of logistics services with minimum possible emissions. (Khan et al., 2017a). conducted the research on green logistics and national scale economic indicators including renewable energy consumption in percentage of total energy consumption. The results show that logistics indices integrate with the national scale economic indicators that provoke green supply chain management in the region. Unquestionably, logistics activities consumed energy in order to achieve their task and consumption of energy become greater (Anable et al., 2012) in the context of global logistics. Shahbaz et al. (2015) highlighted that energy efficiency enhances overall economic growth under the presence of labor and capital, while Bhattacharya et al. (2016) argued that cleaner energy or green energy is the promising solution for green development which may executed with the help of government regulations to encourage to cleaner technologies in the business activities. Ramakrishnan et al. (2016) concluded that air pollutants, population growth, energy demand, trade policy mainly affected to global environmental sustainability in the region. Qureshi et al. (2016) confirmed the highly significant relationship between energy consumption (Kg of oil equivalent per capita) in logistics operations and economic factors in the world's largest economies.

Companies use sustainable procedures as a strategic tool to improve economic efficiency. For example, eco-efficient companies reduce carbon (Schenkel et al., 2015) footprints, and non-renewable resources to save environmental sustainability. On the other hand, companies also save huge cost through reusing, recycling and remanufacturing of products. There is no doubt that countries are realizing the importance of green supply chain management. Zhu et al. (2008) conducted empirical research in the context of China, and their works explain that Chinese organizations continue struggling to improve their environmental image with cleaner production and renewable energy.

Fahimnia et al. (2015) argue that without a strict regulatory and a carbon taxing mechanism, the SC (supply chain) could be more profitable to manage. But the emissions generated are also the highest when there is no financial penalty on the firms which discourages the use of carbon footprints, hazardous chemicals in production and non-renewable resources. On the other hand Dangelico & Pontrandolfo (2013) confirmed that economic performance of enterprise is negatively associated to an increase of CO2 emissions. Companies can take several actions to reduce harmful effects such as using renewable energy, diminishing the use of hazardous and toxic chemicals/materials, and so on. On the basis of above discussion, we create the hypothesis:

H1. Renewable energy deposit positively associated with the green logistics performance.

1.1.1. The relationship between Green Logistics and Environmental Factors.

The concept of GSCM is used to protect environment from the harmful effects of logistics activities and freight transport (Park et al., 2016). Global environment is mainly compromised by freight transport and logistics activities if the appropriate policy is lacking behind towards environmentally-friendly policies in supply chain. (Wang et al., 2015). environmental sustainability, concerns the quality and quantity of natural resources, global warming, and waste management, reductions in resource and energy use, alternative energy manufacturing, and reduced CO2 emissions. (Khan et al., 2017a). highlighted that Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, and also as a result of certain chemical reactions, which contributes to greenhouse effect that the heat energy from the sun will be locked, so if too much carbon dioxide in the atmosphere, it will be difficult to release the heat, and thus the earth's average temperature will rise subsequently. Undeniably, logistics and transport industry is mainly dependent on fossil fuel and the industry consume approximately 96% of its energy needs, therefore, its contribution to GHG (greenhouse gas) emissions is around 35% during 1990–2008 (European Commission, 2011).

Nakamichi et al. (2016) empirical research results show that the pick-up truck suppliers of a Japanese firm are dispersed geographically nearby Bangkok, thereby allowing us to estimate CO2 emissions throughout the cross-border SC (supply chain) as 1.4 times higher than the CO2 from local/domestic plants. D.a et al., (2015) manufacturing goods require fossil fuels, which ascend CO2 emissions, and some SC depend on more energy-efficient technology. On the other hand, JIT delivery has saved 80 to 90 billion USD on a world scale, but this leads to CO2 emissions due to greater trade gains. In contrast to production carbon footprints, consumption based carbon footprints is generated by imports of CO2-concentrated goods which require to be moved through several steps namely including, uploading, moving cargo, and storing in supply chain. Definitely, globalization of supply chain is related to (Khan et al., 2017b; Nakamichi et al., 2016) greater distance between origin and destination in the distribution network and greater distances translate into higher CO2 emissions. Lee & Wu (2014) suggested that logistics and transportation operations should be converted with biofuels sources in order to control climate change, global warming as well as improve environmental sustainability.

Hamelinck et al. (2005) argued that the growth of worldwide energy consumption lifted environmental problems. A number of countries are working on “Green” or “Sustainability” projects mainly including, US, UK, Canada and China to save (Iakovou et al., 2010) the environment and creating public awareness towards environmental-friendly products. Gold & Seuring (2011) claimed that the Bio-ethanol manufacturing is one example of such an argumentative bio-energy form comes to the conclusion that the environmental life-cycle balance of bio-diesel and ethanol is much more favorable than those of fossil fuels. Jingura (2011) confirmed that the use of biofuels are promoted as green alternative to fossil fuels both in energy context and as a technical option to respond to climate change. Main benefit of biofuels is the reduction in the amount of GHG emissions. Zawaydeh (2017) the imported fossil fuel energy resources are not attractive than renewable energy systems that offer locally available energy.

The solution of environmental problems lies in the implementation of green practices in industries especially in logistics activities, from which huge CO2 emissions have been created, PM 2.5 (fine particulate matter). Undeniably, technology and industrial-revolution is a main cause of the environmental problems, but on the other hand, green technology is able to reduce the harmful effects of emissions as much as 15% by 2020 (Savita et al., 2012). In addition, the increased carbon footprints in IT will be offset with the adoption of green practices and green technology. The environmental issues can be solved by collective efforts of regulatory authorities, consumer awareness, industrialist and policy makers to introduce more effective policies. The above cited research papers show the need of green practices in logistics activities; therefore, it is desirable to control and reduce to the environmental concerns from global logistics operations for sustainable growth. The study hypotheses that:

H2. Greater environmental concern in SCM positively associated with the green logistics performance.

1.1.2. The relationship between green logistics and economic health factors

Green practices focus on the reduction of wastes associated with environmental sustainability. In fact, waste reduction will also directly lead to (Jr et al., 2012) cost reduction and enhance economic performance of the firms. According to the (Khan and Qianli, 2017b; Zaman and Shamsuddin, 2017) Country economic performance mainly can measure through the GDP (gross domestic product) per capita, foreign direct investment inflows and trade openness % of GDP. Rao and Holt (2005) validated a link between green practices in SC and economic performance. They revealed that green logistics activities led to competitiveness and healthier economic performance. Khan & Qianli (2017a) found that the economic health is well connected with green logistics activities, while green packaging management under SC (supply chain) process is helpful to geared sound economic health of firms and for overall country economic health. Huang & Yang (2014) concluded that reverse logistics innovation is positively connected with environmental performance.

Zhu et al. (2007) confirmed that green supply chain practices only have slightly enhanced operational and environmental, economic performance of the firms. In a similar way Giovanni et al. (2012) highlighted that green practices in logistics operations and good environmental performance lead to a significant and higher contribution in firms' financial performance. Huang & Yang (2014) argued that huge investment in reverse logistics innovation under higher-level institutional pressures not necessary will always improve financial performance of the firms. Jr et al. (2012) conducted the empirical research on GSCM in manufacturing firms from the perspective of U.S. The results revealed that the adoption of green supply chain management significantly enhances firms' profitability, increases market share and builds competitive edge (Jr et al., 2012). In a similar way Jackson et al. (2016) conducted a research to identify the relationship between green practices and firms' financial performance. The findings showed that green practices in supply chain operations not only improved firms' profitability but also help to build firms' positive image.

Gimenez and Tachizawa (2012) conducted a research to examine the relationship between green logistics and financial performance of firms. They did not find any convincing relationship between green logistics practices and enterprise economic performance. (Khan et al., 2016a; Khan et al., 2017c) highlighted that renewable energy sources and green practices increased the firms' financial performance. Furthermore, the usage of renewable energy sources not only increases the firms' performance but also builds positive image and reputation in the market. (King and Lenox, 2001). suggested that regulatory authority should play their vital role in terms of customer awareness and encouragement of biofuel. Lai et al. (2012) the ecological modernization of China requires changes by Chinese export manufacturers to address emerging environmental problems. Their roles in resolving these problems and their actions to improve and balance their economic and environmental performance (Lai et al., 2012) are crucial for environmental protection. Huang & Yang (2014) the findings confirmed that reverse logistics innovation is positively correlated with economic performance and competitive gain. The previous researches emphasized the need of GL (green logistics) to sustain their activities in an eco-friendly way to encourage green transportation across the countries by sustained economic policies for competitive benefits. The study hypothesizes that:

H3. economic performance is sustained with green logistics activities

2. Methodology and data source

This article draws the linkages among green logistics, environmental factors, economic health and energy demand in a panel of 43 selected countries. Undeniably, energy plays a significant role in countries economic development by the support of logistics mechanism, while economic and environmental concerns are highly affected by SCM or global logistics activities in the absence of green practices and policies. Therefore, this research links worldwide logistics activities with economic health, environmental factors and energy demand under the presence of national scale economic indicators, which encourage green logistics activities across the countries. The given below equation is on the bases of our hypothesis.

$$L_i = \alpha_0 + \beta_1 \text{Engy}_i + \beta_2 \text{Envt}_i + \beta_3 \text{Ecoc}_i + \beta_4 \text{Cont}_i + \varepsilon_i \quad (1)$$

Where, L shows logistics performance including competence and quality of logistics services (LPIQLS), ability to trace consignment (LPITTC), arranging competitively priced shipment (LPICPS), quality of trade and transport-related infrastructure (LPIQTTI), frequency with which shipments reach consignee within schedule (LPIST), and efficiency of customs clearance process (LPICCP). The index value 1 represent low logistics performance and value 5 indicates high logistics performance i.e., (1 ¼ low to 5 ¼ high). Engy shows the energy demand variables contain GDP per unit of energy use (Energy) in constant 2011 PPP $ per kg of oil equivalent and renewable energy consumption in percentage of total energy consumption (REC). Envt indicates Environmental factors include fossil fuel energy consumption (FFUEL) in % of total energy consumption, Total greenhouse gas emissions (TGHG) and CO2 emissions (CO2) in metric tons per capita. Ecoc shows economic health factors include health expenditure per capita (HEPC) in current US$ and GDP per capita (GDPPC) in constant 2005 US$. Cont indicates control variables include foreign direct investments net inflows (FDI) as percentage of GDP, industry value added (IVD) as percentage of GDP, manufacturing value added (MVD) as percentage of GDP, agriculture value added (AVD) as percentage of GDP, export of goods and services (Export) and import of goods and services (Import) as percentage of GDP, while α and ε indicates a constant and error correction in the model.

In this research, we are using panel data of 43 different countries around the world to test our hypothesis, thus generating estimation of panel data. The following equation is used to evaluate the performance of green logistics i.e.,

$$L_{it} = \alpha_0 + \beta_{1t} \text{Engy}_{it} + \beta_{2t} \text{Envt}_{it} + \beta_{3t} \text{Ecoc}_{it} + \beta_{4t} \text{Cont}_{it} + \nu_t + \varepsilon_{it} \quad (2)$$

In the panel data, usually we would face the problem of serial correlation and heteroskedasticity, which may distort the true estimation of model. The serial correlation is the disturbance term correlated to any variable in the model (Attari et al., 2016) has not been influenced by the disturbance term relating to another variable of the model. Simpson (2012) the problem of heteroskedasticity in panel data, in simple words heteroskedasticity occurs when the variance of the error terms differs across observations. The problems of serial correlation and heteroskedasticity can be solved through FGLS model (Maddala and Lahiri, 2006; Judge et al., 1985). The FGLS allows models with heteroskedasticity and no cross-sectional correlation (Greene, 2012; Davidson and Mackinnon, 1993). The asymptotic efficiency of FGLS may not carry over to small sample size due to the variability introduced by the estimated. Griliches and Rao (1969) explained that FGLS is more suitable and efficient than least squares for the big sample size and FGLS have ability to overcome the problems of heterskedasticity and autocorrelation.

As equation (2) contained country time effects and country fixed effects, the model flared with the problem of unobserved country-specific heterogeneity. The research observed this issue by transformation these specified equations by first difference estimators as suggested Arellano and Bond (1991) i.e., dynamic panel GMM (generalized method of moments) estimators that reduced the problem of serial correlation and heterogeneity.

We tested for endogenity of the (independent variables) ivs using Durbin-Wu-Hausman procedure involving 2SLS for panel data and it is evidenced that the some variable are endogenous. Further we put those endogenous variables and exogenous variables in the given below equation forms;

$$\begin{aligned} LPICCP_{it} &= Energy_{it}\gamma_1 + CO2_{it}\gamma_2 + AVG_{it}\gamma_3 + FDI_{it}\beta_1 + REC_{it}\beta_2 \\ &\quad + TGHG_{it}\beta_3 + Export_{it}\beta_4 + Import_{it}\beta_5 + MVD_{it}\beta_6 \\ &\quad + IVD_{it}\beta_7 + GDPPC_{it}\beta_8 + FFUEL_{it}\beta_9 + HEPC_{it}\beta_{10} + \mu_i \\ &\quad + \nu_{it} \\ &= Z_{it}\delta + \mu_i + \nu_{it} \end{aligned} \quad (3)$$

$$\begin{aligned} LPICPS_{it} &= REC_{it}\gamma_1 + MVD_{it}\gamma_2 + IVD_{it}\gamma_3 + GDPPC_{it}\gamma_4 + FDI_{it}\beta_1 \\ &\quad + Energy_{it}\beta_2 + CO2_{it}\beta_3 + TGHG_{it}\beta_4 + Export\beta_5 \\ &\quad + Import_{it}\beta_6 + AVG_{it}\beta_7 + FFUEL_{it}\beta_8 + HEPC_{it}\beta_9 + \mu_i \\ &\quad + \nu_{it} \\ &= Z_{it}\delta + \mu_i + \nu_{it} \end{aligned} \quad (4)$$

$$\begin{aligned} LPIQLS_{it} &= HEPC_{it}\gamma_1 + FDI_{it}\beta_1 + REC_{it}\beta_2 + Energy_{it}\beta_3 + CO2_{it}\beta_4 \\ &\quad + TGHG\beta_5 + Export_{it}\beta_6 + Import_{it}\beta_7 + AVG_{it}\beta_8 \\ &\quad + MVD\beta_9 + IVD\beta_{10} + GDPPC\beta_{11} + FFUEL\beta_{12} + \mu_i \\ &\quad + \nu_{it} \\ &= Z_{it}\delta + \mu_i + \nu_{it} \end{aligned} \quad (5)$$

$$\begin{aligned} LPIQTTI_{it} &= CO2_{it}\gamma_1 + FDI_{it}\beta_1 + REC_{it}\beta_2 + Energy_{it}\beta_3 + HEPC_{it}\beta_4 \\ &\quad + TGHG\beta_5 + Export_{it}\beta_6 + Import_{it}\beta_7 + AVG_{it}\beta_8 \\ &\quad + MVD\beta_9 + IVD\beta_{10} + GDPPC\beta_{11} + FFUEL\beta_{12} + \mu_i \\ &\quad + \nu_{it} \\ &= Z_{it}\delta + \mu_i + \nu_{it} \end{aligned} \quad (6)$$

$$\begin{aligned} LPIST_{it} &= HEPC_{it}\gamma_1 + FDI_{it}\beta_1 + REC_{it}\beta_2 + Energy_{it}\beta_3 + CO2_{it}\beta_4 \\ &\quad + TGHG\beta_5 + Export_{it}\beta_6 + Import_{it}\beta_7 + AVG_{it}\beta_8 \\ &\quad + MVD\beta_9 + IVD\beta_{10} + GDPPC\beta_{11} + FFUEL\beta_{12} + \mu_i + \nu_{it} \\ &= Z_{it}\delta + \mu_i + \nu_{it} \end{aligned} \quad (7)$$

$$\begin{aligned} LPITTC_{it} &= Energy_{it}\gamma_1 + HEPC_{it}\gamma_2 + FDI_{it}\beta_1 + REC_{it}\beta_2 + CO2_{it}\beta_3 \\ &\quad + TGHG\beta_4 + Export_{it}\beta_5 + Import_{it}\beta_6 + AVG_{it}\beta_7 \\ &\quad + MVD\beta_8 + IVD\beta_9 + GDPPC\beta_{10} + FFUEL\beta_{11} + \mu_i \\ &\quad + \nu_{it} \\ &= Z_{it}\delta + \mu_i + \nu_{it} \end{aligned} \quad (8)$$

In equations (3)–(8), we have $LPICCP_{it}$, $LPICPS_{it}$, $LPIQLS_{it}$, $LPIQTTI_{it}$, $LPIST_{it}$, and $LPITTC_{it}$ as dependent variables. The variables mentioned above with coefficient γ are set of observations on g_2 and endogenous variables included as covariates with coefficients noted as γ, and these variables are allowed to be correlated with ν_{it}; while the variables with coefficients β are observations on the exogenous variables included as covariates;

Z_{it} is the set of instruments which can be endogenous, exogenous variables and lags of dependent and independent variables (Arellano and Bond, 1991; Newey and West's, 1994; Windmeijer, 2000).

δ is a K x 1 vector of coefficients, where $K = g_2 + k_1$

Usually the problem of serial correlation, heteroskedasticity and heterogeneity are faced in panel data and these problems can be solved through the adoption of panel GMM (generalized method of moments) (Attari et al., 2016; Bölük and Mert, 2015). The GMM estimator also performs better in a situation where the cross-section identifiers are large in numbers as compared to the small numbers of time period. In this research, Panel GMM is the suitable choice of modeling as the cross-section identifiers are 43 countries, while small number of time period from 2007 to 2016 being used as a sample time period of the research. The research selected a panel of 43 countries (the list of countries are provided in Appendix Table 5).

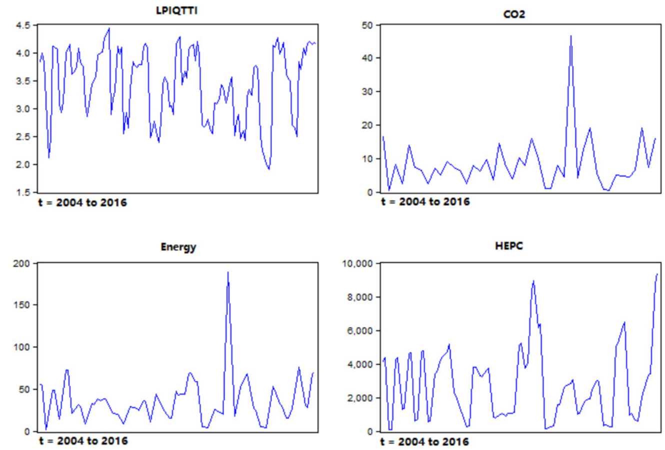

Fig. 1. Plots of level data.

3. Results and discussion

Table 1 illustrate that all variables have positive mean and standard deviation and have a significant peak of the distribution, which confirms the strong logistics performance including competence and quality of logistics services, ability to trace consignment, arranging competitively priced shipment, quality of trade and transport related infrastructure, frequency with which shipments reach consignee within schedule, and efficiency of customs clearance process. The index value 5 show high logistics performance and 1 value show low logistics performance i.e., (5 ¼ high to 1 ¼ low) with the panel of 43 selected countries with better economic health and trade policies that upturn manufacturing value added (annual % growth), GDP per capita (GDPPC) annual growth, industry value added (annual % growth), agriculture value added (annual % growth), export of goods and services (% of GDP), import goods and services (% of GDP) and foreign direct investments net inflows (% of GDP). On the other hand, environment is seriously affected by significant positive mean and standard deviation value of fossil fuel energy consumption in total of energy consumption, GDP per unit of energy use in constant 2011 PPP $ per kg of oil equivalent, total greenhouse gas emissions (TGHG) in metric tons per capita and carbon emissions (CO2) in metric tons per capita that may be controlled and mitigated by usage of renewable energy consumption (REC) in percentage of total energy consumption. Furthermore, the greater usage of renewable energy consumptions in logistics operations may significantly reduce health expenditure per capita (HEPC) in current US$. Fig. 1 shows that energy and logistics operations are the key contributors of CO2 emissions which create significant harmful effect on the environment and human lives. On the other hand, due to greater emissions, health expenditure is also apparently increasing. These problems can be resolved through the adoption of renewable energy sources and green practices in logistics operations (Fig. 2 shows the graph of all variables on level data for ready reference in Appendix).

Table 1
Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
LPICCP	213	3.179283	0.6146224	1.866542	4.20779
LPIQTTI	213	3.369228	0.6806075	1.78	4.439356
LPICPS	213	3.281044	0.4299914	1.93	4.18
LPIQLS	213	3.39492	0.5618273	2.05	4.32
LPIST	213	3.807679	0.4778475	2.31	4.52
LPITTC	213	3.47255	0.5558461	1.89	4.377678
REC	126	1.806176	1.778308	0.0008264	6.572483
FDI	172	0.5035383	0.9347422	−0.3679174	8.744259
TGHG	127	11.39809	22.74076	0.2390058	124.5471
HEPC	168	26.11986	21.14331	0.5686859	94.02537
Import	172	4.102649	3.236468	1.13097	22.4431
Export	172	4.276753	3.500459	0.8149135	22.55616
AVG	171	0.1021177	0.8425395	−2.680784	3.455726
Energy	153	36.6438	28.74681	1.73581	188.9936
FFUEL	149	0.7747863	0.1782291	0.3075437	1
CO2	129	8.613523	7.93223	0.3010834	53.67275
MVG	165	4.003099	5.140805	−13.35871	22.80392
IVD	169	3.529507	5.261878	−13.61922	25.49406
GDPPC	172	2.342755	3.196011	−11.21732	13.63634

Table 2 shows the correlation and found that the environmental variables have a differential impact on logistics performance, as there is positive correlation between logistics and CO2 emissions, while sustainable logistics activities significantly reduce TGHG emissions and fossil fuel energy consumption. Manufacturing value added, health expenditure and GDP growth have a positive correlation with the CO2 emissions, while manufacturing value added increases CO2 emissions but decreasing fossil fuel consumption and TGHG across the 43 countries. Furthermore, manufacturing value added and health expenditure have a strong positive relationship. It means that manufacturing activities badly damage people's health and due to manufacturing activities people's health is compromising and their health expenditure are continuously increasing.

Table 3, illustrates the results of OLS (ordinary least square), FE (fixed effect) and RE (random effect), while the coefficient value of CO2 and TGHG is negatively correlated with transport-related infrastructure and quality of logistics services on 5% and 10% confidence level respectively. In simple words, the poor transport-related infrastructure and quality of logistics services will significantly increase the carbon emissions and global warming, which will directly environmental sustainability. On the other hand, greater export volumes of goods and services are positively and significantly correlated with improved transports-related infrastructure, quality of logistics services and shipments reach consignee within scheduled time frame on 10% confidence level, while poor efficiency of customs clearance process is negatively correlated with export volumes of goods and services.

The results also indicate that energy demand is positively and significantly correlated with poor transport-related infrastructure and inefficiency of customs clearance process on 5% and 10% confidence level respectively, which is an alarming situation for the regulatory authorities, improving transport-related infrastructure and efficiency of customs clearance process. Because greater

Table 2
Correlational matrix.

Variables	FDI	REC	Energy	CO2	TGHG	EXP	IMP	AVD	MVD	IVD	GDPPC	FFUEL	HEPC	LPICCP	LPIQTTI	LPICPS	LPIQLS	LPIST	LPITTC
FDI	1																		
REC	−0.1994	1																	
ENERGY	0.1302	−0.3482	1																
CO2	0.1142	−0.5379	0.9071	1															
TGHG	−0.1049	−0.1512	0.3958	0.4163	1														
EXP	0.4217	−0.314	0.2276	0.2055	−0.3504	1													
IMP	0.4141	−0.3451	0.0758	0.0708	−0.3793	0.918	1												
AVD	0.0215	0.2249	−0.2125	−0.2558	−0.213	0.0552	0.0385	1											
MVD	0.0053	0.0787	−0.1035	−0.0865	−0.0088	0.0006	−0.0413	0.0219	1										
IVD	−0.0097	0.232	−0.1886	−0.1789	0.0029	−0.1144	−0.1217	0.0266	0.8455	1									
GDPPC	0.0084	0.1987	−0.3057	−0.2737	0.0108	−0.1127	−0.1473	0.1077	0.6514	0.7367	1								
FFUEL	0.1661	−0.8274	0.2057	0.513	0.0834	0.2163	0.2507	−0.1126	−0.0777	−0.2192	−0.154	1							
HEPC	0.1003	−0.1689	0.74	0.5797	0.5001	0.064	−0.027	−0.129	−0.2628	−0.3128	−0.3671	−0.0306	1						
LPICCP	0.1835	−0.2102	0.6245	0.4609	0.0981	0.3206	0.2118	−0.0792	−0.1959	−0.2635	−0.3583	−0.0023	0.7764	1					
LPIQTTI	0.1597	−0.2612	0.6749	0.5026	0.1905	0.258	0.1441	−0.0452	−0.2281	−0.2921	−0.4045	0.0324	0.8192	0.9559	1				
LPICPS	0.2249	−0.2692	0.5318	0.4115	0.0609	0.327	0.2404	−0.1163	−0.2243	−0.2551	−0.3621	0.0836	0.6302	0.8945	0.886	1			
LPIQLS	0.1914	−0.2402	0.6149	0.4441	0.1608	0.2621	0.1516	−0.0583	−0.1612	−0.2097	−0.3189	−0.0023	0.7733	0.9596	0.969	0.8834	1		
LPIST	0.1364	−0.2168	0.5706	0.4148	0.1305	0.2478	0.1397	−0.0603	−0.1302	−0.2337	−0.3186	0.0213	0.7182	0.8977	0.903	0.8483	0.9088	1	
LPITTC	0.1554	−0.2407	0.607	0.4455	0.1819	0.2335	0.1274	−0.0874	−0.2174	−0.2654	−0.3522	0.0004	0.7872	0.9449	0.9576	0.8668	0.969	0.9159	1

consumption of energy is a key cause of environmental degradation including, climate change and global warming. Furthermore, health expenditure is positively correlated with competence and quality of logistics services, ability to trace consignment, arranging competitively priced shipment, quality of trade and transport related infrastructure, and efficiency of customs clearance process on 1% confidence level. In other words, health expenditure increased due to greater logistics operations. Because logistics activities are mainly based on fossil fuel consumption, which is not only harmful for environmental sustainability but also has adversity effect on human lives in terms of different diseases including asthma, lungs cancer, and different brain diseases.

Table 4 shows the panel GMM and FGLS estimation regression. The results reveal that logistics performance related with LPICCP required greater energy, as it has a significant and positive association with energy efficiency on 5% level of confidence. This relationship is less elastic in nature, as if there is 1% delay in customs clearance process so it will increase energy consumption by 0.0467%. In other words, efficient customs clearance process not only save the time and money but also increase environmental sustainability. On the other hand, logistics performance related with LPICPS is negatively correlated with energy demand on 5% level of confidence. If there is 1% increase in arranging competitively priced shipments so it will significantly reduce energy consumption by 0.0900%. The quality of logistics services are significantly and positively correlated with energy efficiency on 5% level of confidence. 1% increase in energy consumption will bring 0.032% improvement in quality of logistics services, while the more competitively priced shipments will significantly reduce energy consumption and build green economic growth and reduce harmful effect of carbon emissions on the environment. Khan et al. (2017a) logistics activities are heavily dependent on energy and greater logistics operations required greater consumption of energy. The results confirmed that logistics activities are positively correlated with country economic growth. On the other hand, polluted logistics operations create disaster for environmental sustainability and human lives. The researcher suggested renewable energy sources to encourage green practices in logistics operations to reduce CO2, greenhouse gases and global warming (Imran et al., 2015).

The results imply that renewable energy consumption is negatively correlated with LPIQTTI, LPICPS, and LPITTC on different level of confidence. If there is 1% increase in quality of trade and transport-related infrastructure, it will decrease renewable energy consumption by 0.010%, while 1% increase in arranging competitively priced shipments and ability to track consignments will decrease renewable energy by 0.0388% and 0.011% respectively. In simple words, renewable energy is significantly and negatively correlated with logistics performance due to huge costs in adoption of renewable energy sources and lack of government support and encouragement in terms of tax exemptions, low prices of green energy sources, and subsidies etc. In similar way Mafakheri & Nasiri (2014) biofuel and renewable energy have bright future with the support of government environmental friendly policies. Renewable energy can enhance the environmental sustainability and build positive image of firms in domestic and international markets. Bozan (2015) the bio energy is a viable energy resource that may geared the performance of logistics under environmental constraint business activities. Li (2014) highlighted that firms implementing renewable energy in their logistics systems required government support in terms to encourage firms initiatives.

This research used three environmental factors i.e., CO2, total greenhouse gas emissions and fossil fuel consumption that were influenced by logistics performance index. The results reveal that CO2 emissions are positively and significantly associated with LPIST

Table 3
The results of OLS, FE and RE Effects.

Variables	olsdv1	fedv1	olsdv2	fedv2	olsdv3	redv3	olsdv4	redv4	olsdv5	redv5	olsdv6	redv6
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
FDI	−0.006	−0.005	−0.011	−0.007	0.02	0.045	0.013	0.036	−0.016	0.01	−0.003	0.019
	(-0.16)	(-0.17)	(-0.29)	(-0.20)	(0.57)	(1.33)	(0.35)	(1.08)	(-0.43)	(0.3)	(-0.07)	(0.57)
REC2	−0.051	−0.036	−0.093*	−0.004	−0.044	−0.065	−0.098**	−0.098	−0.04	−0.057	−0.098**	−0.097
	(-1.35)	(-0.21)	(-2.51)	(-0.02)	(-1.32)	(-1.39)	(-2.70)	(-1.91)	(-1.15)	(-1.17)	(-2.68)	(-1.85)
C02	−0.031	−0.148	−0.082**	−0.117	−0.037	−0.026	−0.061*	−0.043	−0.055*	−0.039	−0.045	−0.039
	(-1.07)	(-1.62)	(-2.90)	(-1.06)	(-1.44)	(-0.74)	(-2.18)	(-1.15)	(-2.02)	(-1.10)	(-1.62)	(-1.03)
Export	0.098*	−0.160*	0.126**	−0.057	0.084*	0.061	0.110*	0.009	0.086*	0.025	0.103*	−0.004
	(2.24)	(-2.28)	(2.91)	(-0.68)	(2.16)	(1.3)	(2.6)	(0.18)	(2.1)	(0.52)	(2.44)	(-0.08)
Import	−0.083	0.129	−0.143**	−0.056	−0.077	−0.062	−0.125*	−0.016	−0.096*	−0.049	−0.118*	−0.003
	(-1.64)	(1.74)	(-2.87)	(-0.62)	(-1.70)	(-1.14)	(-2.55)	(-0.28)	(-2.01)	(-0.87)	(-2.41)	(-0.05)
AVG	−0.018	−0.090**	0.041	−0.043	−0.035	−0.059	0.014	−0.019	−0.006	−0.013	−0.005	−0.035
	(-0.42)	(-3.24)	(0.96)	(-1.27)	(-0.90)	(-1.73)	(0.33)	(-0.58)	(-0.15)	(-0.40)	(-0.13)	(-1.08)
MVD	−0.003	−0.001	−0.012	−0.011	−0.015	−0.014	−0.01	−0.005	0.009	0.011	−0.012	−0.008
	(-0.30)	(-0.18)	(-1.02)	(-1.29)	(-1.49)	(-1.59)	(-0.91)	(-0.60)	(0.85)	(1.27)	(-1.03)	(-0.97)
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
IVD	0.018	−0.012	0.032*	0.011	0.026*	0.02	0.032*	0.016	0.006	−0.003	0.024	0.017
	(1.23)	(-1.24)	(2.24)	(0.89)	(2.05)	(1.66)	(2.32)	(1.39)	(0.46)	(-0.23)	(1.76)	(1.52)
GDPPC	−0.174	0.236	−0.390*	−0.069	−0.236	−0.164	−0.24	−0.032	−0.177	−0.077	−0.199	−0.053
	(-1.07)	(1.81)	(-2.43)	(-0.44)	(-1.63)	(-1.15)	(-1.52)	(-0.23)	(-1.15)	(-0.00)	(-1.26)	(-0.38)
FFUEL	0.073	0.346	0.434	0.898	0.315	0.006	0.096	−0.253	0.453	0.113	−0.054	−0.238
	(0.15)	(0.24)	(0.89)	(0.51)	(0.71)	(0.01)	(0.2)	(-0.40)	(0.97)	(0.19)	(-0.11)	(-0.37)
TGHG	−0.012***	−0.025	−0.009**	0.006	−0.006*	−0.006	−0.008**	−0.008*	−0.007**	−0.008*	−0.008**	−0.008*
	(-4.46)	(-1.08)	(-3.32)	(0.21)	(-2.57)	(-1.72)	(-3.26)	(-2.30)	(-2.85)	(-2.39)	(-3.15)	(-2.17)
Energy	0.006	0.054*	0.018**	0.038	0.007	0.007	0.012	0.014	0.01	0.011	0.007	0.012
	(0.95)	(2.21)	(2.81)	(1.26)	(1.18)	(0.89)	(1.81)	(1.55)	(1.65)	(1.32)	(1.16)	(1.37)
HEPC	0.027***	0.001	0.027***	0.008	0.014***	0.010**	0.024***	0.019***	0.019***	0.016***	0.024***	0.020***
	(9.34)	(0.07)	(9.43)	(0.93)	(5.33)	(3.13)	(8.53)	(5.48)	(7.08)	(4.8)	(8.67)	(5.61)
Intercept	2.530***	2.591	2.649***	2.464	2.816***	3.098***	3.033***	3.155***	3.191***	3.451***	3.270***	3.244***
	(5.71)	(1.95)	(6.04)	(1.53)	(7.1)	(5.9)	(7.05)	(5.49)	(7.63)	(6.3)	(7.58)	(5.59)

Note: dv1 indicate LPICCP; dv2 indicate LPIQTTI; dv3 denote LPICPS; dv4 denote LPIQLS; dv5 indicate LPIST; dv6 indicate LPITTC.
ols indicate ordinary least square; fe indicate fixed effect model; re indicate random effect model.
On the basis of Hausman test results, we have run FE or RE model for different DVs. Furthermore, R-square and F-statistics confirm the goodness of fit of the model and model stability respectively.
b/t indicates coefficient value and t value.
***indicate significance at 1%; ** indicate significance at 5%; * indicate significance at 10%.

and LPICPS on 1% level of confidence. In simple words, shipments not reach consignee within scheduled time or expected time will increase CO2 emission by 0.0209, which will significantly harm the environmental sustainability and human lives. On the other hand, CO2 emissions are negatively correlated with LPIQTTI and LPIQLS. 1% increase the quality of logistics services and quality of trade and transport-related infrastructure will significantly reduce CO2 emission by 0.0681% and 0.0382% respectively. Logistics operations are mainly dependent on transportation movement and transportation are the significant emitters of CO2 emissions. Dekker et al. (2012) the transport industry are key responsible for air pollution including CO2, GHG and climate change. Sharma & Gandhi (2016) government should impose heavy taxes on polluted vehicles to discourage fossil fuel consumption and improve environmental sustainability. Bektas et al. (2016) highlighted the need of green transportation in order to mitigate carbon emissions (Leigh and Li, 2015) and improve environmental sustainability, while the adoption of renewable energy is almost not very effective for firms without the involvement of government environmental-friendly policies to protect firms profitability and/or reduce overall logistics systems cost in terms of tax exemptions, low import duty on green materials and subsidies on green products etc.

In our results, GHG emissions have significant and negative relationship with customs clearance process, shipments reach consignee and quality of trade and transport-related infrastructure on 1% level of confidence and moreover fossil fuel has no significant association with logistics performance indexes. It means that longer customs clearance processes are the significant contributor of greenhouse gas emissions and quality of transport infrastructure and quality of logistics services significantly reduce the greenhouse gas emissions, while huge volume of trade create significant load on customs authority which is a key reason of longer custom clearance process. The results shows that 1% improvement in quality of travel and transport infrastructure will significantly reduce greenhouse emissions by 0.009%, while shipments not reach consignee within scheduled or expected time have positive association with greater greenhouse emissions, means if shipments delayed or not reach to consignee in scheduled time so it will increase GHG emissions by 0.018%. Zawaydeh (2017) country economic health is mainly dependent on logistics industries. Undeniably, logistics operations are the key contributor of emissions which create a number of environment-related problems including CO2, GHG, climate change, flora and fauna diseases. Gold & Seuring (2011) highlighted the benefits of biofuels and renewable energy sources to protect environmental sustainability and continue healthier economic. The renewable energy is the first step towards green logistics implementation and firms itself cannot adopt without the support of regulatory authorities Abid & Mraihi (2012).

The greater volume of export is a positive sign for countries economic growth and foreign investment inflows, the results show that countries export volume is positively and significantly correlated with quality of trade and transport-related infrastructure,

Table 4
FGLS and GMM panel estimation regression results.

DVs	LPICCP		LPIQTTI		LPICPS		LPIQLS		LPIST		LPITTC	
	FGLS	GMM	FGLS	GMM	FGLS	GMM	FGLS	GMM	FGLS	GMM	FGLS	GMM
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
CO2	0.011	−0.1103	−0.046*	−0.0382*	−0.002	0.0310*	−0.019	−0.0681*	0.002	0.2094*	−0.021	0.0286
	(0.47)	(-1.303)	(-2.06)	(-0.324)	(-0.07)	(1.931)	(-0.45)	(-0.805)	(0.09)	(1.631)	(-1.03)	(0.239)
MVD	0.009	0.0064	−0.005	−0.0094	−0.024**	−0.0161*	0.005	−0.0010	−0.002	−0.0111	0.003	−0.0151
	(1.81)	(0.652)	(-0.94)	(-0.918)	(-3.01)	(1.743)	(1.11)	(-0.100)	(-0.73)	(-1.085)	(0.43)	(-1.543)
IVD	−0.014	−0.0106	0.011	0.0142	0.021	0.0273**	−0.003	0.0083	0.015***	−0.0045	0.011	0.0184
	(-1.78)	(-0.867)	(1.31)	(1.125)	(1.92)	(2.030)	(-0.41)	(0.648)	(3.78)	(-0.420)	(1.07)	(1.492)
FFUEL	−0.305	0.7390	−0.031	−0.0435	−0.134	−1.6305	0.378	0.5754	0.37	−2.6939	−0.211	−0.7158
	(-1.00)	(0.892)	(-0.08)	(-0.035)	(-0.32)	(-1.121)	(0.39)	(0.576)	(0.73)	(1.594)	(-0.76)	(-0.374)
Energy	0.005	0.0467**	0.015**	0.0121	0.001	−0.0900**	0.032**	0.0034	−0.0012	−0.0325	0.005	0.0276
	(0.88)	(2.411)	(2.95)	(0.399)	(0.17)	(-2.209)	(2.92)	(0.184)	(-0.01)	(-1.136)	(1.1)	(0.895)
AVG	−0.048*	−0.0626*	−0.023	−0.0199	−0.042	−0.0717	0.004	−0.0197	−0.017	−0.0478	−0.001	−0.0409
	(-2.16)	(-1.998)	(-1.11)	(-0.683)	(-1.30)	(-1.627)	(0.19)	(-0.542)	(-1.01)	(-1.519)	(-0.03)	(-1.135)
Export	0.017	−0.1396**	0.131***	−0.0146	0.098***	0.2015***	−0.078	−0.0753	0.199***	0.0277	0.111**	−0.1174
	(0.49)	(-2.120)	(4.21)	(-0.192)	(3.34)	(2.841)	(-1.61)	(-1.209)	(4.04)	(0.356)	(3)	(-1.337)
	FGLS	GMM	FGLS	GMM	FGLS	GMM	FGLS	GMM	FGLS	GMM	FGLS	GMM
	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t	b/t
Import	0.004	0.1247	−0.148***	−0.0155	−0.093**	−0.1815**	0.083	0.1147	−0.193***	−0.0413	−0.124**	0.2442**
	(0.1)	(1.657)	(-4.03)	(-0.182)	(-2.88)	(-2.554)	(1.22)	(1.352)	(-3.51)	(-0.530)	(-2.77)	(2.465)
HEPC	0.019***	−0.0012	0.020***	0.0001	0.010***	−0.0154	−0.013*	−0.0124	0.039***	−0.0026	0.022***	−0.0048
	(8.98)	(-0.165)	(9.11)	(0.007)	(4.16)	(-1.430)	(-2.07)	(-1.127)	(9.14)	(-0.294)	(11.82)	(-0.431)
TGHG	−0.012***	−0.0345***	−0.009***	−0.0061	−0.005*	0.0258	−0.018*	−0.0214	−0.018***	0.0057	−0.009***	−0.0044
	(-6.47)	(-2.852)	(-4.46)	(-0.432)	(-2.43)	(1.065)	(-2.33)	(-1.409)	(-7.50)	(0.211)	(-5.30)	(-0.147)
FDI	0.018	−0.0028	0.015	0.0014	0.052**	0.0285	0.020*	0.0082	−0.012*	0.0121	0.005	0.0178
	(1.17)	(-0.285)	(0.9)	(0.077)	(2.97)	(1.096)	(2.02)	(0.667)	(-2.29)	(0.914)	(0.38)	(0.451)
REC	−0.027	−0.0377	−0.103***	−0.0635	−0.065*	−0.3879**	0.078	0.1218	−0.015	−0.1348	−0.115***	−0.0714
	(-1.14)	(-0.237)	(-3.77)	(-0.432)	(-2.29)	(-2.265)	(0.72)	(0.877)	(-0.37)	(-0.839)	(-5.93)	(-0.321)
GDPPC	0.011	0.0177	−0.019*	−0.0011	−0.015	−0.0191	0.020*	0.0139	−0.008	0.0465***	−0.013	0.0119
	(1.19)	(1.435)	(-2.12)	(-0.085)	(-1.31)	(-1.121)	(2.2)	(0.944)	(-0.95)	(3.139)	(-1.24)	(0.666)
Intercept	2.735***		3.047***		3.297***		0.433		2.855***		3.392***	
	(11.25)		(9.3)		(9.24)		(0.49)		(5.8)		(14.64)	

Note: LPITTC shows logistics performance including ability to track and trace consignments; LPIQLS indicate quality of logistics services; LPICPS shows ease of arranging competitively priced shipments; LPICCP shows efficiency of customs clearance; LPIST indicate frequency with which shipments reach consignee within scheduled time; LPIQTTI indicate quality of trade and transport-related infrastructure.
Sarjan statistics show insignificant at 5% confidence interval, hence we may conclude that the prescribed instrumental lists are valid for empirical analysis. Further, instrumental rank is appropriate for further empirical analysis.
***indicate significance at 1%; **indicate significance at 5%; *indicate significance at 10%.

competitively priced shipments, and shipment reach consignee within expected or schedule time on 1% level of confidence, while ability to trace and trace consignments is related with export volume on 5% level of confidence. The 1% increase in export volume will lead 0.013% increase in LPIQTTI; 0.098% increase in LPICPS, 0.027% increase in LPIST and 0.111% will increase in LPITTC. In simple words, global logistics operations have positive effect on greater export volume. Zawaydeh (2017) FDI inflows are attracted by green logistics and environmental-friendly policies implemented by government. A number of European countries banned the polluted firms and imposed heavily penalty on polluted logistics systems (Barysiene et al., 2015). On the other hand, polluted logistics vehicles reduce the export opportunities in European countries and create negative image in international market due to adopting of non-green practices in their logistics operations (Bölük and Mert, 2015). The study results revealed that greater import volume is significantly and negatively correlated with logistics performance, while this results is also supported by previous researches including (Ruparathna and Hewage, 2015; Niwa, 2014; Wandersee et al., 2012) shows that polluted logistics systems and materials are banned in a number of countries as well as government imposes heavy import duties on polluted logistics operations to encourage green logistics systems. On the other hand, polluted logistics systems are significantly and negatively correlated with greater logistics operations performance. Green & Morton (1998) argue that environmental-friendly policies is a key reason of lower import volume in European countries, while government provide a number of benefits on green products and logistics systems to protect and encourage the sustainable logistics operations.

The results revealed that per capita income is significantly and positively correlated with shipments reach consignee within scheduled time and quality of logistics services, while 1% improvement in quality of logistics services can bring 0.020% positive change in per capita income and 1% increase in shipments reach consignee within scheduled time will lead 0.0465% positive change in per capita income. On the other hand, trade and transport-related infrastructure are negatively correlated with GDP per capita income and 1% increase in GDP per capita income will improve transport-related infrastructure by 0.019%. Khan & Qianli (2017a) the results confirmed that green practices in supply chain and logistics activities have significant and positive relationship with firms' economic performance. In the similar way Benitez et al. (2015); Bose and Pal (2012) found the strong association between green logistics and firm greater financial performance. Environmental-friendly practices in logistics operations have positive effect on the countries' economic growth (Yang et al., 2016). An empirical research conducted by Zhu and Sarkis (2004), the findings shows that green practices in logistics operations not only lead to greater environmental sustainability but also improve economic performance in long-run.

The logistics operations consume greater energy and emit greater carbon emissions, while carbon emissions create environmental and health problems. The findings show that health expenditure are negatively correlated with quality of logistics services on 10% level of confidence, while health expenditure are positively correlated with customs clearance process and shipments reach consignee within scheduled time frame on 1% level of confidence. 1% improvement in quality of logistics services will significantly decrease health expenditure by 0.013%. On the other hand, 1% increase in shipments reach time to consignee and delay in customs clearance process will bring 0.039% and 0.019% increase in health expenditures. Wu & Dunn (1995) conducted the research on environmental sustainability logistics systems, the results indicate that polluted logistics have serious effect on human health and greater emissions create harmful effect on human lives. Boukherroub et al. (2015) firms have started to greening their logistics and manufacturing processes to reduce their negative effect on the human lives and environmental sustainability.

This research shows that FDI inflows and quality of logistics services are positively and significantly correlated on 10% level of confidence, while LPICPS are also positively correlated with FDI inflows on 5% level of confidence. It shows that if 1% improvement in quality of logistics services will bring 0.020% increase in FDI inflows, while 1% improvement in arranging competitively priced shipments will bring positive change in FDI inflows by 0.052%. On the other hand, shipment delays or not reach consignee within schedule time will discourage FDI inflows by 0.012%. In developed and global logistics ranked countries (Yune et al., 2016), FDI inflows are attracted by greater logistics performance and environmental friendly-policies implemented by government. Wanzala & Zhihong (2016) concluded that logistics costs are increasing due to poor quality of logistics infrastructure and government policies and 70% costs of logistics operations increases due to poor and ineffective transportation policies, which have significant impact on countries economic growth and also create negative effect on FDI inflows (United Nations, 2013). The green logistics improves environmental and economic performance further associated with improved firms' positive image (Lai et al., 2012). Firms are implementing green practices to enhance their financial performance and build competitive edge (Zhu et al., 2008). On the other hand, in broad aspects, green practices in logistics operations positively and significantly spur countries economic growth.

3.1. Policy relevance

The environmental-friendly logistics operations are associated with business and trade activities, which is covering product planning to product execution stage. The activities of logistics are mainly dependent on energy demand and fossil fuel consumption to complete their task. Therefore, the policy makers' required all-inclusive knowledge of renewable energy sources which are considerably controlling harmful effect of logistics operations on the environment.

The countries' economic wealth are measured by per capita income, while environmental effect of logistics activities are not only associated with environmental degradation but also have serious negative effect on the countries' economic health. The poor environmental policies and non-green logistics operations have positive relationship with lower FDIs inflows, which is a basic cause of higher unemployment rate in the countries. Undeniably, logistics sector is a key contributor of carbon emissions and climate change, which also have adversity effect on human lives in terms of different diseases including heart attack, cancer, brain diseases and asthma. The government policies for environmental-friendly logistics activities to promote healthy economy are required for our future. The following are the most suitable policies which would support the process of greening logistics operations in the selected panel of 43 countries i.e.,

i) Decrease in freight transport-related CO2 and GHG emissions by green practices and renewable energy usage in logistics operations.
ii) Government should provide subsidies and tax exemptions on eco-design vehicles to promote green transport and logistics activities.
iii) Regulatory authority and government policies to back industrial green growth.
iv) The mutual cooperation between logistics sector and regulatory authority/government for greening the logistics and business activities through ‘certification schemes’ that would support to promote sustainable agenda.
v) Regulatory authorities should enforce heavy taxes, import duties on fossil fuel and polluted materials; government also should impose heavy financial penalties on polluted logistics systems to discourage non-green logistics operations.
vi) Government should provide loans on lowest interest rate to firms for adopting renewable and green energy sources.

4. Conclusion

The significance of global logistics in advancing economic activities is critically assessed and debatable topic under the logistics and supply chain management. This discussion is prolonged with the environmental-friendly logistics operations that are associated with green practices and biofuel sources to address environmental degradation issues that also connected with poor country economic growth. The study employed GMM model and FGLS model as robust results to estimate relationship between logistics performance, economic and environmental factors.

The results show that the efficiency of customs clearance processes are significantly and positively associated with energy demand and total greenhouse emissions. In other words, long process of customs clearance will consume greater energy and emits GHG emissions, which are the main cause of poor environmental sustainability. The quality of trade and transport-related infrastructure have significantly and negatively relationship with renewable energy sources, carbon emissions, and import value added activities and GDP capita per income. Due to the poor transport related infrastructure logistics operations emits greater carbon emissions, while country lower per capita income and lower import volumes are also positively associated with poor trade and transport-related infrastructure. On the other hand, due to the lack of government support to encourage renewable energy sources, a number of firms are using fossil fuel oil which create serious environmental pollution. The competence and quality of logistics services are positively and significantly associated with FDI inflows, country per capita income and energy efficiency. It means that higher quality of logistics services is a key contributor in countries economic development.

The logistics frequency with which shipments not reach within expected time to consignee is significantly and negatively correlated with FDI inflows and GHG emissions. In simple words, the delayed shipment reach to consignee or shipment doesn't reach consignee within schedule time will create negative effect on countries reputation in international arena and it will damage country goodwill moreover foreign investments inflows will be decrease and due to delayed of shipment, it will also emits greater emissions which will not only add huge costs in overall logistics systems but also will create significant harmful effect on the environmental sustainability.

The green logistics policies is required to discourage fossil fuel and non-green practices in logistics operations to control environmental degradation. This research used energy efficiency, environmental and economic factors to measure the relationship with logistics performance indexes. The research findings are helpful in building green logistics policies which are helpful to encourage green practices and renewable energy sources in logistics operations to protect environmental sustainability in order to reduce carbon emissions, global warming, and protect fauna and flora lives. The eco-friendly logistics system is representing global competitive war of healthier economy with greater environmental sustainability. Undeniably, ecofriendly policies are prerequisite to encourage renewable energy sources, green practices in logistics operations to balanced environmental performance and economic growth.

4.1. Future recommendations

The research study has some limitations that should be addressed in future research (Kaiser et al., 2008). The study conducted only in a panel of 43 selected countries around the globe. The self-selection biases of the country may bias the result as those who are more pro-environmental country may have discussed more in-detail, which in turn has over represented the study results (Yadav and Pathak, 2016). Further, the study is limited in measuring the relationship of logistics operations performance with environmental and economic factors. So, future research may report on micro-level, to the consequences of polluted logistics operations and environmental degradation (Hage et al., 2009). On the other hand, this research discussed environmental and economic factors in-details, while future research may discussed polluted logistics systems in social aspects, human, and fauna lives in more detailed.

Appendix A

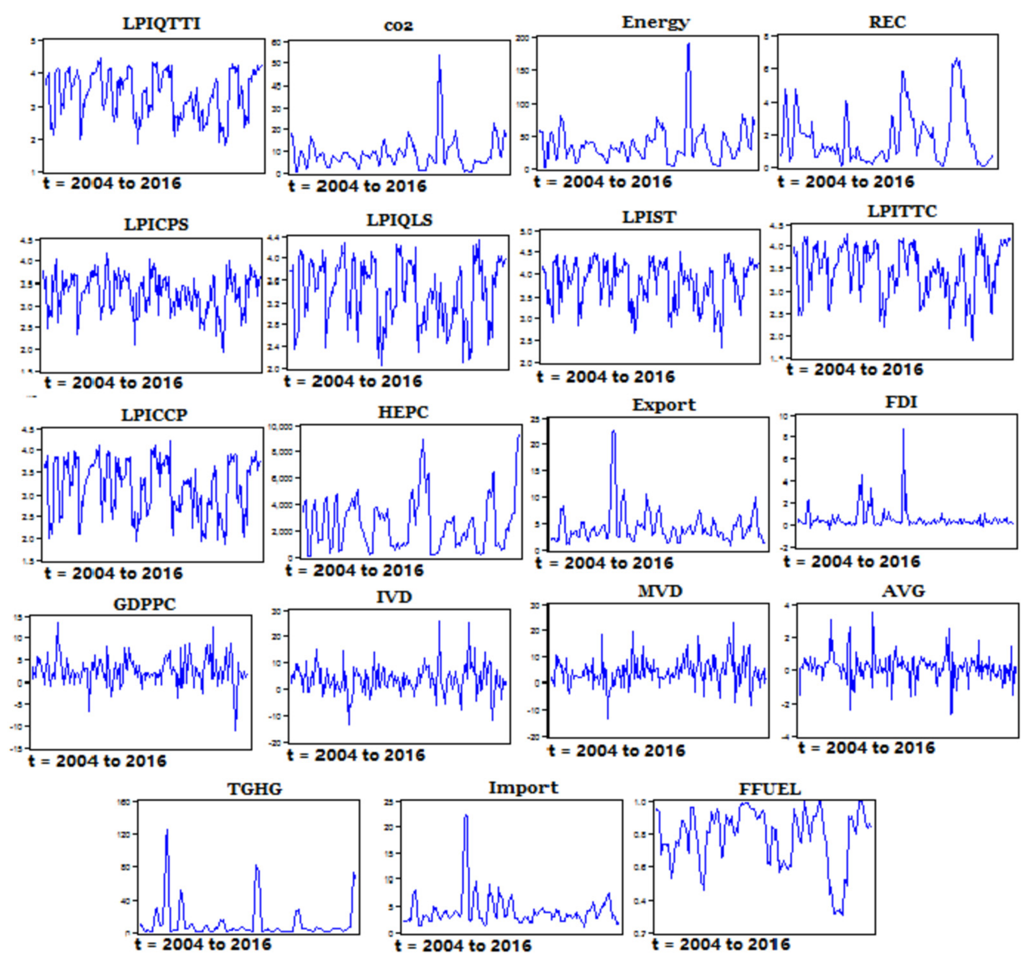

Fig. 2. Graph of Dependent and Independent Variables on Level Data.

Table 5
List of Countries

Country name	Code	Country name	Code	Country name	Code
Australia	AUS	Bangladesh	BGD	Belgium	BEL
Brazil	BRA	Canada	CAN	China	CHN
Denmark	DNK	Egypt	EGY	European Union	EUU
France	FRA	Germany	DEU	Hong Kong	HKG
Greece	GRC	Indonesia	IDN	Ireland	IRL
Italy	ITA	Japan	JPN	Jordan	JOR
Kazakhstan	KAZ	Malaysia	MYS	Netherlands	NLD
Mexico	MEX	New Zealand	NZL	North America	NAC
Norway	NOR	Pakistan	PAK	Philippines	PHL
Poland	POL	Portugal	PRT	Qatar	QAT
Romania	ROU	Russian Federation	RUS	Saudi Arabia	SAU
Spain	ESP	Sudan	SDN	Sweden	SWE
Sri Lanka	LKA	Switzerland	CHE	Turkey	TUR
Ukraine	UKR	United Kingdom	GBR	United States	USA
United Arabic Emirates	ARE				

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