Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-020-08361-8

RESEARCH ARTICLE

Water resources and tourism development in South Asia: an application of dynamic common correlated effect (DCCE) model

Muhammad Saeed Meo[1] · Saeed Ahmad Sabir[2] · Hira Arain[3] · Raima Nazar[4]

Received: 25 July 2019 / Accepted: 9 March 2020

Abstract

The current study explores the relationship between water resources and tourism in South Asia for the period of 1995–2017. The study employs the CIPS unit root test for stationarity of the variables and the CD test for cross-sectional dependence among cross-sectional units. As for the long-run parameters, a novel technique, known as dynamic common correlated effect (DCCE) model, is used which was recently developed by Chudik and Pesaran (J Econ 188:393–420, 2015b). The outcomes from the DCCE method suggest that water resources have a positive impact on tourism in South Asia. It is also proven that ignoring cross-sectional dependence among the cross-sectional units may bring about misleading outcomes. The findings of the study can be helpful for policymakers to understand the role of water resources in boosting tourism and contributing to the economic prosperity of South Asian countries.

Keywords Cross-sectional dependence · PMG · CIPS unit root test · CD test

JEL classification L83 · B23 · Q25 · H5

Highlights

1. The current study explored the relationship between water availability, governance, infrastructure, exchange rate, and tourism in the south Asian context.
2. The study has employed CIPS unit root test and CD test for cross-sectional dependence, while for long-run parameters, a novel technique known as Dynamic common correlated effect (DCCE) model, is used which is recently developed by Chudik and Pesaran (2015b).
3. The DCCE model accommodates heterogeneity, cross-sectional dependence, and stationarity, which is not possible in other long period based econometrical models.
4. It is confirmed from the results that there is a negative relationship between exchange rate and tourism. However, governance, infrastructure, and water availability have a positive relationship with tourism in the South Asian context.
5. It also proves that ignoring cross-sectional dependence among the cross-sectional units may cause misleading outcomes.

Responsible editor: Eyup Dogan

✉ Raima Nazar
raima.6343@wum.edu.pk

Muhammad Saeed Meo
saeedk8khan@gmail.com

Saeed Ahmad Sabir
sasabir422@gmail.com

Hira Arain
arainhira400@gmail.com

Extended author information available on the last page of the article

Introduction

The tourism industry is one of the important industries in the world. The significance of this industry could be demonstrated by the fact that it increases income, reduces inflation, produces jobs, and develops infrastructure (Jalil et al. 2013; Arain et al. 2019). The tourism industry produced about 10.4% of the world's gross domestic product (GDP) and generated almost 319 million jobs globally or 10% of total world employment in 2018 (Travel & Tourism Economic Impact 2019)[1]. Furthermore, tourism receipts can be considered an export because it implies a source of revenue and improving the balance of payment for a destination country (Meo et al. 2018).

In other words, tourism receipts support the economic development of a country through their positive impact on the economy as a whole. According to the report of the World Tourism Organization by the United Nations, the tourism industry will contribute substantially to the world's GDP by the end of 2050 (UNWTO 2015). Therefore, the development of the tourism industry will be a popular approach for economic growth worldwide (Antonakakis et al. 2015; Rasheed et al. 2019) because a positive growth in the tourism industry will

[1] https://www.wttc.org/-/media/files/reports/economic-impact-research/regions-2019/world2019.pdf

Published online: 27 March 2020

lead to an overall economic development and growth (Lee and Chang 2008). As a result, academicians are now focusing more on the tourism industry.

Existing studies on tourism demand have looked into various determinants of tourism growth, such as GDP, terrorism, inflation, peace index, foreign direct investment (FDI), unemployment, trade openness, climate change, law and order conditions, geopolitical issues, macroeconomic policies, trade, visa policies and bilateral relations with other countries, exchange rate, infrastructure, governance, and water resources (Jalil et al. 2013; Meo et al. 2018; Pablo-Romero and Molina 2013; Fareed et al. 2018: Ali et al. 2020). However, this study employs water resources, exchange rate, infrastructure, and governance, as determinants of tourism in South Asia.

Over the past few decades, it has become evident that the scarcity of water is becoming a threat to society due to a gradual increase in water demand. It must be noted that both tourism demand and the sustainability of any tourist destination depend on the availability of water (Rico-Amoros et al. 2009). Many studies have evaluated water consumption by tourists and concluded that tourists in developed countries consume two to three times more water compared with local water consumption (Holden 2003; Garcia and Servera 2003; Tortella and Tirado 2011). Tortella and Tirado (2011) contended that the water demand of tourists could be a threat to sustainability, generally, in those areas where water is already scarce, and especially in those destinations that are visited by a high percentage of world tourists. Gössling et al. (2012) carried out a quantitative and qualitative study to examine the role of fresh water in the tourism industry. They found that the use of fresh water directly in tourism is less than 1% of world consumption. They also found that indirect requirement for water is greater than direct requirement because of production of food, building materials, and energy. In Bali, Cole (2012) found that fresh water supply/availability is one of the major factors that can boost the tourism industry. Hadjikakou (2014) found that tourism significantly affects economic growth, water resources, and tourism demand. It is therefore evident that water scarcity could adversely affect tourism demand because the availability of water is a necessary determinant for tourism growth. In fact, water resources are a major tourist attraction in any country.

We also employed exchange rate as the most important determinant of tourism growth, following Balaguer and Cantavella-Jorda (2002) and Oh (2005), who argued that the exchange rate variable must be placed along with other explanatory variables in the tourism demand model to avoid the omitted variable issue. There are various studies which found that tourist highly consider exchange rate (Crouch 1995; Patsouratis et al. 2005; Önder et al. 2009). Chadeeand and Mieczkowski (1987) analyzed the impact of exchange rate (Canadian-USA) on tourism in Canada, and found that for every 1 % depreciation of the Canadian-US exchange rate, there is a corresponding 1.26% increase in the number of tourists in Canada. Meo et al. (2018) explored impact of exchange rate (LCU per US$) on tourism. They found that increase in exchange rate increases tourism demand, while Önder et al. (2009) and Gan (2015) found negative effect of exchange rate (LCU for unit of foreign currency) on tourism. Furthermore, Quadri and Zheng (2010) carried out a study on exchange rate (LCU per Euro) and tourism, and found that in Italy, exchange rate does not affect tourism. Chi (2015) examined impact of exchange rate (US dollar versus foreign currencies) on tourism in USA, and found that appreciation of US dollar negatively affects tourism. It is also observed that effect of exchange rate varies in different tourist destinations.

Currently, tourists are also concerned with the infrastructure and governance of the destination country, both of which have shown significant contribution to tourism inflows (Chingarande 2014). Gunn (1988) and Inskeep (1991) concluded that the infrastructure of a tourism destination is a potential attraction for tourists because good infrastructure avails accessibility to different areas of the destination country to tourists. Several researchers have studied tourism products and have concluded that infrastructure is one of the most crucial tourism products that affects tourism demand (Khadaroo and Seetanah 2007, 2008; Seetanah et al. 2011). Getahun and Ayele (2016) found in Ethiopia that infrastructure (water and transportation) affects the tourism industry positively. Mustafa (2019) examined the impact of infrastructure on tourism development in Sri Lanka and found that the impact of infrastructure on tourism was positive in both short-run and long-run. Similarly, in China, Yu (2016) also found a positive relationship between improved infrastructure and tourism industry. The governance of a tourism destination (such as accountability, control of corruption, the rule of law, and regulatory quality) is particularly significant in the selection of a tourism destination and also crucial for sustained growth of the tourism industry (Baggio et al. 2010; Tang & Tan 2015). The tourism sector is a very fragile and vulnerable industry in any country. The way a country is governed has an effect on tourists' willingness to visit that country (Bassil 2014). According to Yap and Saha (2013), tourists are more concerned with their safety and security. Meo et al. (2018) investigated the relationship between the governance index and tourism. They found that governance positively affects tourism demand in Pakistan. Hence, good governance of a destination can attract tourists, and it could also lead to increased tourism demand. Araña and León (2008) found that tourists visit those destinations where they find good governance compared with those with weak governance even if the country has attractive sites. Kim et al. (2018) carried out a panel study of 108 counties to investigate the impact of governance (institutional quality) on tourist inflows. They found that governance positively impacts tourist inflows in developed and emerging economies, and has a greater effect on tourism in highly developed economies compared with emerging economies. Ghalia et al. (2019) applied the gravity model and found that governance (institutional quality) affects tourism positively. A recent study accomplished by Lee et al. (2020) found that governance (institutional quality) plays a major role in determining tourism in Malaysia.

Face of tourism in South Asia

South Asian countries (Pakistan, Maldives, Bangladesh, Nepal, India, Bhutan, Sri Lanka, and Afghanistan), with their natural beauty and fascinating tourist sites, attract people from the whole world (Rasul & Manandhar 2009; Ali and Nazar 2017). South Asia is a diverse region, spanning coastal areas to mountains and grasslands to forests, with picturesque beauty, rivers, and diversified climate conditions. For example, Pakistan has Neelum Valley, Shangrila Resort, Naltar Valley, Skardu, Narnan Valley, and Jhelum Valley for tourists. Likewise, Maldives has many tourist attractions, such as Hulhumale Island, Feydhoo, and Veligandu Island. Bangladesh has various historical sites for tourists, for instance, Shahid Minar, Ahsan Manzil, and various beaches. Similarly, Nepal, India, Bhutan, Sri Lanka, and Afghanistan have numerous historical and beautiful places for tourists, but the region's economic conditions are still poor. Despite that, South Asian countries have great potential for tourism, but their share is only 1% of global tourism. The UNWTO (2015) reported that worldwide, tourist arrival was 1133 million but South Asia received just 17.1 million tourists. Considering the potential of tourism in South Asia, this study attempts to analyze the major factors of tourism demand in this region.

The present study contributes to the body of knowledge from various perspectives. Firstly, previous studies on tourism, water resources, exchange rate, infrastructure, and governance have assumed homogeneity across the countries. However, practically, this assumption is not viable (Sadorsky 2013). Secondly, the present study includes water resources as an additional determinant of tourism in the South Asian context; water scarcity is currently an issue in South Asian economies, and earlier studies have ignored this variable. Thirdly, previous studies have ignored the issue of cross-sectional dependence among different countries. If the series suffer from cross-sectional dependence, traditional approaches, such as the GMM model, random-effect model, fixed-effect model, or pooled regression, provide invalid outcomes (Sadorsky 2013; Turkay 2017). Besides, De Hoyos and Sarafidis (2006) found that in the current globalization era, cross-sectional dependence among the economies is not an expectation but a rule to financial integration among the economies. Fourth, the empirical results of this study have significant policy implications for the policymakers who devise policies for boosting tourism in South Asia. Various studies have employed mean group (MG) and pooled mean group (PMG) for the long-term panel data. However, these methods only consider the heterogeneity problem (Pesaran and Smith 1995) and give misleading results due to the presence of cross-sectional dependence (Al Mamun et al. 2015). Therefore, due to the importance of cross-sectional dependence and heterogeneity, we employed the dynamic common correlated effect (DCCE) model recently introduced by Chudik and Pesaran (2015b). The DCCE model considers both cross-sectional dependence and heterogeneity, and provides results that are more accurate compared with PMG, MG, and AMG models. Hence, the present study is very useful for tourism policymakers in South Asian and other developing economies.

The rest of the paper is organized as follows. The second section elaborates on data and methodology, section three consists of results, and section four gives the conclusion and policy implications.

Data and methodology

Variables and data sources

The present study examines the impact of water resources and other control variables (exchange rate, infrastructure, governance) on tourism in South Asian countries, such as India, Pakistan, Bangladesh, Sri Lanka, and Nepal. Due to the unavailability of data, the other South Asian countries are not included. We measured tourism by the total number of tourist arrivals in each of those countries. Numerous empirical studies have used various proxies of water resources, such as Raskin et al. (1997), Falkenmark (1997), Vörösmarty et al. (2000), and Oki and Kanae (2006) used ratio of water consumption to availability; Seckler (1998) used supply of water; Aldaya (2012) used signified ratio of water unavailability with the footprint of water-to-water accessibility; while Falkenmark et al. (2009), Ohlsson and Appelgren (1998), and Falkenmark et al.(1989) employed per capita water resources. Therefore, we also used per capita water availability as a proxy for water resources, while real exchange rate was measured by the change in annual percentage in the official currency rate per USD, following Bano et al. (2018). The governance index[2] was constructed with various governance indicators, and the infrastructure index[3] was calculated by following Palei (2015). Table 1 shows the description of variables and data sources.

[2] We employed principal component analysis (PCA) using reviews to construct governance index of various components of governance from World Bank data (including rule of law, government effectiveness, voice and accountability, absence of violence, political stability, regulatory quality, and control of corruption).

[3] The study constructed infrastructure index following Palei (2015). In this study, infrastructure index was developed by using basic physical infrastructure, i.e., transport infrastructure, telecommunication infrastructure, water sanitation, and energy infrastructure.

Table 1 Variables description and data sources

Variables	Description	Unit of measurement	Data source
TOR	Tourism development	Number of tourist's arrival	WDI
WR	Water resources	Per capita water availability	FAO
EXCH	Real exchange rate	Based on US dollar exchange rate	WDI
GOV	Governance index	Index	ICRG
INFRA	Infrastructure index	Index	(Palei 2015)

The study used annual data from 1995 to 2017

Unit root tests in the presence of cross-sectional dependence

A growing body of literature indicated that panel data models are suffered by the issue of cross-sectional dependence in error terms which may arise due to the presence of unobserved components and common shocks that conclusively become the part of spatial dependence, error term, and idiosyncratic pairwise dependence (Pesaran 2004). Moreover, the interaction between economies and financial integration also gives rise to cross-sectional dependence (De Hoyos and Sarafidis 2006). This phenomenon becomes very severe in dynamic panel estimation. In most prior studies, first-generation unit root tests have been used (Maddala and Wu 1999; Levin et al. 2002; Im et al. 2003). These tests, however, have not considered cross-sectional dependence.

On the other hand, the second-generation unit root tests consider the cross-sectional dependencies among panel data (Moon and Perron 2004; Smith et al. 2004; Bai and Ng 2004; Pesaran 2007). In recent studies, third-generation unit root tests have also been reported, which can tackle structural breaks in data. These unit root tests have some drawbacks related to statistical size and power property, as indicated by Hossain (2011). Specifically, the first-generation unit root tests show issues with size properties of data and a false rejection of the null hypothesis in the presence of cross-sectional dependence (Banerjee et al. 2001). Choi (2006) and Pesaran (2007) introduced second-generation unit root tests, which have corrected the issue of false rejection of the null hypothesis. However, the assumption of homogeneity across the cross-sectional dependence is still not true as stated by Urbain and Westerlund (2006).

The present study employed Pesaran's (2004) unit root test since it addresses the issue of false rejection of the null hypothesis in cross-sectional dependence data.

$$a_{\mathrm{it}} = \delta_{\mathrm{i}} + \beta_{\mathrm{it}} b_{\mathrm{it}} + \mu_{\mathrm{it}} \tag{1}$$

Equation (1) states the relationship between a_{it} which depends on residuals = μ_{it} and time invariant individual nuisance parameters = δ_{i}. The slopes to be estimated are denoted by β_{it}, and b_{it} refers to the number of regressors. In the subscript, the "i" refers to the cross-section and "t," the time period.

The following hypothesis was tested to investigate the presence of cross-sectional dependence among panel data.

$$H_0 = p_{\mathrm{iz}} = p_{\mathrm{zi}} = \mathrm{cor}(\mu_{\mathrm{it}}, \mu_{\mathrm{it}}) = 0 \text{ for } \mathrm{i} \neq \mathrm{z} \tag{2}$$

$$H_1 = p_{\mathrm{iz}} = p_{\mathrm{zi}} = \mathrm{cor}(\mu_{\mathrm{it}}, \mu_{\mathrm{it}}) = \neq 0 \text{ for some } \mathrm{i} \neq \mathrm{z} \tag{3}$$

The correlation between the two roots validates CSD as stated in Eqs. 2 and 3 above. The null hypothesis (H_0) indicates that there is no cross-sectional dependence among cross-sectional units and vice versa for the alternate hypothesis (H_1).

Panel cointegration

A literature review indicates that cointegration techniques have been widely used in empirical studies. These cointegration techniques have historically been under strict scrutiny for long-series data estimation (Pedroni 1997). Many studies have reported that these cointegration techniques exhibit more problems in application concerning period and less concerning data frequency (Shiller and Perron 1985; Perron 1991). In this research, we used the bootstrap cointegration approach introduced by Westerlund and Edgerton (2007) to explore the long-term relationship among the variables under study. This approach is more efficient than other cointegration techniques. For example, contrary to Pedroni's (2004) cointegration approach, it takes structural breaks into account as well. Moreover, this method considers lead-lag lengths when applied to short-duration data (Persyn and Westerlund 2008).

Equation (4) refers to the bootstrap panel cointegration approach proposed by Westerlund and Edgerton (2007).

$$\Delta y_{\mathrm{it}} = \delta' d_{\mathrm{t}} + \alpha_{\mathrm{i}}\left(y_{\mathrm{i,t-1}} - \beta \mathrm{i}' x_{\mathrm{i,t-1}}\right) + \sum_{\mathrm{j=-qi}}^{\mathrm{qi}} a_{\mathrm{ij}} \Delta y_{\mathrm{i,t-1}} + \sum_{\mathrm{j=-qi}}^{\mathrm{qi}} \gamma_{\mathrm{ij}} \Delta x_{\mathrm{i,t-1}} + e_{\mathrm{i,t}} \tag{4}$$

The above equation shows the relationship for the endogenous variable = Δy_{it}, for three various cases, d_{t} refers to the deterministic component. Subscript t and i denote time-period and cross-sectional units, respectively.

Dynamic common correlated effects

The literature review shows that researchers have not considered cross-sectional effects and have only worked with homogenous slopes in earlier studies. The related studies show various techniques for panel data analysis, including GMM, random-effect, and fixed-effect models, In these models, only the intercept changes among the cross-sectional units, leaving a high degree of homogeneity. This assumption is not true and produces misleading results (Turkay 2017).

Due to these reasons, panel data estimation with heterogeneous coefficients among cross-sectional units over longer periods has attracted the attention of researchers in the recent past (Pesaran and Smith 1995; Pesaran et al. 1999). Researchers, the world over, have also paid attention to the issue of the dependence of cross-sectional units (Pesaran 2006; Chudik and Pesaran 2015b). In this work, we applied the dynamic common correlated effect (DCCE) approach introduced by Chudik and Pesaran (2015b). This approach uses the principles of PMG estimation by Shin et al. (1999), MG estimation of Pesaran and Smith (1995), CCE estimation of Pesaran (2006), and the estimation by Chudik and Pesaran (2015a). Blackburne and Frank (2007) suggested xtpmg command (pooled mean group estimator) for non-stationary and heterogonous large data sets, as the PMG estimator does not consider the cross-sectional dependence. Eberhardt (2012) used common correlated effects without pooled coefficients or DCCE. The CCE estimation also does not consider the lag value of an endogenous variable as an explanatory variable (Chudik & Pesaran 2015), while the DCCE method considers homogenous and heterogeneous coefficients and the DCCE and also takes into account cross-sectional dependence. This technique incorporates heterogeneous slopes and cross-sectional dependence by taking cross-sectional means and lags into consideration.

Moreover, this method works well for small sample size by using the jack-knife correction approach (Chudik & Pesaran 2015). Another major benefit of this technique is its estimation robustness in the presence of structural breaks in data (Kapetanios et al. 2011). This technique also performs satisfactorily for unbalanced panel data (Ditzen 2016).

We used the dynamic equation of the DCCE model from Chudik and Pesaran (2015b) as follows:

$$\mathrm{WR}_{\mathrm{it}} = \alpha_{\mathrm{i}}\mathrm{WR}_{\mathrm{it-1}} + \delta_{\mathrm{i}}x_{\mathrm{it}} + \sum_{\mathrm{P=0}}^{\mathrm{P_T}} \gamma_{\mathrm{xip}}\overline{X}_{\mathrm{t-p}} + \sum_{\mathrm{P=0}}^{\mathrm{P_T}} \gamma_{\mathrm{yip}}\overline{Y}_{\mathrm{t-p}} + \mu_{\mathrm{it}} \quad (6)$$

For our work, in Equation (6), WR refers to water resources, $\alpha_{\mathrm{i}}\mathrm{WR}_{\mathrm{it-1}}$ is the lag of WR as an independent variable, $\delta_{\mathrm{i}}x_{\mathrm{it}}$ refers to the set of independent variables, and P_{T} is the limit of lags included in the cross-section averages.

Table 2 Descriptive statistics

	TOR	WR	EXCH	GOV	INFRA
Mean					
Median	1,528,207	3519.44	69.25	− 0.07	9.46
Maximum	6,968,000	2549.00	129.06	− 0.52	10.01
Minimum	125,000.0	1391.00	36.31	− 2.63	5.02
Std. dev.	1,976,441	2802.96	25.95	0.27	3.06
Skewness	1.709536	1.14	0.92	0.27	0.03
Kutosis	4.657334	2.48	2.86	1.87	2.50
Jarque-Bera	17.44447	6.61	4.14	1.89	0.30
Probability	0.000163	0.03	0.12	0.38	0.85

Results and discussion

In recent empirical research, cross-sectional dependence and macroeconomic determinants have received greater attention. Currently, cross-sectional dependence is considered a basic rule and not an expectation between the cross-sectional units (Turkay 2017). To prevent cross-sectional dependencies between the cross-sectional units and misleading parameters (Hsiao and Tahmiscioglu 2008), we employed the Pesaran (2004) test of cross-sectional dependence (CD) by considering the cross-sectional dependence between the cross-sectional units' significances. Furthermore, the test was done on pairwise mean correlated ordinary least square (OLS) residuals of the individual regression in a panel. The results of descriptive statistics are shown in Table 2 and the results of cross-sectional dependence are provided in Table 3. The CD test's null hypothesis represents the independence in cross-sectional units or non-cross-sectional dependence. The findings in Table 3 confirm the existence of cross-sectional dependence between the units of the cross-section.

Due to the importance of the cross-sectional dependence among the variables in the globalization era, the CD test was employed in the study and the results are presented in Table 3. It is observed that the data series experience cross-sectional dependence. Another significance of the CD test is that it is helpful for knowing whether the first-generation panel unit root tests (Levin et al. 2002; Im et al. 2003) or second-

Table 3 Cross-sectional dependence test results

	CD Test	*p* value
TOR	15.87	0.00*
WR	9.42	0.00*
EXCH	7.87	0.00*
GOV	7.41	0.00*
INFRA	8.52	0.00*

*Refers to the rejection of null hypothesis of CD at 1% level of significance

Table 4 First-generation unit root tests (LLC & IPS)

	Levin, Lin, and Chu				Im, Pesaran, and Shin W-stat			
	Level		1st diff.		Level		1st diff.	
	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.	Stat.	Prob.
TOR	− 1.12	0.41	− 12.74	0.00*	− 1.08	0.13	− 11.41	0.00*
WR	0.32	0.62	− 2.90	0.00*	− 0.23	0.40	− 2.85	0.00*
EXCH	− 1.24	0.10	− 4.85	0.00*	− 2.57	0.00*	− 6.19	0.00*
GOV	− 2.37	0.00*	− 7.07	0.00*	− 0.72	0.23	− 8.76	0.00*
INFRA	− 5.43	0.00*	− 6.50	0.00*	− 4.59	0.00*	− 7.17	0.00*

*Refers to level of significance at 1%

generation unit root techniques (Pesaran 2007; Chang 2004) are appropriate for the proposed variables of the study. Cross-sectional dependence is accommodated by first-generation unit root tests, and they assume homogeneity across the cross-sections. However, second-generation unit root tests consider cross-sectional dependence (Kahia et al. 2016). Hence, this study employed both first and second-generation unit root tests to prevent misleading inferences. The findings of first-generation unit root tests are shown in Table 4, and the findings of the second-generation unit root tests in Table 5. All the variables are stationary at the first difference and level as shown in Table 4.

Furthermore, this study employed the second-generation Pesaran's (2007) CIPS unit root test that allows cross-sectional dependence among the series and provides more accurate results compared with first-generation unit root tests. The findings of CIPS unit root test are presented in Table 5 that confirm that the governance index is stationary at level, while tourism, exchange rate, infrastructure, and water resources are stationary at first difference. None of the variables is stationary at the second difference according to both first and second-generation unit root tests. Hence, we proceeded with the DCCE method to estimate the long-run association among the proposed variables.

In Table 6, the findings of Pedroni's cointegration tests are shown which confirm the absence of a long-run association among the purposed variables. Westerlund and Edgerton (2008) found that most cointegration tests cannot account for structural breaks as these tests may provide misleading results. However, Westerlund and Edgerton's (2008) test of cointegration deals with cross-sectional dependence, structural breaks, serial correlation, and heteroskedasticity issues and provides robust outcomes compared with traditional cointegration tests. In Table 7, the Westerlund (2007) bootstrap panel cointegration results are presented which confirm the presence of long-run association or cointegration between TOR, WR, EXCH, GOV, and INFRA. The probability values of Gt, Ga, Pt, and Pa (Persyn & Westerlund (2008)[4]) cointegration tests are less than 0.05 that reject the null hypothesis of no cointegration.

[4] We employed xtwest command for Westerlund cointegration.

Table 5 Second-generation unit root test (CIPS)

	Level	First difference
TOR	− 1.96	− 6.17*
WR	0.29	− 3.00*
EXCH	− 1.91	− 5.66*
GOV	− 2.16***	− 3.82**
INFRA	− 1.21	− 5.68*

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

The findings of the PMG model in Table 8 confirm that water resources (WR), exchange rate (EXCH), and infrastructure index (INFRA) have a negative and significant relationship with tourism. It means an increase in water resources, exchange rate, and infrastructure index decreases tourism development in South Asia. However, the governance index (GOV) is positively and significantly linked to tourism. It means an increase in governance leads to an increase in tourism in South Asia.

Considering the diagnostic issues of the model, the CD test confirms that series suffer from cross-sectional dependence, while the PMG model does not accommodate the cross-sectional dependence issue. Therefore, the PMG approach could provide misleading outcomes. Hence, considering the issues with PMG model, the study also employed the DCCE model. Table 9 shows the results of the DCCE model. It is found that exchange rate using the DCCE model has a negative and significant relationship with tourism. However, we found a major change in coefficients using the DCCE model. We found that water resources, governance index, and infrastructure index are positively and significantly linked to tourism development. It means an increase in water resources, governance index, and infrastructure index leads to an increase in tourism in South

Table 6 Pedroni residual cointegration tests

	t-stat	Prob.	Weight t-stat	Prob.
H1: common coefficients (within dimensions)				
V-stat	− 0.51	0.69	− 0.57	0.71
Rho-stat	0.67	0.74	0.75	0.77
PP-stat	− 0.67	0.24	− 0.26	0.39
ADF-stat	− 0.35	0.36	− 0.08	0.46
H1: individual coefficients (between dimensions)				
Rho-stat	1.46	0.92		
ADF-stat	− 1.12	0.13		
PP-stat	− 1.77	0.03**		

**Refers to level of significance 5%

Table 7 Westerlund ECM panel cointegration tests

H0: no cointegration	Value	Robust *P* value
Gt	− 5.567	0.000*
Ga	− 24.168	0.000*
Pt	− 12.363	0.000*
Pa	− 23.983	0.000*

*Refers to level of significance at 1%

Asia. The findings of the study are aligned with Rico-Amoros et al. (2009), who argued that water resources play a vital role in tourist destination selection. Meo et al. (2018) found that the exchange rate negatively affects tourism demand. They also found that governance and tourism are linked positively and significantly because good governance motivates tourists to visit a destination due to security. Khadaroo and Seetanah (2008) also found that infrastructure plays a vital role in attracting tourists. However, the DCCE model provides more accurate results compared with the PMG or other cointegration-based long data set panel approaches.

Conclusion and policy

The current study explores the relationship between water resources and tourism in the South Asian context using a novel technique, known as the dynamic common correlated effect (DCCE) model. The study used annual data from 1995 to 2017. From a theoretical aspect, this study makes a contribution, in that, it considers cross-sectional dependence among cross-sectional units (using the DCCE approach), which means during this era of globalization, the countries suffer a lot from changes in some other countries. In addition, we incorporated water resources in the tourism model as one of the major tourist attraction factors, which has not been discussed empirically in earlier studies by incorporating cross-sectional dependence. The study confirms a positive and significant effect of water resources on tourism. Therefore, based on the findings, it can be claimed that sufficient water resources can enhance the tourism sector. The tourism sector depends on water resources. Therefore, water scarcity, poor quality of water resources, or media news about the water crisis in South Asia can hugely harm the tourism industry (Hall 2010; Hall and Stoffels 2006). The policymakers should devise policies for the tourism industry by considering water management. Currently, South Asia is facing water issues, and in the near future, water will be a scarce natural resource in South Asia. Furthermore, based on analysis of the UNWTO (2015), the tourism industry will grow in the coming decades, and some regions will face water scarcity issues if reasonable measures are not taken. Therefore, for sustainable tourism, water management requires proper attention. Furthermore, water management is needed not only at country level but also at individual level. Companies, and more importantly, tourism-related industries, such as the hotel industry that use water for their production, must have a solid plan for water-saving. In hotels, there must be proper plans for water usage in bathrooms, for laundry, swimming pools, gardens, the kitchen, and for housekeeping.

Table 8 Results of pooled mean group (PMG) estimation

Exog. var	Coefficient	*P* value
WR	− 0.02	0.00*
EXCH	− 0.07	0.86
GOV	0.44	0.00*
INFRA	− 0.15	0.01*
C	16.09	0.00*

*Refers to level of significance at 1%

Table 9 Results of dynamic common correlated effect (DCCE) estimation

Exog. var	Coefficient	p value
TOR (− 1)	− 0.09	0.02**
WR	0.15	0.00*
EXCH	− 0.09	0.02**
GOV	0.01	0.01*
INFRA	0.11	0.00*

The symbols * and ** refer to level of significance at 1% and 5% respectively

The current study suffers from one limitation, i.e., we only targeted South Asia. Due to the unavailability of data, a few countries were excluded. In future, a research can be conducted to compare developing and developed nations. Furthermore, research should incorporate other natural factors, such as effects of temperature and rain in the tourism model using quantile on quantile regression or quantile ARDL model that can provide more accurate results.

Acknowledgments We would like to acknowledge the contributions of research participants to this paper.

Contribution All the authors contributed equally.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

References

Al Mamun M, Sohag K, Uddin GS, Shahbaz M (2015) Remittance and domestic labor productivity: evidence from remittance recipient countries. Econ Model 47:207–218

Aldaya MM, Chapagain AK, Hoekstra AY, Mekonnen MM (2012) The water footprint assessment manual: setting the global standard. Routledge.

Ali S, Nazar R (2017) Impact of foreign capital inflows and money supply on exchange rate: a case study of Pakistan. Rev Econ Dev Stud 3(1): 83–90

Ali S, Yusop Z, Kaliappan SR, Chin L (2020) Dynamic common correlated effects of trade openness, FDI, and institutional performance on environmental quality: evidence from OIC countries. Environ Sci Pollut Res:1–12. https://doi.org/10.1007/s11356-020-07768-7

Antonakakis N, Dragouni M, Filis G (2015) How strong is the linkage between tourism and economic growth in Europe? Econ Model 44: 142–155

Arain H, Han L, Sharif A, Meo MS (2019) Investigating the effect of inbound tourism on FDI: the importance of quantile estimations. Tour Econ 1354816619859695

Araña JE, León CJ (2008) The impact of terrorism on tourism demand. Ann Tour Res 35(2):299–315

Baggio R, Scott N, Cooper C (2010) Improving tourism destination governance: a complexity science approach. Tour Rev 65(4):51–60

Bai J, Ng S (2004) A PANIC attack on unit roots and cointegration. Econometrica 72(4):1127–1177

Balaguer J, Cantavella-Jorda M (2002) Tourism as a long-run economic growth factor: the Spanish case. Appl Econ 34(7):877–884

Banerjee A, Cockerell L, Russell B (2001) An I (2) analysis of inflation and the markup. J Appl Econ 16(3):221–240

Bano S, Zhao Y, Ahmad A, Wang S, Liu Y (2018) Why Did FDI Inflows of Pakistan decline? From the perspective of terrorism, energy shortage, financial instability, and political instability. Emerg Mark Financ Trade 55(1):90–104

Bassil C (2014) The effect of terrorism on tourism demand in the Middle East. Peace Econ Peace Sci Public Policy 20(4):669–684

Blackburne EF, Frank MW (2007) Estimation of nonstationary heterogeneous panels. Stata J 7(2):197–208

Chadeeand D, Mieczkowski Z (1987) An empirical analysis of the effects of the exchange rate on Canadian tourism. J Travel Res 26(1):13–17

Chang Y (2004) îBootstrap Unit root tests in panels with cross-sectional dependencyî. J Econ 120:263–293

Chi J (2015) Dynamic impacts of income and the exchange rate on US tourism, 1960–2011. Tour Econ 21(5):1047–1060

Chingarande A (2014) Does political instability affect tourism: a case of Egypt. Int J Soc Relev Concern 2(6)

Choi I (2006) Nonstationary panels, palgrave handbooks of econometrics, Vol. 1. Palgrave Macmillan, St Martin's Press LLC, 175 Fifth Avenue, New York

Chudik, A., and M. H. Pesaran (2015a) Large panel data models with cross-sectional dependence: A survey. In The Oxford Handbook Of Panel Data, ed. B. H. Baltagi, 2-45. Oxford: Oxford University Press

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

Cole S (2012) A political ecology of water equity and tourism: a case study from Bali. Ann Tour Res 39(2):1221–1241

Crouch GI (1995) A meta-analysis of tourism demand. Ann Tour Res 22(1):103–118

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

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

Eberhardt M (2012) Estimating panel time-series models with heterogeneous slopes. Stata J 12(1):61–71

Falkenmark M (1997) Meeting water requirements of an expanding world population. Philos Trans R Soc B 352(1356):929–936

Falkenmark M, Lundqvist J, Widstrand C (1989) Macro-scale water scarcity requires micro-scale approaches: aspects of vulnerability in semi-arid development. In Natural resources forum, 13, 4, 258–267. Oxford: Blackwell Publishing Ltd.

Falkenmark M, Rockström J, Karlberg L (2009) Present and future water requirements for feeding humanity. Food Sec 1(1):59–69

Fareed Z, Meo MS, Zulfiqar B, Shahzad F, Wang N (2018) Nexus of tourism, terrorism, and economic growth in Thailand: new evidence from asymmetric ARDL cointegration approach. Asia Pac J Tour Res 23(12):1129–1141

Gan Y (2015) An empirical analysis of the influence of exchange rate and prices on tourism demand (doctoral dissertation)

Garcia C, Servera J (2003) Impacts of tourism development on water demand and beach degradation on the island of Mallorca (Spain). Geografiska Annaler: Series A, Phys Geogr 85(3–4):287–300

Getahun TB, Ayele B (2016) Impact of transportation infrastructure in tourism management in Ethiopia: Lake Tana region in focus'9 th International Conference on African Development, May27–28/2016, hosted by West Michigan University's Center for African Development Policy Research

Ghalia T, Fidrmuc J, Samargandi N, Sohag K (2019) Institutional quality, political risk and tourism. Tour Manag Perspect 32:100576

Gossling S, Peeters P, Hall M, Ceron JP, Dubois G, Lehman LV, Scott D (2012) Tourism and water use: supply, demand, and security. An international review. Tour Manag 33:1–5

Gunn, C (1988) Tourism planning. 2nd. Revised and expanded New York

Hadjikakou M (2014) Measuring the impact of tourism on water resources: alternative frameworks (Doctoral dissertation, University of Surrey)

Hall CM (2010) Crisis events in tourism: Subjects of crisis in tourism. Curr Issue Tour 13(5):401–417

Hall CM, Stoffels M (2006) Lake tourism in New Zealand: Sustainable management issues. Lake tourism. An Integrated Approach to Lacustrine Tourism Systems:182–206

Holden A (2003) In need of new environmental ethics for tourism? Ann Tour Res 30(1):94–108

Hossain MS (2011) Panel estimation for CO2 emissions, energy consumption, economic growth, trade openness and urbanization of newly industrialized countries. Energy Policy 39(11):6991–6999

Hsiao C, Tahmiscioglu AK (2008) Estimation of dynamic panel data models with both individual and time-specific effects. Journal of Statistical Planning and Inference 138(9):2698–2721

Im KS, Pesaran MH, Shin Y (2003) Testing for unit roots in heterogeneous Panels. J Econ 115(1):53–74

Inskeep, E. (1991). Tourism planning: an integrated and sustainable development approach: Van Nostrand Reinhold

Jalil A, Mahmood T, Idrees M (2013) Tourism–growth nexus in Pakistan: evidence from ARDL bounds tests. Econ Model 35:185–191

Kahia M, Aïssa MSB, Charfeddine L (2016) Impact of renewable and non-renewable energy consumption on economic growth: new evidence from the MENA Net Oil Exporting Countries (NOECs). Energy 116:102–115

Kapetanios G, Pesaran MH, Yamagata T (2011) Panels with non-stationary multifactor error structures. J Econ 160(2):326–348

Khadaroo J, Seetanah B (2007) Transport infrastructure and tourism development. Ann Tour Res 34(4):1021–1032

Khadaroo J, Seetanah B (2008) The role of transport infrastructure in international tourism development: a gravity model approach. Tour Manag 29(5):831–840

Kim YR, Saha S, Vertinsky I, Park C (2018) The impact of national institutional quality on international tourism inflows: a cross-country evidence. Tour Anal 23(4):533–551

Lee C-C, Chang C-P (2008) Tourism development and economic growth: a closer look at panels. Tour Manag 29(1):180–192

Lee HS, Sin Yee LEE, Har WM (2020) Roles of institutional quality on the relationship between tourism and economic development in Malaysia. Journal of Environmental Treatment Techniques 8(1): 119–124

Levin A, Lin CF, Chu CSJ (2002) Unit root test in panel data: asymptotic and finite sample Propertiesî. J Econ 108:1–24
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
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
Moon HR, Perron B (2004) Testing for a unit root in panels with dynamic factors. J Econ 122(1):81–126
Mustafa AMM (2019) The impact of infrastructure on tourism: the case of Sri Lanka. Asian Soc Sci 15(7):174. https://doi.org/10.5539/ass.v15n7p174
Oh C-O (2005) The contribution of tourism development to economic growth in the Korean economy. Tour Manag 26(1):39–44
Ohlsson L, Appelgren B (1998) Water and social resource scarcity. Food and Agricultural Organization, Rome
Oki T, Kanae S (2006) Global hydrological cycles and world water resources. Science 313(5790):1068–1072
Önder AÖ, Candemir A, Kumral N (2009) An empirical analysis of the determinants of international tourism demand: the case of Izmir. Eur Plan Stud 17(10):1525–1533
Pablo-Romero M d P, Molina JA (2013) Tourism and economic growth: a review of empirical literature. Tour Manag Perspect 8:28–41
Tatyana Palei (2015) Assessing the impact of infrastructure on economic growth and global competitiveness. 2nd GLOBAL CONFERENCE on BUSINESS, ECONOMICS, MANAGEMENT and TOURISM, 30–31 October 2014, Prague, Czech Republic
Patsouratis V, Frangouli Z, Anastasopoulos G (2005) Competition in tourism among the Mediterranean countries. Appl Econ 37(16):1865–1870
Pedroni P (1997) Cross sectional dependence in cointegration tests of purchasing power parity in panels. Indiana University, WP Department of Economics
Pedroni P (2004) Panel cointegration: Asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric Theory 20(3):597–625
Perron P (1991) Test consistency with varying sampling frequency. Econometric Theory 7(3):341–368
Persyn D, Westerlund J (2008) Error-correction-based cointegration tests for panel data. Stata J 8(2):232–241
Pesaran, M. Hashem (2004) General diagnostic tests for cross section dependence in panels' IZA Discussion Paper No. 1240
Pesaran MH (2006) Estimation and inference in large heterogeneous panels with a 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 22:265–312
Pesaran MH, Smith R (1995) Estimating long-run relationships from dynamic heterogeneous panels. J Econ 68(1):79–113
Pesaran MH, Shin Y, Smith RP (1999) Pooled mean group estimation of dynamic heterogeneous panels. J Am Stat Assoc 94(446):621–634
Quadri DL, Zheng T (2010) A revisit to the impact of exchange rates on tourism demand: the case of Italy. The Journal of Hospitality Financial Management 18(2):47–60
Rasheed R, Meo MS, Awan RU, Ahmed F (2019) The impact of tourism on deficit in balance of payments of Pakistan: an application of bounds testing approach to cointegration. Asia Pac J Tour Res 24(4):325–332
Raskin I, Smith RD, Salt DE (1997) Phytoremediation of metals: using plants to remove pollutants from the environment. Curr Opin Biotechnol 8(2):221–226
Rasul G, Manandhar P (2009) Prospects and problems in promoting tourism in South Asia: a regional perspective. South Asia Economic Journal 10(1):187–207
Rico-Amoros AM, Olcina-Cantos J, Saurí D (2009) Tourist land use patterns and water demand: evidence from the Western Mediterranean. Land Use Policy 26(2):493–501
Sadorsky P (2013) Do urbanization and industrialization affect energy intensity in developing countries? Energy Econ 37:52–59
Seckler DW (1998) World water demand and supply, 1990 to 2025: scenarios and issues. International Water Management Institute, Colombo
Seetanah B, Juwaheer T, Lamport M, Rojid S, Sannassee R, Subadar A (2011) Does infrastructure matter in tourism development? Univ Maurit Res J 17(1):89–108
Shiller, R. J., & Perron, P. (1985). Testing the random walk hypothesis: power versus frequency of observation
Shin Y, Pesaran MH, Smith RP (1999) Pooled mean group estimation of dynamic heterogeneous panels. J Am Stat Assoc 94:621–634
Smith LV, Leybourne S, Kim TH, Newbold P (2004) More powerful panel data unit root tests with an application to mean reversion in real exchange rates. J Appl Econ 19(2):147–170
Tang CF, Tan EC (2015) Does tourism effectively stimulate Malaysia's economic growth? Tour Manag 46:158–163
Tortella BD, Tirado D (2011) Hotel water consumption at a seasonal mass tourist destination. The case of the island of Mallorca. J Environ Manag 92(10):2568–2579
Travel & Tourism Economic Impact (2019). World Travel & Tourism Council, London, UK. https://www.wttc.org/-/media/files/reports/economic-impact-research/regions-2019/world2019.pdf Assessed 10-5-2019
Turkay M (2017) Heterogeneity across emerging market central bank reaction functions. Central Bank Review 17(3):111–116
United Nations World Tourism Organization (UNWTO). (2015). Tourism highlights. Madrid, Spain. https://www.e-unwto.org/doi/pdf/10.18111/9789284416899 Assessed 15-5-2019
Urbain JP, Westerlund J (2006) Spurious regression in nonstationary panels with cross-unit cointegration. METEOR, Maastricht Research School of Economics of Technology and Organizations
Vörösmarty CJ, Green P, Salisbury J, Lammers RB (2000) Global water resources: vulnerability from climate change and population growth. Science 289(5477):284–288
Westerlund J (2007) Testing for error correction in panel data. Ox Bull Econ Stat 69(6):709–748
Westerlund J, Edgerton DL (2007) A panel bootstrap cointegration test. Econ Lett 97(3):185–190
Westerlund J, Edgerton DL (2008) A simple test for cointegration in dependent panels with structural breaks. Oxf Bull Econ Stat 70(5):665–704
Yap G, Saha S (2013) Do political instability, terrorism, and corruption have deterring effects on tourism development even in the presence of UNESCO heritage? A cross-country panel estimate. Tour Anal 18(5):587–599
Yu M (2016) Research on the impact of infrastructure construction on tourism industry: evidence from the "Wuhan-Guangzhou high-speed rail". Open J Soc Sci 4(01):126

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

Affiliations

Muhammad Saeed Meo[1] · **Saeed Ahmad Sabir**[2] · **Hira Arain**[3] · **Raima Nazar**[4]

[1] Department of Management Sciences, The Superior College, Lahore, Pakistan

[2] Universiti Utara Malaysia, Changlun, Malaysia

[3] Department of Finance, School of Economics & Management, Beihang University (BUAA), Beijing, People's Republic of China

[4] Department of Economics, The women university, Multan, Pakistan