Environmental Science and Pollution Research (2020) 27:11671–11682
https://doi.org/10.1007/s11356-020-07768-7

RESEARCH ARTICLE

Dynamic common correlated effects of trade openness, FDI, and institutional performance on environmental quality: evidence from OIC countries

Sajid Ali[1] · Zulkornain Yusop[1,2] · Shivee Ranjanee Kaliappan[1] · Lee Chin[1]

Received: 7 December 2019 / Accepted: 16 January 2020 / Published online: 22 January 2020

Abstract

The study aims to address the dynamic common correlated effects of trade openness, FDI, and institutional performance on environmental quality in OIC countries. Mostly, pollutants like CO_2 and SO_2 emissions are considered as the environmental indicators. However, for this study, we have selected ecological footprint as the indicator of environmental quality. The new econometric approach Dynamic Common Correlated Effects (DCCE) by Chudik and Pesaran (2015) has been used to measure the cross-sectional dependence among cross-sectional units. Results confirm that previous techniques for long panel data, like MG and PMG, give ambiguous outcomes in the presence of cross-sectional dependence. According to DCCE estimation, trade openness, FDI, and urbanization have a positive and significant relationship with ecological footprint while a significant and negative association is found between institutional performance and ecological footprint. The OIC countries must encourage green technology, clean production, and improved institutions for sustainable development and better environmental quality.

Keywords Ecological footprint · Trade openness · FDI · Institutional performance · Westerlund cointegration · Cross-sectional dependence

JEL classification Q57 · F18 · P48

Introduction

During the growth process, the ecological quality of any nation degrades swiftly due to decrease in forest cover, deterioration of ambient air quality, and soil erosion (Destek and Sinha 2020). Mostly, pollutants like carbon dioxide (CO_2) and sulfur dioxide (SO_2) emissions are considered as the ecological or environmental indicators. However, for the indicator of environmental quality, we have selected ecological footprint. There is a long-lasting discussion about the selection of ecological footprint as an ecological indicator (Templet 2000; Kissinger and Haim 2008; Wiedmann and Barrett 2010; Moore et al. 2013; Galli 2015). Ecological footprint explains the carrying capacity of the collective area of the ecosystem to generate the resources which are consumed by the economic process, and also shows the ability to absorb the generated waste (Wackernagel et al. 1999; Solis-Guzman and Marrero 2015; Peng et al. 2019). There are two main reasons for selecting ecological footprint as an indicator of environmental quality. First, it represents the carrying capacity of the earth, and hence, a better measurement device for the sustainability of ecological system with compare to pollutants. According to Sustainable Development Goals (SDGs), the ecological footprint is the only tool which considers the ecological and biological capability of earth for sustainable economic activities and development (Rashid et al. 2018; Nazar et al. 2018; Pan et al. 2019). Second, natural resources (water, minerals, land resources, and forests) are consumed due to economic activities. So, if emissions are chosen as environmental indicators, then they will ignore the ecological sustainability as well as the significant human and industrial activities which can damage the sustainability of the ecosystem (Li et al. 2019).

Responsible Editor: Nicholas Apergis

✉ Sajid Ali
sajidali1136@gmail.com

1 Faculty of Economics and Management, Universiti Putra, Seri Kembangan, Malaysia

2 Putra Business School, Seri Kembangan, Malaysia

Trade openness affects environmental quality negatively or positively by various channels according to the level of industrialization and globalization in an economy (Raza et al. 2017; Destek and Sinha 2020). According to the pollution haven hypothesis (PHH), a host economy with lax or slacker environmental laws becomes dirtier with trade openness (Copeland and Taylor 1994; Talukdar and Meisner 2001; Hoffman et al. 2005; He 2006; Baek and Koo 2009). Grossman and Krueger (1991) and Antweiler et al. (2001) made a holistic attempt at explaining the effects of trade openness on the environmental quality and decomposed these effects into scale effect, technique effect, and composition effect. The scale effect defines the expansion of the economy due to trade openness. With the consumption of natural resources and energy, the total amount of pollution generated will increase in the economy. The technique effect refers to the improvement of environmental quality as income level increases (Grossman and Krueger 1991). The composition effect of trade openness reflects a change in the constituents of a country's output when it opens up to trade and becomes more globalized. If comparative advantages of a country are disposed to clean industries, then trade openness will lead to a shift from polluted or dirty goods to less polluted or clean goods and services. It is observed that the production process of dirty goods is capital-intensive while the output of clean goods is more human capital-intensive or labor-intensive. If the scale of production and other factors remain constant, a country that shifts its output towards capital-intensive products will create more pollution, while a country that shifts its production towards labor-intensive products or away from capital-intensive products will generate less pollution (Grossman and Krueger 1991; Cole and Elliott 2003; Shao et al. 2019).

Another concept comes into view about environmental quality is foreign direct investment (FDI), which enhances the growth process by the accumulation of capital, increasing productivity, and the diffusion of technology (Ali et al. 2012; Sarwar et al. 2013; Seker et al. 2015; Alvarado et al. 2017). The debate about the importance of FDI for environmental quality, which started in the early 1990s (UNCTAD 2008), has given two justifications about the relationship between FDI and environmental quality. First, FDI can cause the implementation of PHH, which explains that environmental regulations of an economy can impact the location of industries (Zarsky 1999; Millimet and Roy 2016; Sapkota and Bastola 2017). Chandran and Tang (2013), D'Agostino (2015), Sun et al. (2017), Solarin et al. (2017), and You and Lv (2018) confirm this hypothesis and describe that developed countries shift their industries to underdeveloped economies due to their lax environmental laws and regulations. Second, FDI can cause Pollution Halo Hypothesis, which advocates that foreign firms bring energy-efficient, advanced, and cleaner technology in the form of FDI to the host economy which improves environmental quality (Zarsky 1999; Wang et al. 2013). Therefore, FDI is considered as a determinant of degradation as well as improvement of environmental quality, although its relationship with the environment stays vague and needs further investigation (Al-Mulali and Tang 2013).

The relationship between institutional performance and the environmental quality is another complex topic. Institutional performance involves a complicated structure passing through different institutional channels and affects both political and market forces (Kang and He 2018; Glicksman et al. 2019). Designing targeted environmental and economic policies is assumed an essential role in encouraging the transition process but will need to be combined with improved institutions to guarantee that policies are monitored and implemented effectively (Dasgupta et al. 2016; Liao et al. 2017; Khan et al. 2019a, b). Therefore, the effectiveness of environmental policies depends on the policy adoption as well as on the institutional performance, cultural discourses, dominant ideas, the distribution of resources, and the industrial structure (Meyer et al. 2003; Hughes and Lipscy 2013). Politically and economically open societies which respect laws and regulations, market allocation of resources, and private property developed faster than those economies where these freedoms are restricted (Scully 1988; Knack and Keefer 1995; Hayek 2018).

The Organization of Islamic Cooperation (OIC) is an international organization grouping 57 countries, having Muslim population and constitutes a substantial part of the developing economies. OIC member states have collective population of over 1.8 billion people accounted for 23.8% of the total world population in 2017 (SESRIC 2018). In recent decades, due to industrial development, the environmental challenges in OIC countries have been accelerated (including water scarcity, climate change, land degradation, air pollution, and degradation of the coastal and marine ecosystem), fascinating considerable attention from international institutions (SESRIC 2017; Konac 2004). The environment has been defined as one of the ten areas of cooperation in the OIC plan of action of 2014 (COMCEC 2014). Due to trade openness and FDI, the volume of trade and production in OIC countries is expanding, so the consumption of natural resources and energy is also increasing which creates pollution (Sharif and Raza 2016; Mirjalili and Motaghian Fard 2019; Sharif et al. 2020). Among OIC countries, Indonesia recorded the highest total ecological footprint of 441 million global hectares followed by Turkey, Iran, and Nigeria with 267, 256, and 202 million global hectares of ecological footprint, respectively. On the other side, if we look on per capita ecological footprint, then Qatar has highest level of 14.4 global hectors of per capita ecological footprint followed by UAE, Bahrain, and Kuwait with 8.9, 8.6, and 8.6 global hectors of per capita ecological footprint as shown in Appendix A Table 10 (Global Footprint Network 2016). "Paris agreement" is considered the latest international deal and global initiative on climate change with

196 signatories, of which 166 have ratified it. Forty-three OIC member countries have ratified it, whereas 13 countries have the status of signatory (SESRIC 2018). Moreover, environmental scarcity and its degradation can generate economic and social conflicts in OIC countries (Tolba and Saab 2008; Nekooei et al. 2015; Gholipour and Farzanegan 2018).

Motivated by the ensuing contradiction in the literature, this study seeks to find out the overall effect of trade openness, FDI, and institutional performance on the environmental quality in OIC countries. Although many studies found this impact in different groups of economies, but in case of OIC countries, activities in this critical area are still very limited and comprehensive studies on the subject are even missing (Konac 2004; Pal and Tok 2019; Kaminski 2019). This study contributes to the literature in various ways: (i) this is the first study which examines the link between trade openness, FDI, institutional performance, and environmental quality in OIC countries; (ii) previous studies examined this relationship by using simple techniques, whereas, in this study, we have used new methodology named Dynamic Common Correlated Effects (DCCE), this technique overcomes the methodological issues which the existing literature suffers from; (iii) in this study, the use of ecological footprint as a new variable is an attempt to address the environmental issue in OIC countries in a modern context; (iv) this study gives valuable implications based on results, which will pursue the attention of policymakers and also make a significant contribution to the existing literature.

Literature review

There have been an increasing number of studies defining the impact of macroeconomic variables on environmental quality since last few decades. Many indicators of environmental quality are used and most are considered negative indicators, like pollutants. For example, Cole (2007) and Liao et al. (2017) used sulfur dioxide (SO_2), while Cole et al. (1997) used nitrous oxide (NO_2), and Abdouli and Hammami (2017), Zhang et al. (2017a, b), and You and Lv (2018) used CO_2 emissions. Very limited studies are found in which ecological footprint has been used, which is a positive indicator of environmental quality (Al-Mulali et al. 2015; Ozturk et al. 2016; Sharif et al. 2019). In this section, we will give a brief review of the literature and thereby, substantiating the parameterization of the study.

Various studies about environmental degradation considered trade openness as one of the important indicators that influence environmental quality (Grossman and Krueger 1991; Dinda 2004; Frankel 2009; Nekooei et al. 2015; Abdouli and Hammami 2017). Pioneer study of Grossman and Krueger (1991) investigated the impact of trade openness on the environment and found scale effect while taking composition effect and technique effect constant, and found that the impact of comparative advantage on environmental quality was conditional on environment and trade policies of a country (Copeland and Taylor 2004). Frankel and Rose (2005) analyzed the influence of trade openness on the environment with the help of instrumental variables and gravity model. The coefficients of openness and policy variable were found negative. In another study, Managi et al. (2009) investigated the impact of trade openness on environmental quality and found that trade openness had a positive effect on the environment in OECD countries. Similarly, Tsurumi and Managi (2014) explored the role of trade openness in the deforestation process in 142 countries and found that deforestation was slowed down in OECD countries and increased in non-OECD countries. Al-Mulali et al. (2015) found the effect of trade openness on the environment by using the ecological footprint for 58 selected countries. After applying difference and system GMM approaches, a positive impact was observed between trade openness and ecological footprint.

Nekooei et al. (2015) studied the association between trade openness, economic growth, democracy, and environment quality in OIC countries. Estimated results showed that trade openness, democracy, and growth had a positive effect on the environment. However, population had a negative and significant effect on the environment. Similarly, Ozturk et al. (2016) observed the impact of trade openness and urbanization on the ecological footprint for 144 countries for 20 years. Following the EKC framework, a positive relationship was found between trade openness and ecological footprint. Similarly, another study by Abdouli and Hammami (2017) explored the impact of FDI inflows, economic growth, and trade openness on environmental degradation for 17 MENA countries and confirmed the existence of EKC and pollution haven hypothesis in these countries. Other studies by Zhang et al. (2017a, b) observed negative relationship between trade openness and carbon dioxide emissions in 10 newly industrialized countries. You and Lv (2018) reported the spatial impact of economic globalization on pollution for the panel of 83 countries by applying spatial panel data method. There was negative indirect effects of economic globalization on CO_2 emissions and overcame the direct positive effects, and hence the total net effect was negative and significant. Similarly, Sharif et al. (2019) identified the impact of globalization on ecological footprint in top 10 globalized countries of the world by applying quantile-on-quantile approach. The results suggested that globalization had positive effect on ecological footprint in Denmark, Netherlands, Belgium, Switzerland, Norway, Portugal, Canada, and Sweden. On the other hand, there was a negative association between globalization and ecological footprint in the UK, Germany, France, and Hungary.

The impact of FDI on environmental quality is also discussed in number of empirical studies. Zhang (2011) elaborated the role of financial development in environmental

Table 1 Description of variables

Variables	Description	Unit of measurement	Data sources
LNECF	Log of ecological footprint	Global hectares (gha)	Global Footprint Network
LNTOP	Log of trade openness	Exports plus imports divided by GDP	World Bank
LNIP	Log of institutional performance	Calculated through panel principal component analysis (PCA)	International Country Risk Guide (ICRG)
LNFDI	Log of foreign direct investment	Constant 2010 US$	World Bank
LNURB	Log of urbanization	Total number of people living in urban areas	World Bank

degradation in China and indicated that FDI was mostly used in carbon-intensive production techniques and promoted CO_2 emissions. The validation of the pollution haven hypothesis was checked by Asghari (2013) in MENA countries by applying the fixed and random effect method. The outcomes indicated that FDI inflows had improved the environmental quality of MENA countries and also validated the pollution haven hypothesis. Wang et al. (2013) assessed both negative and positive aspects of FDI and analyzed that FDI increased the labor productivity, economic growth, and innovation in host city, but it also caused pollution and unemployment. In another study, Seker et al. (2015) found the effect of FDI and GDP on CO_2 emissions in Turkey over the period 1974–2010. The results indicated a positive and relatively small impact of FDI on CO_2 emissions, while the impact of GDP on CO_2 emissions was quite large. Similarly, Sun et al. (2017) validated the impact of trade openness and FDI inflows on CO_2 emissions by using ARDL model and observed that both trade openness and FDI promoted CO_2 emissions and the evidence of pollution haven hypothesis existed. Solarin and Al-Mulali (2018) looked at the influence of FDI inflows on carbon footprints, ecological footprints, and CO_2 emissions for 20 countries. Augmented mean group (AMG) estimation and common correlated effect (CCE) estimator were utilized. It was found that FDI inflows and urbanization mitigated pollution in developed countries while they increased pollution in the underdeveloped countries. Liu et al. (2018) analyzed the dynamics at work and spatial agglomeration effects in environmental pollution and FDI for the Chinese economy and concluded that FDI had a negative impact on different types of environmental pollutants in China. Similarly, Zafar et al. (2019) explored the effects of FDI on the ecological footprint using USA data from 1970 to 2015. ARDL model along Zivot-Andrews unit root test was used and the findings suggested that FDI had a negative association with the ecological footprint.

There are many studies that have linked various indicators of institutional performance with environmental quality by applying different econometric techniques. As pioneer studies, Torras and Boyce (1998) and Deacon (1999) found that democracy and good governance had a positive effect on environmental quality. This relationship is further supported by many studies including Neumayer (2003), Deacon (2003), Fredriksson and Svensson (2003), and De Mesquita et al. (2005). Bhattarai and Hammig (2001) examined the relationship between institutions and deforestation in 66 countries of Africa, Latin America, and Asia and found that good governance and political institutions had significantly reduced deforestation. Cole (2007) analyzed the linkage between corruption and pollution for 94 countries. Corruption had a positive direct impact on both CO_2 emissions and SO_2 emissions. Castiglione et al. (2012, 2013) observed that stronger rule of law had a negative association with pollution. Similarly, Liao et al. (2017) examined the nexus of income, energy, and SO_2 emissions for China by taking corruption as an institutional variable. The empirical evidence showed negative relationship between the number of anti-corruption cases and SO_2 emissions. Moreover, growth in income had a negative relationship with SO_2 emissions. Nekooei et al. (2015) explored the association between democracy and environment in selected OIC countries and showed a positive correlation between democracy and environment quality. Charfeddine and Mrabet (2017) analyzed the impacts of social and political factors and energy consumption on the ecological footprint for 15 MENA countries by applying DOLS and FMOLS approaches and observed that political

Table 2 Descriptive statistics and pair-wise correlation

	LNECF	LNTOP	LNIP	LNFDI	LNURB
Mean	16.87	− 0.18	0.21	8.53	6.71
Median	16.80	− 0.19	0.13	8.64	6.68
Minimum	13.92	− 1.17	− 3.40	4.60	5.29
Maximum	19.90	0.45	3.55	10.59	8.15
Skewness	− 0.02	− 0.70	0.12	− 0.64	0.07
Std.Dev.	1.38	0.24	1.34	0.98	0.65
Jarque-Bera	16.5	18.16	12.08	20.45	10.99
Kurtosis	2.31	5.29	2.46	3.48	2.45
Observations	1269	1269	1269	1269	1269
LNECF	1.00	0.59*	0.61*	0.62*	0.30**
LNTOP		1.00	0.49*	0.79*	− 0.23**
LNIP			1.00	0.69*	0.16*
LNFDI				1.00	− 0.10
LNURB					1.00

* and ** show 1 and 5% level of significance, respectively

Table 3 Results of cross-sectional dependence tests

Variables	Pesaran-CD		Pesaran-scaled LM		Bias-corrected scaled LM	
	Statistic	Probability	Statistic	Probability	Statistic	Probability
LNECF	130.63	0.00*	381.02	0.00*	380.12	0.00*
LNTOP	19.01	0.00*	85.15	0.00*	84.29	0.00*
LNIP	45.99	0.00*	110.57	0.00*	109.67	0.00*
LNFDI1	70.44	0.01*	141.25	0.00*	140.39	0.00*
LNURB	143.56	0.01*	531.52	0.01*	530.65	0.02**

* and ** show 1 and 5% level of significance, respectively

institutions and energy consumption degraded environment by increasing the level of the ecological footprint. Gholipour and Farzanegan (2018) explored the role of governance in environmental protection in MENA countries. Results showed that GEEP (government consumption on environmental protection) alone could not promote environmental quality, but the rule of law and good governance were the main determinants of the final effects of GEEP on environmental quality.

Data and methodology

In this study, the dynamic common correlated effects of trade openness, FDI, and institutional performance on environmental quality are presented for OIC countries. From 57 OIC member countries, 47 countries are selected for sample size according to the availability of data (a list of selected countries is given in the Appendix B Table 11) for the period 1991–2016. Conventionally different techniques have been used in the estimation of panel data like GMM, random effect and fixed effect methods, but these techniques consider homogeneity and only allow changing the intercepts of cross-sectional units while, in the real world, the issue of heterogeneity in panel data exists. Therefore, nowadays the researchers around the world are more concerned about the cross-sectional dependence.

Various studies in the literature found that many times, panel data suffer from the problem of cross-sectional dependence. There are many unobserved factors and shocks which occur at the same time due to financial or economic integration of countries (De Hoyos and Sarafidis 2006; Dogan et al. 2017; Latif et al. 2018). Therefore it is necessary to check whether all cross-sectional units are equally affected by shocks. Contemporary methods of estimation have gained remarkable worldwide attention in the field of macroeconomic research, but during this era of globalization where countries suffer a lot from changes in some other countries, it is impossible to proceed with traditional methods. For this purpose, the most recent DCCE approach by Chudik and Pesaran (2015) is applied.

The DCCE approach is designed on the principles of pooled mean group (PMG) technique developed by Pesaran et al. (1996), Mean group (MG) estimation developed by Pesaran and Smith (1995), and CCE estimation developed by Pesaran (2006). This approach considers main issues which are not recognized by other conventional methods. The most important is the consideration of the cross-sectional dependence by taking the logs and averages of cross-sectional units. Secondly, it allows for heterogeneous slopes and dynamic common correlated effects. One of the other implications of this technique is that it is also applicable if the sample size is small by using the method of Jackknife correction (Chudik and Pesaran 2015). This approach can also be used in case of unbalanced panel data (Ditzen 2016) and when structural breaks are present in data (Kapetanios et al. 2011). The equation of DCCE model can be written as follows:

$$LNECF_{it} = \alpha_i LNECF_{it-1} + \delta_i X_{it} + \sum_{p=0}^{p_T} \gamma_{xip} \overline{X}_{t-p} + \sum_{p=0}^{p_T} \gamma_{yip} \overline{X}_{t-p} + \mu_{it}$$

In this equation, LNECF shows a log of ecological footprint and its lag is used as an independent variable and X_{it} shows a set of other independent variables, and P_T represents lag of cross-sectional averages.

One of the major problems with previous studies is that institutional performance is proxied by a single variable measures such as government stability (Naude and Saayman 2005; Ingram et al. 2013; Habibi 2017), corruption (Saha and Yap 2015; Lv and Xu 2017; Meo et al. 2018), and law and order (Moyo and Ziramba 2013; Cui et al. 2016; Gozgor et al. 2019). Use of a single proxy for institutional performance could be biased and misleading. Moreover, indicators of institutional performance are highly associated with each other (Globerman and Shapiro 2002; Daude and Stein 2007; Buchanan et al. 2012; Sabir et al. 2019), and it is difficult to combine all the indicators in one equation (Ullah and Khan 2017; Sabir et al. 2019). Therefore, we have used panel principal component analysis (PCA)[1] estimation technique to

[1] We followed Globerman and Shapiro (2002), Buchanan et al. (2012), Law et al. (2014), and Khan et al. (2019a, b) which used panel PCA to construct a composite institutional indicator.

Table 4 First-generation panel unit root tests

	Levin, Lin, and Chu				Im, Pesaran, and Shin W-stat			
	Level		1st Diff.		Level		1st Diff.	
	Stat	Prob	Stat	Prob	Stat	Prob	Stat	Prob
LNECF	− 2.33	0.00*	− 32.20	0.00*	− 6.27	0.00*	− 31.68	0.00*
LNTOP	− 3.11	0.00*	− 25.78	0.00*	− 2.48	0.00*	− 22.59	0.00*
LNIP	− 6.15	0.00*	− 24.45	0.00*	− 6.09	0.00*	− 23.21	0.00*
LNFDI	− 1.92	0.01*	− 28.30	0.00*	− 2.09	0.02**	− 28.35	0.00*
LNURB	− 14.88	0.00*	− 7.21	0.00*	− 7.31	0.01*	− 4.03	0.00*

* and ** refer to the level of significance at 1 and 5%, respectively

obtain the variable of institutional performance (IP) made up of five selected indicators (socioeconomic conditions, government stability, law and order, corruption, and investment profile). These indicators are chosen on the basis of their ability to affect environmental quality as explained by various studies (Habibi 2017; Liao et al. 2017; Meo et al. 2018; Gholipour and Farzanegan 2018; Gozgor et al. 2019). These indicators reflect various institutional factors and important issues that significantly affect the environment and ecosystem of a country (Bhattarai and Hammig 2001; Mavragani et al. 2016; Charfeddine and Mrabet 2017). The IP duplicates the original data of all the indicators of institutions into a single variable with minimal loss of information (Tang and Tan 2014; Le et al. 2016; Batuo et al. 2018; Khan et al. 2019a, b). The ICRG assigns a rating to these indicators on the scale of 100 points, the highest score indicates low risk (high quality), and the lowest score is the evidence of high risk (low quality).[2] We prefer the indicators of International Country Risk Guide (ICRG) to the Worldwide Governance Indicators (WGI) due to their longitudinal coverage.[3]

In panel PCA technique, the *j*th factor index can be written as:

$$IP_j = W_{j1}X_1 + W_{j2}X_2 + W_{j3}X_3 + \ldots\ldots + W_{jp}X_p$$

Here, IP_j is the institutional performance; W_j represents weight of the parameter of the factor score; original figure of the respective indicators are represented by X; while P shows the number of variables in the equation.

Many previous studies like Maddala and Wu (1999), Levin et al. (2002), and Im et al. (2003) used first-generation unit root tests which have not considered cross-sectional dependence. Therefore, a second-generation unit root test is also used in this study which is developed by Pesaran (2007) and Choi (2006) and provides more reliable results. The null hypothesis of no cross-sectional dependence is tested against the alternative hypothesis of cross-sectional dependence. To estimate long-run results, a bootstrap cointegration technique by Westerlund and Edgerton (2008) is employed as compared to conventional cointegration techniques. This approach is preferred because it considers structural breaks and in short time dimension, the outcomes are more sensitive to lag and lead length (Persyn and Westerlund 2008). The variables of this study are presented in Table 1 with a detail description of the unit of measurement and sources of data collection.

Results and discussion

Descriptive statistics (measures of dispersion and central tendency) and pair-wise correlation for all the variables (in log form) are presented in Table 2. Ecological footprint is significantly correlated with all the explanatory variables (i.e., trade openness, institutional performance, FDI, and urbanization).

Due to the nature of macroeconomic variables and panel data, there are increasing chances that cross-sectional dependence may prevail. For this purpose, Pesaran (2004)-CD, Pesaran (2004) scaled LM, and Baltagi et al. (2012) biased-corrected scaled LM tests are employed to check the presence of cross-sectional dependence as shown in Table 3. Findings of these tests are useful not only to decide estimation technique but also helpful to decide that whether first-generation panel unit root tests (Levin et al. 2002; Im et al. 2003) are

Table 5 Results of CIPS-Test

	Level	First difference
LNECF	− 2.83*	− 4.96*
LNTOP	− 1.58	− 4.86*
LNIP	− 2.83*	− 4.61*
LNFDI	− 2.95*	− 5.46*
LNURB	− 1.90	− 2.76**

* and ** refer to the levels of significance at 1 and 5%, respectively

[2] Further details can be obtained from the official website of ICRG (https://www.prsgroup.com/)

[3] Worldwide Governance Indicators (WGI) by Kaufmann et al. (2008) covers short time period, i.e., from 1996 to date, while the indicators of International Country Risk Guide (ICRG) have relatively long time span, i.e., from 1984 to date.

Table 6 Pedroni residual cointegration tests

	t-stat	Prob.	Weight t-stat	Prob.
H1: common coefficients (within dimensions)				
Panel V-stat	− 0.47	0.68	− 2.40	0.99
Panel Pedroni Panel-stat	− 6.18	0.00*	− 9.38	0.00*
Panel Rho-stat	− 0.49	0.31	− 0.16	0.43
Panel ADF-stat	− 2.87	0.00*	− 5.79	0.01*
H1: individual coefficients (between dimensions)				
Group Pedroni Panel-stat	− 10.63	0.00*		
Group Rho-stat	2.97	0.99		
Group ADF-stat	− 3.28	0.00*		

* and ** refer to levels of significance at 1 and 5%, respectively

suitable which assume cross-sectional independence or second-generation panel unit root tests (Chang 2004; Pesaran 2007) are more appropriate that consider the cross-sectional dependence. In this study, both types of panel unit root tests are conducted to avoid misleading results.

The null hypothesis for above cross-sectional dependence tests is the absence of cross-sectional dependence, and according to the empirical findings of this study, there is sufficient evidence to reject the null hypothesis and conclude that there is a presence of cross-sectional dependence among the cross-sectional units.

Results of first-generation panel unit root tests are presented in Table 4. Variables are stationary at the level and first difference; however, no variable is stationary at second difference.

In Table 5, the findings of the second-generation panel unit root test (Pesaran 2007) are presented, which is also called CIPS-Test. This test considers the cross-sectional dependence among the variables, and according to these outcomes, the variables have again mix order of stationarity at the level and first difference and no one is stationary at the second difference.

Pedroni (1999) test of cointegration is applied to check the long-run association among the variables, as shown in Table 6. There are seven statistics which are divided into sections within and between dimensions, and according to these statistics there is no close evidence of long-run association among the variables. The results of Pedroni (1999) test may

Table 7 Westerlund ECM panel cointegration test

H0: no cointegration	Value	Robust *p* value
Ga	− 3.30	0.00*
Gt	− 23.90	0.00*
Pa	− 11.09	0.02**
Pt	− 12.97	0.00*

* and ** refer to the level of significance at 1 and 5%, respectively

Table 8 Results of PMG estimation

Independent variables	Coefficients	*p* value
LNTOP	0.36	0.01*
LNIP	0.04	0.03**
LNFDI	0.03	0.00*
LNURB	− 0.13	0.00*
_cons	5.70	0.00*

*, **, and *** refer to the level of significance at 1, 5, and 10%, respectively

be misleading because it does not consider several important issues like heteroskedasticity, serial correlation, structural breaks, and cross-sectional dependence among the countries or cross-sectional units, while Westerlund and Edgerton (2008) is an advanced test of cointegration among the variables because it considers all above-mentioned issues, therefore, the results are more reliable. Outcomes of Westerlund test (Table 7) shows that probability values of Ga, Gt, Pa, and Pt of Persyn and Westerlund (2008)[4] cointegration tests are significant, which reject the null hypothesis of no cointegration and confirm the presence of long-run relationship among the variables.

Estimation of the PMG is presented in Table 8, which rejects the null hypothesis of no cointegration and shows a positive relationship of trade openness, FDI, and institutional performance with the ecological footprint. According to these estimates, all the relationships are according to expectations except the relationship between institutional performance and ecological footprint, which is surprising. It can be the result of flaws in the earlier approaches like MG, PMG, and AMG estimators. In other words, a change affecting one country will be transferred to other countries due to trade openness and globalization, and therefore, DCCE is the most appropriate estimation technique in this situation. To deal with the flaws of earlier estimation techniques, the primary purpose of this study is to apply DCCE estimation technique, and the results are presented in Table 9 which rejects the null hypothesis of no cointegration.

Results show a positive association of trade openness, FDI, and urbanization with ecological footprint, which means any increase in these variables will degrade the environmental quality. A positive association between trade openness and ecological footprint in DCCE estimation also confirms the existence of PHH in OIC countries according to which host economies with slacker environmental regulations becomes dirtier with trade openness (Copeland and Taylor 1994). The finding is also consistent with the studies of Talukdar and Meisner (2001), Xing and Kolstad (2002), Dinda (2004), Hoffman et al. (2005), He (2006), and Baek and Koo (2009).

[4] xtwest command is used for Westerlund cointegration

Table 9 Results of DCCE estimation

Exogenous variable	Coefficient	*p* value
LNECF (− 1)	− 0.67	0.00*
LNTOP	0.373	0.00*
LNIP	− 0.03	0.01*
LNFDI	0.023	0.02**
LNURB	1.58	0.06***
_cons	8.55	0.04**

*, **, and *** refer to the level of significance at 1, 5, and 10%, respectively

The positive association between FDI and ecological footprint in DCCE estimation is also explained by PHH which describes that due to FDI, developed countries shift their production to underdeveloped countries where environmental regulations are weak. The finding is also consistent with the studies of Chandran and Tang (2013), D'Agostino (2015), Sun et al. (2017), Solarin et al. (2017), and You and Lv (2018). The institutional performance has a negative and significant relationship with the ecological footprint. It means improvements in determinants of institutional performance, i.e., socioeconomic conditions of a country, the stability of government, corruption, and law and order, will reduce the ecological footprint and hence improve the environmental quality of OIC countries. The finding is aligning with Bhattarai and Hammig (2001), Cole (2007), Nekooei et al. (2015), and Liao et al. (2017). Furthermore, we have found a significant and positive relationship between urbanization and ecological footprint, which means an increase in urban population will cause environmental degradation in OIC countries.

Thus we have realized that PMG estimation provides some misleading results (as the unexpected relationship of institutional performance and ecological footprint shown in Table 8). Moreover, Neal (2015) and Arain et al. (2019) found that PMG, MG, DOLS, and FMOLS methods provide conflicting results in the presence of cross-sectional dependence. So, it is better to rely on the results of DCCE estimation technique in the presence of cross-sectional dependence.

Concluding remarks and recommendations

The present study has evaluated the dynamic common correlated effects of trade openness, FDI, and institutional performance on environmental quality in OIC countries by taking the data for the year 1990 to 2016. We have used newly developed DCCE approach to tackle the weaknesses of earlier methods of panel data such as PMG, AMG, and MG estimators. It is also found that trade openness and institutional performance have more substantial effects on ecological footprint than FDI. In our study, it is found that FDI and trade openness are the cause of environmental degradation in OIC countries. Additionally, this relationship also relies on the negative externalities that can be created through natural demand in the form of environmental degradation. The results concluded that trade openness and FDI inflows in these countries harm the nature and ecological system instead of focusing on proper utilization of technology-oriented resources. OIC countries should shift their production from labor-intensive to capital-intensive technology because capital-intensive technology is more appropriate for clean production technology. Policymakers should prefer green investment, green technology, and low-carbon production. To achieve sustainable development goals (SDGs) like better health, low-cost and green energy, infrastructure, openness, responsible consumption and production, and climate change, the green technology is the appropriate option; it will reduce ecological footprint when compared to conventional production technology.

Index for institutional performance is developed through panel PCA by taking five indicators of institutional quality or performance. However, for future research, the indicators of institutional performance like socioeconomic conditions, government stability, corruption, and law and order can be treated separately for the individual effect of each indicator on ecological footprint. Furthermore, we took overall ecological footprint in this study, while for the future research, ecological footprint can be segregated in different parts, i.e., carbon footprint, biocapacity, cropland, grazing lands, fishing grounds and forest products, etc. The rapid increase in urban population will result in the growth of squatter settlements and urban slums and the overburdening of the water supply and waste-disposal systems, thus resulting in environmental degradation. Government of OIC countries should make different productive projects and produce new jobs in villages so that migration towards big cities should be minimized. The main reservation from the analysis pertains that whether society prevails to live in the way to affect the environmental quality or whether they can change the production methods which can upgrade towards clean production which leads to a sustainable environment by outweighing the adverse effects of trade openness and FDI. The insistence on sustainable environment is required to check out how the economies are utilizing their resources and natural capacity. Knowing about the aspects of what factors can cause positive effects on natural accounts and what causes the declination of natural reserves will lead to better awareness of the potentiality of business, production, and environmental quality. Moreover, the proper management and utilization of natural resources will lead to achieve the target of green economy and improved environmental quality.

Appendix A

Table 10 List of OIC countries with ecological footprint

OIC countries with total ecological footprint			OIC countries with per capita ecological footprint		
Rank	Country	Total ecological footprint (in global hectares)	Rank	Country	Per capita ecological footprint (in global hectares)
1	Indonesia	441,000,000	1	Qatar	14.4
2	Turkey	267,000,000	2	UAE	8.9
3	Iran	256,000,000	3	Bahrain	8.6
4	Nigeria	202,000,000	4	Kuwait	8.6
5	Saudi Arabia	201,000,000	5	Oman	6.8
6	Egypt	173,000,000	6	Saudi Arabia	6.2
7	Pakistan	161,000,000	7	Kazakhstan	5.5
8	Bangladesh	137,000,000	8	Turkmenistan	5.3
9	Malaysia	122,000,000	9	Brunei	4.2
10	Kazakhstan	99,800,000	10	Malaysia	3.9
11	Algeria	97,800,000	11	Libya	3.7
12	UAE	82,700,000	12	Mauritius	3.5
13	Iraq	64,900,000	13	Guyana	3.4
14	Uzbekistan	60,500,000	14	Turkey	3.4
15	Morocco	60,000,000	15	Lebanon	3.3
16	Sudan	48,300,000	16	Iran	3.2
17	Uganda	44,100,000	17	Suriname	3.0
18	Qatar	37,000,000	18	Algeria	2.4
19	Kuwait	34,800,000	19	Djibouti	2.4
20	Niger	34,300,000	20	Mauritania	2.3
21	Cameroon	32,300,000	21	Gabon	2.3
22	Turkmenistan	30,100,000	22	Tunisia	2.2
23	Oman	29,900,000	23	Azerbaijan	2.1
24	Mali	28,300,000	24	Jordan	2.1
25	Cote d'Ivore	28,000,000	25	Albania	2.0
26	Syria	25,500,000	26	Uzbekistan	1.9
27	Afghanistan	25,200,000	27	Egypt	1.8
28	Tunisia	25,000,000	28	Iraq	1.7
29	Libya	23,500,000	29	Morocco	1.7
30	Mozambique	23,500,000	30	Indonesia	1.7
31	Burkina Faso	22,500,000	31	Niger	1.7
32	Chad	21,900,000	32	Kyrgyzstan	1.7
33	Azerbaijan	20,200,000	33	Mali	1.6
34	Lebanon	19,700,000	34	Guinea	1.6
35	Jordan	19,700,000	35	Chad	1.5
36	Guinea	19,300,000	36	Guinea-Bissau	1.5
37	Yemen	18,500,000	37	Benin	1.4
38	Senegal	17,600,000	38	Syria	1.4
39	Benin	15,400,000	39	Cameroon	1.4
40	Somalia	13,900,000	40	Comoros	1.2
41	Bahrain	12,300,000	41	Sudan	1.2
42	Mauritania	9,960,000	42	Burkina Faso	1.2
43	Kyrgyzstan	9,860,000	43	Sierra Leone	1.2
44	Sierra Leone	8,800,000	44	Cote d'Ivore	1.2
45	Tajikistan	8,280,000	45	Senegal	1.1
46	Togo	8,030,000	46	Nigeria	1.1
47	Albania	5,880,000	47	Uganda	1.1
48	Gabon	4,540,000	48	Togo	1.1
49	Mauritius	4,450,000	49	Gambia	1.0
50	Guinea-Bissau	2,690,000	50	Somalia	1.0
51	Guyana	2,620,000	51	Tajikistan	0.9
52	Djibouti	2,260,000	52	Bangladesh	0.9
53	Gambia	2,040,000	53	Pakistan	0.8
54	Brunei	1,790,000	54	Mozambique	0.8
55	Suriname	1,660,000	55	Afghanistan	0.7
56	Comoros	989,000	56	Yemen	0.7
57	Palestine	–	57	Palestine	–

Source: Global Footprint Network 2016

Appendix B

Table 11 List of selected OIC countries in sample

Indonesia	Algeria	Guinea-Bissau	Bahrain
Bangladesh	Albania	Benin	Qatar
Sudan	Guyana	Sierra Leone	Saudi Arabia
Senegal	Azerbaijan	Syria	Brunei Darussalam
Mauritania	Gabon	Burkina Faso	UAE
Cameroon	Iraq	Mali	Kuwait
Morocco	Iran	Chad	Turkey
Cote d'Ivoire	Kazakhstan	Uganda	Oman
Tunisia	Jordan	Mozambique	Guinea
Nigeria	Libya	Togo	Malaysia
Pakistan	Lebanon	Gambia	Niger
Egypt	Suriname	Yemen	

References

Abdouli M, Hammami S (2017) Economic growth, FDI inflows and their impact on the environment: an empirical study for the MENA countries. Qual Quant 51(1):121–146

Ali S, Chaudhry IS, Farooq F (2012) Human capital formation and economic growth in Pakistan. Pak J Soc Sci 32(1):229–240

Al-Mulali U, Tang CF (2013) Investigating the validity of pollution haven hypothesis in the gulf cooperation council (GCC) countries. Energy Policy 60:813–819

Al-Mulali U, Weng-Wai C, Sheau-Ting L, Mohammed AH (2015) Investigating the environmental Kuznets curve (EKC) hypothesis by utilizing the ecological footprint as an indicator of environmental degradation. Ecol Indic 48:315–323

Alvarado R, Iñiguez M, Ponce P (2017) Foreign direct investment and economic growth in Latin America. Econ Anal Policy 56:176–187

Antweiler W, Copeland BR, Taylor MS (2001) Is free trade good for the environment? Am Econ Rev 91(4):877–908

Arain H, Han L, Meo MS (2019) Nexus of FDI, population, energy production, and water resources in South Asia: a fresh insight from dynamic common correlated effects (DCCE). Environ Sci Pollut Res 26(26):27128–27137

Asghari M (2013) Does FDI promote MENA region's environment quality? Pollution halo or pollution haven hypothesis. Int J Sci Res Environ Sci 1(6):92–100

Baek J, Koo WW (2009) A dynamic approach to the FDI-environment nexus: the case of China and India. J Int Econ Stud 13(2):87–107

Baltagi BH, Feng Q, Kao C (2012) A Lagrange Multiplier test for cross-sectional dependence in a fixed effects panel data model. J Econ 170(1):164–177

Batuo M, Mlambo K, Asongu S (2018) Linkages between financial development, financial instability, financial liberalisation and economic growth in Africa. Res Int Bus Financ 45:168–179

Bhattarai M, Hammig M (2001) Institutions and the environmental Kuznets curve for deforestation: a crosscountry analysis for Latin America, Africa and Asia. World Dev 29(6):995–1010

Buchanan BG, Le QV, Rishi M (2012) Foreign direct investment and institutional quality: some empirical evidence. Int Rev Financ Anal 21:81–89

Castiglione C, Infante D, Smirnova J (2012) Rule of law and the environmental Kuznets curve: evidence for carbon emissions. Int J Sustain Econ 4(3):254–269

Castiglione C, Infante D, & Smirnova J (2013). Institutional enforcement, environmental quality and economic development. A panel VAR approach. In Proceedings of the IV CICSE conference on structural change, dynamics and economic growth. Livorno, Italy

Chandran VGR, Tang CF (2013) The impacts of transport energy consumption, foreign direct investment and income on CO2 emissions in ASEAN-5 economies. Renew Sust Energ Rev 24:445–453

Chang Y (2004) Bootstrap unit root tests in panels with cross-sectional dependency. J Econ 120(2):263–293

Charfeddine L, Mrabet Z (2017) The impact of economic development and social-political factors on ecological footprint: a panel data analysis for 15 MENA countries. Renew Sust Energ Rev 76:138–154

Choi I (2006) Nonstationary panels. In: Patterson K, Mills TC (eds) Palgrave handbooks of econometrics 1. Palgrave Macmillan, New York, pp 11–539

Chudik A, Pesaran MH (2015) Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. J Econ 188(2):393–420

Cole MA (2007) Corruption, income and the environment: an empirical analysis. Ecol Econ 62(3–4):637–647

Cole MA, Elliott RJ (2003) Determining the trade–environment composition effect: the role of capital, labor and environmental regulations. J Environ Econ Manag 46(3):363–383

Cole MA, Rayner AJ, Bates JM (1997) The environmental Kuznets curve: an empirical analysis. Environ Dev Econ 2(4):401–416

COMCEC (2014).Preferential trade agreements (PTAs) and trade openness efforts in the OIC member states with a special emphasis on the TPS-OIC. The annual report published by "Standing Committee for Economic and Commercial Cooperation of the Organization of Islamic Cooperation" (COMCEC)

Copeland BR, Taylor MS (1994) North-south trade and the environment. Q J Econ 109(3):755–787

Copeland BR, Taylor MS (2004) Trade, growth, and the environment. J Econ Lit 42(1):7–71

Cui F, Liu Y, Chang Y, Duan J, Li J (2016) An overview of tourism risk perception. Nat Hazards 82(1):643–658

D'Agostino LM (2015) How MNEs respond to environmental regulation: integrating the Porter hypothesis and the pollution haven hypothesis. Econ Polit 32(2):245–269

Dasgupta S, De Cian E, & Verdolini E (2016) The political economy of energy innovation. The Political Economy of Clean Energy Transitions, 123

Daude C, Stein E (2007) The quality of institutions and foreign direct investment. Econ Polit 19(3):317–344

De Hoyos RE, Sarafidis V (2006) Testing for cross-sectional dependence in panel-data models. Stata J 6(4):482–496

De Mesquita BB, Smith A, Morrow JD, Siverson RM (2005) The logic of political survival. MIT Press, Cambridge

Deacon R (1999) Dictatorship, democracy and the provision of public goods. University of California at Santa Barbara Economics Working Paper, 11-99

Deacon R (2003) Dictatorship, democracy, and the provision of public goods. University of California, Santa Barbara, working paper

Destek MA, Sinha A (2020) Renewable, non-renewable energy consumption, economic growth, trade openness and ecological footprint: evidence from Organisation for Economic Co-operation and Development countries. J Clean Prod 242:118537

Dinda S (2004) Environmental Kuznets curve hypothesis: a survey. Ecol Econ 49(4):431–455

Ditzen J (2016) xtdcce: estimating dynamic common correlated effects in Stata. SEEC Discussion Papers, 1601

Dogan E, Seker F, Bulbul S (2017) Investigating the impacts of energy consumption, real GDP, tourism and trade on CO2 emissions by accounting for cross-sectional dependence: a panel study of OECD countries. Curr Issue Tour 20(16):1701–1719

Frankel JA (2009) Environmental effects of international trade. Faculty research working paper series no. RWP09-006. Harvard University, Cambridge

Frankel JA, Rose AK (2005) Is trade good or bad for the environment? Sorting out the causality. Rev Econ Stat 87(1):85–91

Fredriksson PG, Svensson J (2003) Political instability, corruption and policy formation: the case of environmental policy. J Public Econ 87(7–8):1383–1405

Galli A (2015) On the rationale and policy usefulness of ecological footprint accounting: the case of Morocco. Environ Sci Pol 48:210–224

Gholipour HF, Farzanegan MR (2018) Institutions and the effectiveness of expenditures on environmental protection: evidence from Middle Eastern countries. Constit Polit Econ 29(1):20–39

Glicksman RL, Markell DL, Buzbee WW, Mandelker DR, Bodansky D (2019) Environmental protection: law and policy. Aspen Publishers

Global Footprint Network (2016) Global footprint network. Obtenido de Global Footprint Network: http://www.footprintnetwork.org online. Accessed 1-10-2019

Globerman S, Shapiro D (2002) Global foreign direct investment flows: the role of governance infrastructure. World Dev 30(11):1899–1919

Gozgor G, Lau CKM, Zeng Y, Lin Z (2019) The effectiveness of the legal system and inbound tourism. Ann Tour Res 76:24–35

Grossman GM, and Krueger AB (1991) Environmental impacts of a North American Free Trade Agreement. NBER, Working Paper Series No.3914, 1–57
Habibi F (2017) The determinants of inbound tourism to Malaysia: a panel data analysis. Curr Issue Tour 20(9):909–930
Hayek FA (2018) New studies in philosophy, politics, economics, and the history of ideas. University of Chicago Press
He J (2006) Pollution haven hypothesis and environmental impacts of foreign direct investment: the case of industrial emission of sulfur dioxide (SO2) in Chinese provinces. Ecol Econ 60:228–245
Hoffman R, Ging LC, Ramasamy B, Yeung M (2005) FDI and pollution: a Granger causality test using panel data. J Int Dev 17:311–317
Hughes L, Lipscy PY (2013) The politics of energy. Annu Rev Polit Sci 16(1):449–469
Im KS, Pesaran MH, Shin Y (2003) Testing for unit roots in heterogeneous panels. J Econ 115(1):53–74
Ingram H, Grieve D, Ingram H, Tabari S, Watthanakhomprathip W (2013) The impact of political instability on tourism: case of Thailand. Worldw Hosp Tour Themes 5(1):1755–4217
Kaminski JJ (2019) The OIC and the Paris 2015 Climate Change Agreement: Islam and the environment. In: Global governance and Muslim organizations. Palgrave Macmillan, Cham, pp 171–195
Kang Y, He X (2018) Institutional forces and environmental management strategy: moderating effects of environmental orientation and innovation capability. Manag Organ Rev 14(3):577–605
Kapetanios G, Pesaran MH, Yamagata T (2011) Panels with nonstationary multifactor error structures. J Econ 160(2):326–348
Kaufmann, D., Kraay, A., & Mastruzzi, M. (2008). Governance matters VII: aggregate and individual governance indicators 1996–2007. The World Bank
Khan MA, Khan MA, Abdulahi ME, Liaqat I, Shah SSH (2019a) Institutional quality and financial development: the United States perspective. J Multinatl Financ Manag 49:67–80
Khan SAR, Jian C, Zhang Y, Golpîra H, Kumar A, Sharif A (2019b) Environmental, social and economic growth indicators spur logistics performance: from the perspective of South Asian Association for Regional Cooperation countries. J Clean Prod 214:1011–1023
Kissinger M, Haim A (2008) Urban hinterlands—the case of an Israeli town ecological footprint. Environ Dev Sustain 10(4):391–405
Knack S, Keefer P (1995) Institutions and economic performance: cross-country tests using alternative institutional measures. Econ Polit 7(3):207–227
Konac H (2004) Environmental issues and sustainable development in OIC countries. J Econ Cooperation 25(4):1–60
Latif Z, Latif S, Ximei L, Pathan ZH, Salam S, Jianqiu Z (2018) The dynamics of ICT, foreign direct investment, globalization and economic growth: panel estimation robust to heterogeneity and cross-sectional dependence. Telematics Inform 35(2):318–328
Law SH, Tan HB, Azman-Saini WNW (2014) Financial development and income inequality at different levels of institutional quality. Emerg Markets Finance Trade 50(sup1):21–33
Le TH, Kim J, Lee M (2016) Institutional quality, trade openness, and financial sector development in Asia: an empirical investigation. Emerg Mark Financ Trade 52(5):1047–1059
Levin A, Lin CF, Chu CSJ (2002) Unit root tests in panel data: asymptotic and finite-sample properties. J Econ 108(1):1–24
Li JX, Chen YN, Xu CC & Li Z (2019) Evaluation and analysis of ecological security in arid areas of Central Asia based on the emergy ecological footprint (EEF) model. Journal of Cleaner Production 235:664–677
Liao X, Dogan E, Baek J (2017) Does corruption matter for the environment? Panel evidence from China. Econ Open Access Open Assess E J 11(27):1–12
Liu Q, Wang S, Zhang W, Zhan D, Li J (2018) Does foreign direct investment affect environmental pollution in China's cities? A spatial econometric perspective. Sci Total Environ 613:521–529
Lv Z, Xu T (2017) A panel data quantile regression analysis of the impact of corruption on tourism. Curr Issue Tour 20(6):603–616
Maddala GS, Wu S (1999) A comparative study of unit root tests with panel data and a new simple test. Oxf Bull Econ Stat 61(S1):631–652
Managi S, Hibiki A, Tsurumi T (2009) Does trade openness improve environmental quality? J Environ Econ Manag 58(3):346–363
Mavragani A, Nikolaou I, Tsagarakis K (2016) Open economy, institutional quality, and environmental performance: a macroeconomic approach. Sustainability 8(7):601
Meo MS, Chowdhury MAF, Shaikh GM, Ali M, Masood Sheikh S (2018) Asymmetric impact of oil prices, exchange rate, and inflation on tourism demand in Pakistan: new evidence from nonlinear ARDL. Asia Pac J Tour Res 23(4):408–422
Meyer AL, Van Kooten GC, Wang S (2003) Institutional, social and economic roots of deforestation: a cross-country comparison. Int For Rev 5(1):29–37
Millimet DL, Roy J (2016) Empirical tests of the pollution haven hypothesis when environmental regulation is endogenous. J Appl Econ 31(4):652–677
Mirjalili SH, Motaghian Fard M (2019) Climate change and crop yields in Iran and other OIC countries. Int J Bus Dev Stud 11(1):99–110
Moore J, Kissinger M, Rees WE (2013) An urban metabolism and ecological footprint assessment of Metro Vancouver. J Environ Manag 124:51–61
Moyo B, Ziramba E (2013) The impact of crime on inbound tourism to South Africa: an application of the bounds test. Afr Secur Rev 22(1):4–18
Naude AW, Saayman A (2005) Determinants of tourist arrivals in Africa: a panel data regression analysis. Tour Econ 11(3):365–391
Nazar R, Chaudhry IS, Ali S, Faheem M (2018) Role of quality education for sustainable development goals (SDGS). PEOPLE Int J Soc Sci 4(2):486–501
Neal, T. (2015). Estimating heterogeneous coefficients in panel data models with endogenous regressors and common factors. Working Paper
Nekooei MH, Zeinalzadeh R, Sadeghi Z (2015) The effects of democracy on environment quality index in selected OIC countries. Iran J Econ Stud 4(2):113–133
Neumayer E (2003) Are left-wing party strength and corporatism good for the environment? Evidence from panel analysis of air pollution in OECD countries. Ecol Econ 45(2):203–220
Ozturk I, Al-Mulali U, Saboori B (2016) Investigating the environmental Kuznets curve hypothesis: the role of tourism and ecological footprint. Environ Sci Pollut Res 23(2):1916–1928
Pal LA, Tok ME (2019) Global governance and Muslim organizations: introduction. In: Global governance and Muslim organizations. Palgrave Macmillan, Cham, pp 1–43
Pan H, Zhuang M, Geng Y, Wu F, Dong H (2019) Emergy-based ecological footprint analysis for a mega-city: the dynamic changes of Shanghai. J Clean Prod 210:552–562
Pedroni P (1999) Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxf Bull Econ Stat 61(S1):653–670
Peng B, Li Y, Elahi E, Wei G (2019) Dynamic evolution of ecological carrying capacity based on the ecological footprint theory: a case study of Jiangsu Province. Ecol Indic 99:19–26
Persyn D, Westerlund J (2008) Error-correction–based cointegration tests for panel data. Stata J 8(2):232–241
Pesaran MH (2004) General diagnostic tests for cross section dependence in panels. CESifo Working Papers No. 1233, 255-60
Pesaran MH (2006) Estimation and inference in large heterogenous panels with multifactor error structure. Econometrica 74(4):967–1012
Pesaran MH (2007) A simple panel unit root test in the presence of cross-section dependence. J Appl Econ 22(2):265–312

Pesaran MH, Smith R (1995) Estimating long-run relationships from dynamic heterogeneous panels. J Econ 68(1):79–113

Pesaran MH, Shin Y, Smith RJ (1996) Testing for the 'Existence of a Long-run Relationship' (No. 9622). Faculty of Economics, University of Cambridge

Rashid A, Irum A, Malik IA, Ashraf A, Rongqiong L, Liu G et al (2018) Ecological footprint of Rawalpindi; Pakistan's first footprint analysis from urbanization perspective. J Clean Prod 170:362–368

Raza SA, Sharif A, Wong WK, Karim MZA (2017) Tourism development and environmental degradation in the United States: evidence from wavelet-based analysis. Curr Issue Tour 20(16):1768–1790

Sabir S, Rafique A, Abbas K (2019) Institutions and FDI: evidence from developed and developing countries. Financ Innov 5(1):1–20

Saha S, Yap G (2015) Corruption and tourism: an empirical investigation in a non-linear framework. Int J Tour Res 17(3):272–281

Sapkota P, Bastola U (2017) Foreign direct investment, income, and environmental pollution in developing countries: panel data analysis of Latin America. Energy Econ 64:206–212

Sarwar F, Fakher A, Ali S, Mudassar K (2013) Human capital, population and economic growth: a cointegration approach. Univ J Manag Soc Sci 3(10):20–32

Scully GW (1988) The Institutional Framework and Economic Development. Journal of Political Economy 96(3):652–662

Seker F, Ertugrul HM, Cetin M (2015) The impact of foreign direct investment on environmental quality: a bounds testing and causality analysis for Turkey. Renew Sust Energ Rev 52:347–356

SESRIC (2017) OIC economic outlook. Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC), Ankara

SESRIC (2018) OIC economic outlook. Statistical, Economic and Social Research and Training Centre for Islamic Countries (SESRIC), Ankara

Shao Q, Wang X, Zhou Q, Balogh L (2019) Pollution haven hypothesis revisited: a comparison of the BRICS and MINT countries based on VECM approach. J Clean Prod 227:724–738

Sharif A, Raza SA (2016) Dynamic relationship between urbanization, energy consumption and environmental degradation in Pakistan: evidence from structure break testing. J Manag Sci 3(1):1–21

Sharif A, Afshan S, Qureshi MA (2019) Idolization and ramification between globalization and ecological footprints: evidence from quantile-on-quantile approach. Environ Sci Pollut Res 26(11): 11191–11211

Sharif A, Mishra S, Sinha A, Jiao Z, Shahbaz M, Afshan S (2020) The renewable energy consumption-environmental degradation nexus in top-10 polluted countries: fresh insights from quantile-on-quantile regression approach. Renew Energy

Solarin SA, Al-Mulali U (2018) Influence of foreign direct investment on indicators of environmental degradation. Environ Sci Pollut Res 25(25):24845–24859

Solarin SA, Al-Mulali U, Musah I, Ozturk I (2017) Investigating the pollution haven hypothesis in Ghana: an empirical investigation. Energy 124:706–719

Solis-Guzman J, Marrero M (2015) Ecological footprint assessment of building construction. Bentham Science Publishers

Sun C, Zhang F, Xu M (2017) Investigation of pollution haven hypothesis for China: an ARDL approach with breakpoint unit root tests. J Clean Prod 161:153–164

Talukdar D, Meisner CM (2001) Does the private sector help or hurt the environment? Evidence from carbon dioxide pollution in developing countries. World Dev 29:827–840

Tang CF, Tan BW (2014) The linkages among energy consumption, economic growth, relative price, foreign direct investment, and financial development in Malaysia. Qual Quant 48(2):781–797

Templet PH (2000) Externalities, subsidies and the ecological footprint: an empirical analysis. Ecol Econ 32(3):381–383

Tolba MK, Saab N (eds) (2008) Arab environment: future challenges. Arab Forum for Environment and Development, Beirut

Torras M, Boyce JK (1998) Income, inequality, and pollution: a reassessment of the environmental Kuznets curve. Ecol Econ 25(2):147–160

Tsurumi T, Managi S (2014) The effect of trade openness on deforestation: empirical analysis for 142 countries. Environ Econ Policy Stud 16(4):305–324

Ullah I, Khan MA (2017) Institutional quality and foreign direct investment inflows: evidence from Asian countries. J Econ Stud 44(6): 1030–1050

UNCTAD (2008) World investment report. United Nations Publication, New York

Wackernagel M, Onisto L, Bello P, Linares AC, Falfán ISL, García JM et al (1999) National natural capital accounting with the ecological footprint concept. Ecol Econ 29(3):375–390

Wang DT, Gu FF, David KT, Yim CKB (2013) When does FDI matter? The roles of local institutions and ethnic origins of FDI. Int Bus Rev 22(2):450–465

Westerlund J, Edgerton DL (2008) A simple test for cointegration in dependent panels with structural breaks. Oxf Bull Econ Stat 70(5): 665–704

Wiedmann T, Barrett J (2010) A review of the ecological footprint indicator-perceptions and methods. Sustainability 2(6):1645–1693

Xing Y, Kolstad CD (2002) Do lax environmental regulations attract foreign investment? Environ Resour Econ 21:1–22

You W, Lv Z (2018) Spillover effects of economic globalization on CO2 emissions: a spatial panel approach. Energy Econ 73:248–257

Zafar MW, Zaidi SAH, Khan NR, Mirza FM, Hou F & Kirmani SAA (2019) The impact of natural resources, human capital, and foreign direct investment on the ecological footprint: The case of the United States. Resources Policy 63:101428

Zarsky L (1999) Havens, halos and spaghetti: untangling the evidence about foreign direct investment and the environment. Foreign Direct Invest Environ 13(8):47–74

Zhang YJ (2011) The impact of financial development on carbon emissions: an empirical analysis in China. Energy Policy 39(4):2197–2203

Zhang Q, Yang J, Sun Z, Wu F (2017a) Analyzing the impact factors of energy-related CO2 emissions in China: what can spatial panel regressions tell us? J Clean Prod 161:1085–1093

Zhang S, Liu X, Bae J (2017b) Does trade openness affect CO2 emissions: evidence from ten newly industrialized countries? Environ Sci Pollut Res 24(21):17616–17625

Publisher's note Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.