Natural Resource Abundance, Renewable Energy, and Ecological Footprint Linkage in MENA Countries

SOLOMON PRINCE NATHANIEL[1], NGOZI ADELEYE[2], FESTUS FATAI ADEDOYIN[3]

[1]Department of Economics, UNIVERSITY OF LAGOS, AKOKA, NIGERIA,
E-mail: nathaniel_solomon21@yahoo.com
[2] Department of Economics and Development Studies, COVENANT UNIVERSITY, NIGERIA,
E-mail: ngozi.adeleye@covenantuniversity.edu.ng
[3]Department of Accounting, Finance and Economics, BOURNEMOUTH UNIVERSITY, UNITED KINGDOM,
E-mail: fadedoyin@bournemouth.ac.uk

ABSTRACT

Apart from being vulnerable to the menace created by climate change, the MENA countries consume more of non-renewable energy despite their resource endowments and great renewable energy potentials. Energy consumption, natural resources and urbanization may add to environmental degradation since ecological distortions mostly emanate from human activities. This study investigates the effects of the aforementioned variables on the ecological footprint (EFP) in MENA countries. The findings confirm the Environmental Kuznets Curve (EKC) hypothesis and further reveal the negative impact of natural resources and economic growth on the environment. Renewable energy and urbanization reduce EFP. The Fully Modified Ordinary Least Squares (FMOLS) and Dynamic Ordinary Least Squares (DOLS) were applied to obtain the country-specific results which reveal that urbanization surge promotes environmental degradation in all the countries except in Algeria, Bahrain, Tunisia, and Morocco were it is not particularly harmful. Natural resource rent increases the EFP in the UAE, Oman, and Lebanon. Further findings suggest a feedback causality between urbanization, economic growth and EFP. Policy directions based on the findings are extensively discussed.

Keywords: Renewable Energy; Ecological Footprint; Natural Resources; Urbanization; MENA.

JEL Classifications: Q45, Q32, Q40.

1. Introduction

The world currently faces many challenges. The core of these challenges relates to sustainable growth/development and environmental preservation. The later have gained lots of attention because the protection of the biodiversity is sacrosanct (Ahmed et al. 2021; Nathaniel and Iheonu 2019; Dogan et al. 2019). Human activities have been recognized as a major threat to environmental preservation, as it contributes to climate change and ecological distortions (Pata 2020; Ahmed et al. 2020b;c; Ulucak and Khan, 2020; Aydin et al. 2019). Questions relating to the existence of climate change are becoming less popular, rather, attention has been shifted to the effects of such 'change' on the environment. The continuous deterioration of the environment by human activities portrays danger for humanity, as it is just a matter of time until the evils associated with climate change becomes irreversible. As such, this study seeks to explore the impact of natural resources, urbanization, renewable energy, and economic growth on the ecological footprint in MENA countries within the EKC framework.

Developing countries, MENA inclusive, are vulnerable to climate change because they lack the capacity to efficiently cope with the problems emanating from it (Nkengfack and Fotio, 2019). Many developing economies have witnessed economic improvements in the current century. However, these improvements are not devoid of environmental pressure. For instance, humanity consumed more than 50% of the earth's biodiversity in 1961 and 44% more than was available in 2006 (Global Footprint Network, 2010). Therefore, to sustainably cater for the need of humanity, the regeneration capacity of 1.6 Earths is currently needed (Ahmed and Wang 2019; Lin et al. 2016).

The consumption of energy has an immense impact on poverty reduction, sectoral development, and economic growth (Kirikkaleli et al., 2020; Udi et al., 2020). Energy contributes to economic accomplishment and serves as a panacea for human needs. Economic growth and urbanization are the chief contributors to the unprecedented increase in energy consumption, especially non-renewable energy (NRE) (Ahmad et al. 2019; Wu et al. 2019). NRE are pollutants. They are finite and contributes to health hazards (Feron et al. 2019; Destek and Sarkodie 2019; Wang and Dong 2019; Ali et al. 2020). The desire to reduce GHGs have informed the call for renewable energy (RE) adoption (Destek and Sinha 2020; Sharif 2020; Ibrahiem 2020; Asongu 2020; Vélez-Henao 2020; Nathaniel et al. 2020a; Ahmed et al. 2020a; Khan et al. 2020). RE is clean (Baloch et al. 2019; Nathaniel 2019) and low in emissions (Nathaniel and Bekun 2020).

As of 2009, MENA has about 60% of the global oil reserves which depleted to about 51% in 2016. The intense consumption of NRE in the region promotes environmental degradation through CO_2 emissions. In 2011, for instance, six MENA countries (Kuwait, Qatar, the UAE, Oman, Bahrain, and Saudi Arabia) were among the world's top twenty emitters (CDIAC, 2011). The over-reliance on crude oil made MENA countries to be vulnerable oil shock. This follows an increase in hydrocarbons consumption, hence an increase in the EFP (World Bank, 2016). About 170million of the region's population resides in urban centres. The UN has projected that MENA's population will hit 430million in 2020, of which 280million will live in urban areas. This shows a 65% increase in urbanization which could have a far-reaching impact on the regions ecological setup.

MENA countries have gained significant economic progress in the past few decades. It is a heterogeneous region with similar challenges which include high unemployment rate, increasing demand for energy, weak research capacity, and inadequate investment in RE (Saidi, et al. 2018). MENA has gained lots of attention because of its resource endowments, RE potentials, and vulnerability to climate change (Gorus & Aslan 2019). Despite its RE potentials and abundant resource endowments, the region still suffers from environmental issues resulting from the continuous consumption of fossil fuels. Policymakers in this region aim to achieve environmental sustainability amidst sustainable development. Sustainable development, energy consumption and environmental quality are interconnected. Therefore, sustainable development requires the adoption of environment-friendly energy. This will require a transition from the consumption of fossil fuels to renewables which is a core tenet of the SDGs 9.

Economic growth has persisted in MENA countries. The Gross Domestic Product (GDP) of MENA countries rose from US$4,973.38b to US$7,809.72b between 1990 and 2016, with 6.9% growth rate in 2016 (World Bank, 2018). This growth has informed an increase in energy demand in the region. Economic growth/expansion drives industrialization which in turn promotes natural resource extraction. An increase in the consumption of natural resources (NRR), through deforestation, mining, industrialization, and agriculture can deteriorate the environment (Danish et al. 2019a). The extraction and exploitation of NRR give rise to income increase while decreasing biocapacity and increasing the EFP.

Of recent, EFP has gained attention as an adequate measure for environmental quality (Danish et al. 2019b). Recent studies (like Mikayilov et al. 2019; Destek & Sarkodie 2019) have used the EFP for this purpose. If the inculcation of efficient environmental management practices into consumption and production activities declines NRR depletion, thereby allowing resources to regenerate. However, production activities in MENA countries are driven by NRE sources. The energy consumed in MENA is dominated by fossil fuels because of its abundance. On the flip side, RE is sustainable and low in emissions. Though, urbanization can also create positive externalities, public service provision, and economies of scale. Urbanization can improve the income of people living in urban centres. This income increase will drive their demand for RE, resulting in EFP decrease.

The contributions of this study are hydra-headed. (i) This is the first study to investigate the determinants of EFP in MENA countries while accounting for natural resource rent, urbanization, and RE. (ii) Potential factors like RE and natural resource rent are included in the pre-determined model of EFP and income. These factors would provide insight and expose the contributions of NRR earning of the MENA region to their pollution drive and policy. The mitigation of climate change is the lead policy agenda in the MENA region. The need to provide a guideline to achieving mitigation targets makes this study which examined the drivers to attaining SDGs by 2030 in terms of reducing the EFP in MENA countries to be sacrosanct. (iii) We adopt estimation techniques (mainly second-generation) which are reliable and robust for cross-sectional dependence (CSD), endogeneity, heterogeneity, autocorrelation, and heteroscedasticity issues. The findings revealed that economic growth and NRR contribute to environmental deterioration, while RE and urbanization enhance environmental quality by decreasing the EFP.

The current study is organized as follows: section 2 delivers the literature review. The methodology, model and data are presented in section 3. Section 4 discusses the results. Section 5 presents the conclusion along with policy directions.

2. Literature Review

Energy consumption may lead to environmental degradation, although increased consumption of RE contributes to mitigating environmental deterioration while the consumption of energies that are NRE, contributes to CO_2 emissions (Murshed & Dao 2020; Khan et al. 2020; Murshed et al. 2020a;b Destek & Sinha 2020; Wang et al. 2019; Murshed 2020a;b). However, how abundant the NRR is may affect environmental sustainability and contribute to environmental degradation. This is because, during exploration and extraction of natural resources, emission of greenhouse gases may occur which may affect the environment. Also, Urbanization which leads to trade openness, tourism and inter-nation dependence may be good for economic development and growth. Cities go through a number of environmental challenges as they develop, this may be due to emission of greenhouse gases which contributes to environmental degradation. However, in order to reduce the adverse effect of urbanization, activities should be located closer to each other so as to ensure better access to services. Meanwhile, ecological modernization requires that there is environmental re-adaptation of the developments in the industrial developments and economic growth. This will mean economic development, industrial development and the growth of the economy.

2.1. Impact of Energy Consumption on the Ecological Footprint

Energy consumption has become an issue of necessity for the economic development of nations; however nonrenewable energies have been known to contribute immensely to the environmental degradation of countries. Therefore, more relevance should be placed on RE sources in the energy mix so as to encourage and support the use of RE and clean technologies. This requires that when considering energy sources, RE sources such as wind, solar, biomass should be adopted in the energy mix of MENA countries, this will lead to the reduction in the emission of greenhouse gases that may deplete the environment. Furthermore, the pattern of energy consumption and the path economic development takes have begun to be in line with the environmental policies of countries (Ozcan et al., 2020).

There exists a two-way causality link between energy consumption and CO_2 emission, suggesting that the former may drive the later and CO_2 emission increases (Al-Mulali and Ozturk, 2015). This has made it necessary to ensure that energy consumption policies and economic development policies are made to promote the sustainability of the environment. Energy consumption, GDP, urbanization, and trade openness increase air pollution both in the short and long run (Al-Mulali et al., 2016). Also, RE can help enhance environmental quality (Bélaïd and Youssef, 2017). Countries should focus more on energy consumption from RE and NRE sources for an increased level of income. It is important for countries like France, Canada, Japan, England and the US to invest in techniques that inculcate renewables (Tugcu et al., 2012). It should be noted that the result as to whether there exists a relationship between them differs by country, while some studies attach economic growth to energy consumption, other studies such as Tugcu et al., (2012) and Destek and Aslan (2017) concluded that neither RE nor NRE necessarily adds to economic growth.

2.2. Impact of Urbanization on Ecological Footprint

Urbanization is usually as a result of globalization. This is because as trade increases, tourism grows, industrialization sets in, and the more the population moves towards urbanization. However, environmental sustainability is usually threatened as urbanization grows this is because industrial activities increases and greenhouse gases such as carbon dioxide is released into the atmosphere. Khan et al., (2019) discovered that financial development, urbanization, energy consumption, and globalization are determinants of CO_2 emissions in Pakistan, while innovation, FDI, and trade mitigate CO_2 emissions. Also, urbanization is a key factor driving energy consumption. Although its contribution to energy consumption may vary among income countries, (Wang et al., 2019).

Furthermore, in order to reduce climate change and its impact on the environment, the quality of governance plays an important role in the economic and social readiness, (Sarkodie and Adams, 2018). However, in order to ensure that urbanization positively affects the environment and its effect on the economy is significant, RE should be adopted in industrial activities. Also, the direction of the causality between RE and economic growth depends on the market conditions of the countries (Wadström et al., 2019). Energy consumption, which is imperative for industrial activities, real income/output, as well as the level of globalization, plays a significant role in ensuring the sustainability of the environment (Akadiri et al., 2018).

2.3. Impact of Economic Growth on the Ecological Footprint

The aim of any nation will be to achieve environmentally sustainable economic growth, this is because economic development as much as economic growth is important, environmental sustainability is imperative. The environmental performance level is contributed to by economic growth and pattern of energy consumption (Ozcan et al., 2020). Economic growth promotes the sustainability of the environment when there is a shift away from the NRE consumption that may cause CO_2 emissions which may lead to environmental degradation. Electricity consumption causes economic growth (Adom, 2011). There exists a significant relationship between RE and NRE generation and economic growth (Atems & Hotaling, 2018). Promoting renewable energies contributes not only

to the environment but also to the economy (Ozcan et al. 2020; Ahmed & Le 2020). The consumption of NRE increases EFP (Destek and Sarkodie, 2019). Many studies have looked at the relationship that exists between energy consumption, urbanization and environmental sustainability, and how economic growth. This study, however, looks at how natural resources abundance, RE and urbanization affect environmental sustainability in MENA countries. Also, according to Acheampong (2018), economic growth does not exacerbate energy consumption. For most countries, economic growth has no causal impact on carbon emissions. Carbon emission positively causes economic growth. This is however contrary to findings from other researches on the relationship.

3. Data and Methodology

3.1. Data

To explore the linkage between urbanization, RE, natural resources, economic growth, and EFP, we utilized annual data from 1990-2016 for 13 MENA countries. The time period for the study was informed by data availability. Data on EFP ends in 2016, while the data on RE starts from 1990. See Table 1 on the source and measurements of the variables.

Table 1: Data Source and Measurement

S/N	Indicator Name	Measurement	Source
1	Urbanization	percentage of total population	WDI (2019)
2	Natural Resource Rent	% of GDP	WDI (2019)
3	GDP Per Capita	in constant 2010 USD	WDI (2019)
4	Renewable Energy	% of total energy consumption	WDI (2019)
5	Ecological Footprint	global hectares per capita	Global Footprint Network (2019)

Sources: Authors' compilation.

Our measure of environmental degradation (EFP) is made up of grazing land, forest land, ocean, carbon footprint, cropland, and built-up land). The EFP is also used to juxtapose between a nation's wealth and how much of it they have consumed. Environmental wellness, evaluation, sustainability, resources management could all be assessed through the EFP. All these and other features make the EFP far more superior to CO_2 emissions.

3.2. Method

The econometric procedure of this study begins with the CSD test. The CSD test will serve as a guide for other procedures. Ignoring CSD will result in biased estimates and estimator inefficiency. The null hypothesis of the test is given as:

$$H_0: \rho_{ij} = corr(\mu_{it}, \mu_{jt}) = 0 \ \forall \ i \neq j \tag{1}$$

Where ρ_{ij} represents the pairwise correlation coefficient of the disturbance term. The existence of CSD may render the conventional unit root tests invalid and therefore misleading. The study focused on unit root tests that account for CSD. We used the Cross-sectional augmented Im-Pesaran-Shin (CIPS) test to achieve this purpose. See Eq. 2 for the test equation.

$$\Delta y_{it} = \varphi_i + \beta_i y_{i,t-1} + \tau_i \bar{y}_{t-1} + d_i \Delta \bar{y}_t + \varepsilon_{it} \tag{2}$$

The Prais-Winsten regression model with panel-corrected standard errors (PCSE), which is robust for CSD, was used to show the interactions among the variables. The PCSE was further preferred to the feasible generalized least squares (FGLS) method because the later yields incorrect standard errors, while the PCSE is robust amidst heteroskedastic and serial correlation. Since we used 27 annual observations for 13 MENA countries, we corrected for first-order autocorrelation, AR(1), within panels. We also controlled for time-specific and country-specific disturbances by estimating the model through a two-way fixed effect technique. The model takes the form:

$$Y_{it} = \varphi X_{it} + \mu_i + \varepsilon_t + e_{it} \qquad (3)$$

Where Y_{it} is the dependent variable, while φX_{it} is the independent variable for each country which varies over time. μ_i and ε_t are the country-specific and time-specific disturbance terms respectively. The unique disturbance term is represented as e_{it}. For robustness, the FMOLS proposed by Pedroni (2000) and the DOLS suggested by Mark and Sul (2001) and Kao and Chiang (2000) were used. The DOLS is estimated using Eq 4. which is given as:

$$\begin{aligned}
EFP_{it} = \mu_i + x_{i,t}\Psi_{i,t} + &\sum_{j=-p}^{p} \beta_j EFP_{i.t-j} + \sum_{j=-q0}^{q0} p_{1.j} NRR_{i.t-j} + p_{2.j} \sum_{j=-q1}^{q1} GDP_{i.t-j} \\
&+ p_{3.j} \sum_{j=-q2}^{q2} GDPsq_{i.t-j} + p_{4.j} \sum_{j=-q3}^{q3} URB_{i.t-j} + p_{5.j} \sum_{j=-q4}^{q4} RE_{i.t-j} + \varepsilon_{it}
\end{aligned} \qquad (4)$$

p and q are the number of leads/lags. Where EFP, NRR, GDP, GDPsq, URB, and RE stand for ecological footprint, natural resource rent, Gross Domestic Product, the square of GDP, urbanization, and renewable energy respectively.

The long-run relationship is estimated from the FMOLS equation given as:

$$EFP = \mu_i + x_{i.t}\psi + v_{it} \qquad (5)$$

$$x_{i.t} = x_{i.t} + \mathfrak{C}_{i.t}$$

Where x is 5*1 vector of explanatory variables, μ_i is the intercept while $\mathfrak{C}_{i.t}$ and v_{it} are the error terms. However, the estimation of ψ is expressed as:

$$\begin{aligned}
\hat{\psi}_{FMOLS} = &\left(\sum_{i=1}^{N} \sum_{t=1}^{T} (x_{i.t} - \bar{x}_{i.t}) * (x_{i.t} - \bar{x}_{i.t})' \right)^{-1} \\
&* \left(\sum_{i=1}^{N} \left(\sum_{t=1}^{T} (x_{i.t} - \bar{x}_{i.t}) * \widehat{EFP}_{it} - T\hat{\Delta}_{v\mathfrak{C}} \right) \right)
\end{aligned} \qquad (6)$$

The DOLS and FMOLS provide robust estimates amidst endogeneity.

4. Results and Discuss of Findings

Table 2: Descriptive Statistic and Correlation

	EFP	GDP	GDPsq	RE	NRR	URB
Mean	50526	12694	4.580	9.615	12.482	63.137
Median	30020	4181.4	17485	2.1671	5.9623	64.393
Maximum	2.620	70298	4.940	85.628	64.149	90.506
Minimum	41571	765.60	58614	0.0000	0.0000	20.931
Std. D.	55203	17259	1.010	19.081	14.788	19.214
Correlation						
EFP	1					
GDP	-0.1303	1				
GDPsq	-0.0907	0.9586	1			
RE	0.0034	0.2710	-0.1844	1		
NRR	0.2819	0.0589	0.0248	-0.2259	1	
URB	-0.1875	0.3825	0.2497	-0.5004	-0.0758	1

Source: Authors' Computation.

The descriptive statistic and correlation results are reported in Table 2. NRR is the least volatile. RE is also less volatile than URB, and GDP, but EFP is less volatile than GDPsq. All variables except RE and

NRR have a negative association with EFP, while NRR and URB are positively associated with GDP. This, however, does not suggest causation.

When dealing with a sample of countries that are spatially close, the data may be suffering from cross-dependence which if not dealt with may lead to wrong inferences. Therefore, to establish if this problem exists and to adequately control for it, the data is tested with a battery of techniques. The outcomes shown in Table 3 indicate the tenacity of the problem. The significance of the test statistics across the three specifications confirms CSD. Therefore, techniques that control and corrects for CSD are deployed in subsequent analysis.

Table 3: Cross-sectional Dependence Test

Variables	Breusch-Pagan LM	Pesaran scaled LM	Pesaran CD
Ecological Footprint (log)	1501.454***	113.9675***	35.08649***
GDP (log)	1089.012***	80.94575***	20.03653***
GDP squared (log)	1088.494***	80.90426***	19.95165***
Urbanization (log)	1562.966***	118.8925***	33.1762***
Natural Resources (log)	550.5551***	37.83469***	13.11325***
Renewable Energy (log)	364.0479***	29.46656***	2.003187**

Note: *** and ** imply statistical significance at the 1% and 5% levels respectively.
Source: Authors' Computations

Having ascertained the presence of CSD, the Pesaran (2007) and augmented Dickey-Fuller panel unit root tests which control for CSD are used. The findings from these tests abbreviated as CIPS and CADF are shown in Table 4.

Table 4: Panel Unit Root Tests

Variables	Level		First Difference	
	CIPS	CADF	CIPS	CADF
Ecological Footprint (log)	0.98718	22.693	-9.84816***	141.783***
GDP (log)	1.77425	18.8763	-4.59348***	67.9005***
GDP squared (log)	1.94947	18.2182	-4.5585***	67.155***
Urbanization (log)	0.08769	45.7235	-2.65272***	57.5896***
Natural Resources (log)	-0.24968	27.1463	-8.37345***	120.723***
Renewable Energy (log)	2.20956	14.8987	-7.10036***	93.7697***

Note: *** implies statistical significance at the 1% level; CIPS: Cross-sectional Im, Pesaran and Shin; CADF: Cross-sectional Augmented Dickey-Fuller
Source: Authors' Computations

With the outcome of the stationarity tests (I(1)), analysing long-run associations begin by establishing whether the variables move together in the long-run. This is validated from the results of the cointegration analyses using both Kao and Chiang (1999) and Pedroni (1999) techniques. The cointegration regression is performed on two different specifications: (1) with intercept and (2) without cross-sectional means. The outcomes shown in Table 5 confirm that the null hypotheses of no co-integration is rejected at different statistical significance levels ranging from 1% to 10%.

In the event that there exist panel-level heteroskedasticity and correlation across the panels, estimations from the panel-correlated standard errors (PCSE) technique which also corrects for cross-sectional dependence and heteroskedasticity are performed based on three different expectations of the form of autocorrelation: (1) no autocorrelation, (2) common autocorrelation of $AR(1)$ process, and (3) panel-specific autocorrelation of $AR(1)$ process. The findings which are mostly consistent across the three specifications are shown in Table 6.

Table 5: Panel Cointegration Results

Cointegration Tests		Intercept	No Cross-Sectional Means
Kao (1999)	Modified Dickey-Fuller	1.3316*	-2.0473**
	Dickey-Fuller	0.853	-1.6257*
	Augmented Dickey-Fuller	2.7297***	0.523
	Unadjusted modified Dickey-Fuller	-0.9287	-3.146***
	Unadjusted Dickey-Fuller	-1.1221	-2.1133**
Pedroni (1999, 2004)	Modified Phillips-Perron	0.4002	1.1822
	Phillips-Perron	-4.7165***	-3.7415***
	Augmented Dickey-Fuller	-4.3826***	-3.7496***

Note: Tests performed using 2 lags. ***, ** and * represent significance at the 1%, 5% and 10% levels, respectively.
Source: Authors' Computations

The EKC hypothesis is evident in the data given the positive (negative) and statistically significant coefficient of GDP (GDP squared). Both relationships are significant at the 1% level across the three specifications. The outcome suggests that at the initial stages of economic growth, environmental degradation increases but as the economy grows and per capita income improves such that people resort to using efficient alternative energy sources, the contribution to the EFP declines. In essence, environmental degradation slows. This outcome is supported by Danish et al. (2019a) and Nathaniel (2020). Contradicting findings on the EKC hypothesis across similar studies is not unconnected to different econometric techniques deployed and the study scope under survey.

Table 6: Panel-Corrected Standard Errors Results

Variables	No Autocorrelation	AR(1) Process	Panel AR(1) Process
Constant	-0.0977	4.2617	9.8967***
	(-0.03)	(1.28)	(3.11)
GDP (log)	4.5426***	3.7461***	2.5621***
	(5.18)	(4.44)	(3.30)
GDP squared (log)	-0.2265***	-0.1920***	-0.1291***
	(-4.88)	(-4.29)	(-3.13)
Urbanization (log)	-1.1305***	-1.1011***	-1.1685***
	(-5.07)	(-3.99)	(-4.82)
Natural Resources (log)	0.1579***	0.0450***	0.0543***
	(10.39)	(3.01)	(3.94)
Renewable Energy (log)	-0.1521***	-0.0238	-0.0704**
	(4.31)	(-0.68)	(-2.13)
No. of Observations	281	281	281
R-Squared	0.365	0.984	0.991
Wald Statistic	215.33***	42.66***	88.05***

Note: ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively; t-statistics are in parentheses.
Source: Authors' Computations

Across the three specifications, the negative coefficients of urbanization show its positive impact on reducing the EFP. It indicates that a percentage change in urban expansion yields a more than a percentage decline in the EFP thereby contributing to a cleaner environment. This finding gives credence to the supposition that increases in the purchasing power of urban dwellers leads to more demand for clean and alternative energy which reduces environmental pollution (Charfeddine et al. 2018; Ozturk et al., 2016) but contradicts Nathaniel et al., (2019) who discovered that urbanization has the most devastating impact on the EFP. Other studies that have reported the horrendous effects of

urbanization on the EFP include: Nathaniel et al. (2020) for CIVETS, and Wang and Dong (2019) for 14 SSA.

The coefficient of NRR is significant across the three specifications. It supports the argument that increasing NRR depletion worsens the environment. Studies like Hassan et al., (2019) and Danish et al. (2019c) noted that increasing the extraction of NRR expedites the EFP. This is because economic growth spurs the need for natural resource extraction which contributes to environmental degradation (Danish et al., 2019a). MENA countries most rely on their natural endowment. The region has more than sixty per cent of the world's oil reserves (USDOE 2011). The exploitation of natural resources drives environmental degradation and reduces biodiversity. For instance, Bahrain, Saudi Arabia, UAE, Oman, Kuwait, and Qatar were among the world's top 20 emitters in 2011 (CDIAC, 2011).

Table 7: Robustness DOLS and FMOLS Results

Variables	DOLS	FMOLS
GDP (log)	5.073*** (6.281)	1.544** (2.438)
GDP squared (log)	-0.264*** (-6.257)	-0.081** (-2.369)
Urbanization (log)	2.246*** (3.556)	2.759*** (9.292)
Natural Resources (log)	0.085*** (3.409)	0.008 (0.481)
Renewable Energy (log)	0.057 (0.623)	0.011 (0.163)

Notes: ***, ** and * represent statistical significance at the 1%, 5% and 10% levels, respectively; fixed leads and lags (1,1) for DOLS analysis.
Source: Authors' Computations

Our findings on the impact of RE is somewhat inconsistent. The negative and statistically significant coefficient when no autocorrelation is assumed indicates that RE abates environmental degradation. Similar findings to (Danish et al. 2019c; Bello et al., 2018; Alola et al., 2019; Wang and Dong, 2019) on the contributory impact of RE to the environment is obtained when panel-specific autocorrelation is assumed and the coefficient is negative. To test the robustness of our results, the dynamic and fully modified ordinary least squares techniques which control for possible autocorrelation and endogeneity of the variables are used. The findings shown in Table 7 are very similar and consistent with those of Table 6. For instance, both findings on the EKC hypothesis and natural resource are sustained and previous interpretations hold. Contrarily, the impact of urbanization on the EFP is reversed. The plausible argument for the aggravating impact of urbanization is that urban surge increases fossil fuel consumption thereby increasing the EFP (Danish and Wang 2019). In essence, the overall impact of urbanization on the EFP is uncertain in MENA.

Table 8: Dumitrescu & Hurlin Causality Results

Null Hypothesis:	W-Stat.	Zbar-Stat.	Prob.	Conclusion
GDP ≠> EFP	3.66863	2.09903	0.0358	Bidirectional causality
EFP ≠> GDP	6.79775	6.64003	3.00E-11	
URB ≠> EFP	4.63851	3.50654	0.0005	Bidirectional causality
EFP ≠> URB	9.28165	10.2447	0.0000	
NRR ≠> EFP	2.21035	-0.01723	0.9863	Unidirectional causality
EFP ≠> NRR	4.58583	3.43008	0.0006	
URB ≠> GDP	5.14445	4.24075	2.00E-05	Bidirectional causality
GDP ≠> URB	8.10143	8.53195	0.0000	
NRR ≠> GDP	3.65749	2.08286	0.0373	Bidirectional causality
GDP ≠> NRR	4.3347	3.06564	0.0022	
NRR ≠> URB	2.43982	0.31578	0.7522	Unidirectional causality
URB ≠> NRR	5.68574	5.02628	5.00E-07	

Note: GDP = gross domestic product; EFP = ecological footprint; URB = urbanization; NRR = natural resources. Renewable energy is excluded due to missing data in some of the cross-sections.
Source: Authors' Computations

We finalize our analysis by testing for causal relationships between/among the variables using the Dumitrescu-Hurlin (DH) (2012) non-Granger causality approach. As indicated in Table 8, there exist bi-causal relationships between GDP/EFP, URB/EFP, URB/GDP and NRR/GDP while uni-causal relationships exist between NRR/EFP, and NRR/URB. The outcomes of these causal analyses give support to the choice of variables used in this study.

The results from Table 9 (FMOLS) confirm the EKC hypothesis for Bahrain, Iran, Israel, Jordan, Morocco, Sudan, Tunisia, Yemen, and the UAE. RE mitigates environmental deterioration in all the countries except in Iran. However, the abating role of RE appears not to be significant in most of the countries. Urbanization surge promotes environmental degradation in all the countries except in Algeria, Bahrain, Tunisia, and Morocco were it is not particularly harmful. NRR adds to the EFP in the UAE, Oman, and Lebanon. The UAE is one of the highest exporters of crude oil in the world. Our result strongly suggest that the exploitation of NRR in the UAE declines environmental quality. Studies like (El Gawad et al. 2008; Rawazik and Carroll 2009) have all confirmed the devastating influence of NRR on the environment in the UAE, while Soto and Haouas (2012) believed that the UAE must have outlived the NRR curse by making the benefits from NRR exploitation supersede its negative impacts. Lebanon is rich in natural gas, salt, gypsum, limestone, oil, iron ore, etc. Though, most of these resources are for local consumption, its exploitations have done no good to the environment. Earthquakes, sandstorms, deforestation, and dust storms in Lebanon have been attributed to the incessant exploitation of the countries NRR. Some of these results are further confirmed in the DOLS estimation.

5. Conclusion and Policy Direction

The study examined the effects of natural resource, renewable energy, and urbanization on the EFP in MENA countries from 1990 to 2016 within the EKC framework. With the evidence of CSD, we applied econometrics techniques that suit the characteristics of the dataset, and also yield robust estimates. A bidirectional causality was discovered between GDP and EFP, URB and EFP, URB and GDP, and GDP and natural resources, while a one-way causality flows from URB to natural resources and from NRR to EFP. Further findings from the results confirmed the EKC hypothesis for MENA. Economic growth and NRR drive environmental degradation by increasing EFP, while the overall impact of RE consumption and urbanization on environmental quality is uncertain.

The findings suggest the need for MENA countries to improve basic amenities, household income, infrastructural facilities etc. since increase in urbanization mainly emanates from discrepancies in development factors. Economic growth in MENA have encouraged the movement of economic activities to the urban centres resulting in rural-urban drift. An improvement in basic facilities that will improve the quality of life in the rural areas will help mitigate the upsurge in urbanization. The creation of smart cities will be a good step in the right direction. Smart cities encourage the efficient performance and quality of urban services including transportation, energy, etc. to attain environmental sustainability, innovation and efficiency.

Also, since the consumption of NRE is detrimental to the environment, policymakers need to adjust their energy portfolio and intensify the consumption of RE sources like hydropower, wind, tide, solar, etc. RE are clean, unlike fossil fuels (the major energy source in MENA) that degrades the environment. An aggressive investment in these energy sources will enhance environmental quality, ensure the safety of life, promote economic growth, and expedite the achievement of the SDGs by 2030. The transition from NRE to RE sources have not been smooth in MENA countries due to low income, low level of environmental awareness, and high cost of renewables. The provision of subsidized loans, tax rebates and holiday and low interest rate could act as a temporal palliative to the household. The government can also provide incentives to encourage industries to embark on clean production while heavily taxing the dirtier ones.

Table 9: Country-Specific FMOLS and DOLS Results

	FMOLS												
	Algeria	Bahrain	Egypt	Iran	Israel	Jordan	Lebanon	Morocco	Oman	Sudan	Tunisia	UAE	Yemen
	lefp	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*
lngdp	-40.29 [a]	1219.9 [a]	-2.457	88.10 [a]	5.170 [b]	44.98 [c]	-7.528 [c]	10.46 [a]	-108.9	39.71 [a]	4.872 [c]	56.81 [a]	17.34
	(-4.63)	(176.58)	(-1.24)	(8.15)	(3.08)	(1.97)	(-2.02)	(4.01)	(-0.63)	(3.94)	(2.08)	(6.02)	(1.80)
lgdp2	2.522 [a]	-61.19 [a]	0.225	-5.028 [a]	-0.248 [b]	-2.746	0.439 [c]	-0.580 [a]	5.661	-2.855 [a]	-0.215	-2.679 [a]	-1.198
	(4.77)	(-176.10)	(1.72)	(-8.12)	(-3.23)	(-1.94)	(2.07)	(-3.48)	(0.64)	(-4.15)	(-1.51)	(-6.07)	(-1.74)
lre	-0.062 [a]	-0.124	-0.360 [a]	0.009	-0.143 [a]	-0.163	-0.233 [a]	-0.075	-0.546	-1.080	-0.302 [b]	-0.284 [a]	-0.209
	(-4.10)	(-1.23)	(-3.45)	(1.02)	(-3.58)	(-0.86)	(-10.95)	(-1.45)	(-0.34)	(-1.73)	(-2.97)	(-6.35)	(-1.84)
lurb	1.236 [a]	84.51 [a]	-9.853 [a]	1.511 [a]	10.24 [a]	4.184 [a]	10.43 [a]	-1.188 [b]	9.988 [a]	4.201 [c]	-2.717 [a]	6.466 [a]	1.606 [a]
	(8.15)	(10.97)	(-6.52)	(13.15)	(7.16)	(5.28)	(12.64)	(-2.81)	(10.53)	(2.47)	(-3.44)	(7.59)	(10.68)
lnrr	-0.043	0.237 [b]	0.047 [a]	-0.027	-0.005	-0.030	0.045 [a]	-0.018	0.550 [b]	-0.002	-0.041 [b]	0.105 [b]	-0.054
	(-1.80)	(2.93)	(3.48)	(-1.60)	(-1.17)	(-1.48)	(4.58)	(-1.52)	(2.73)	(-0.11)	(-2.63)	(3.03)	(-1.54)
Const.	173.5 [a]	-6442.7	61.91 [a]	-372.9 [a]	-51.35 [a]	-186.2 [c]	2.906	-23.59 [c]	494.8	-129.9 [a]	3.571	-312.5 [a]	-51.16
	(4.84)	(6.34)	(5.60)	(-7.91)	(-8.56)	(-2.08)	(0.18)	(-2.40)	(0.59)	(-3.49)	(0.41)	(-6.54)	(-1.53)

t statistics in parentheses; =" [c] p<0.05, [b] p<0.01, [a] p<0.001"

	DOLS												
	Algeria	Bahrain	Egypt	Iran	Israel	Jordan	Lebanon	Morocco	Oman	Sudan	Tunisia	UAE	Yemen
	lefp	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*	*lefp*
lgdp	-52.89 [b]	399.5	-2.208	69.39 [a]	5.319	36.26	-1.301	12.70 [c]	-145.8	36.71	5.105	53.55 [a]	13.28
	(-2.66)	(1.56)	(-0.49)	(3.69)	(0.95)	(1.42)	(-0.70)	(2.05)	(-0.87)	(1.62)	(0.64)	(3.76)	(1.27)
lgdp2	3.279 [b]	-20.05	0.210	-3.958 [a]	-0.256	-2.203	0.085	-0.734	7.535	-2.647	-0.214	-2.526 [a]	-0.908
	(2.70)	(-1.56)	(0.71)	(-3.67)	(-1.00)	(-1.39)	(0.79)	(-1.87)	(0.88)	(-1.72)	(-0.44)	(-3.79)	(-1.22)
lre	-0.029	-0.453	-0.336	0.016	-0.155	-0.301	-0.222 [a]	-0.087	-0.452	-1.098	-0.335	-0.261 [a]	-0.189
	(-0.91)	(-1.56)	(-1.43)	(0.51)	(-1.19)	(-1.47)	(-7.74)	(-0.68)	(-1.65)	(-0.74)	(-0.98)	(-4.61)	(-1.61)
lurb	1.632 [a]	85.48 [a]	-9.382 [b]	1.477 [a]	10.86 [c]	4.284 [a]	9.958 [a]	-0.588	10.79 [a]	2.933	-4.118	6.751 [a]	1.577 [a]
	(5.10)	(3.94)	(-2.92)	(3.73)	(2.38)	(5.15)	(9.16)	(-0.63)	(10.37)	(0.88)	(-1.70)	(4.95)	(9.56)
lnrr	-0.068	0.351	0.045	-0.044	-0.007	-0.026	0.046 [a]	-0.020	0.465 [c]	0.008	-0.046	0.106	-0.040
	(-1.18)	(1.57)	(1.51)	(-0.84)	(-0.49)	(-1.16)	(3.38)	(-0.71)	(2.28)	(0.18)	(-0.88)	(1.89)	(-1.05)
_cons	224.4 [b]	-2357.8	59.07 [c]	-290.9 [a]	-54.57 [b]	-151.4	-22.42 [c]	-34.03	673.6	-114.6	7.555	-296.4 [a]	-36.90
	(2.72)	(-1.90)	(2.39)	(-3.62)	(-2.79)	(-1.51)	(-2.03)	(-1.49)	(0.83)	(-1.42)	(0.26)	(-4.12)	(-1.02)

t statistics in parentheses; =" cp<0.05, bp<0.01, ap<0.001"

Source: Authors' Computations

Referencias

1. Acheampong, A. O. (2018). Economic growth, CO2 emissions and energy consumption: what causes what and where?. *Energy Economics*, *74*, 677-692.
2. Adom, P. K. (2011). Electricity consumption-economic growth nexus: the Ghanaian case. International Journal of Energy Economics and Policy, 1(1), 18-31.
3. Ahmad, M., Zhao, Z. Y., & Li, H. (2019). Revealing stylized empirical interactions among construction sector, urbanization, energy consumption, economic growth and CO2 emissions in China. Science of the Total Environment, 657, 1085-1098.
4. Ahmed, Z., & Le, H. P. (2020). Linking Information Communication Technology, trade globalization index, and CO 2 emissions: evidence from advanced panel techniques. Environmental Science and Pollution Research, 1-12.
5. Ahmed, Z., & Wang, Z. (2019). Investigating the impact of human capital on the ecological footprint in India: An empirical analysis. Environmental Science and Pollution Research, 26(26), 26782-26796.
6. Ahmed, Z., Ali, S., Saud, S., & Shahzad, S. J. H. (2020c). Transport CO 2 emissions, drivers, and mitigation: an empirical investigation in India. Air Quality, Atmosphere & Health, 1-8.
7. Ahmed, Z., Asghar, M. M., Malik, M. N., & Nawaz, K. (2020b). Moving towards a sustainable environment: The dynamic linkage between natural resources, human capital, urbanization, economic growth, and ecological footprint in China. Resources Policy, 67, 101677.
8. Ahmed, Z., Zafar, M. W., & Ali, S. (2020a). Linking urbanization, human capital, and the ecological footprint in G7 countries: An empirical analysis. Sustainable Cities and Society, 102064.
9. Ahmed, Z., Zhang, B., & Cary, M. (2021). Linking economic globalization, economic growth, financial development, and ecological footprint: Evidence from symmetric and asymmetric ARDL. Ecological Indicators, 121, 107060.
10. Akadiri, S. S., Lasisi, T. T., Uzuner, G., & Akadiri, A. C. (2020). Examining the causal impacts of tourism, globalization, economic growth and carbon emissions in tourism island territories: bootstrap panel Granger causality analysis. Current Issues in Tourism, 23(4), 470-484.
11. Ali, H. S., Nathaniel, S. P., Uzuner, G., Bekun, F. V., & Sarkodie, S. A. (2020). Trivariate modelling of the nexus between electricity consumption, urbanization and economic growth in Nigeria: Fresh insights from Maki Cointegration and causality tests. Heliyon, 6(2), e03400.
12. Al-Mulali, U., & Ozturk, I. (2015). The effect of energy consumption, urbanization, trade openness, industrial output, and the political stability on the environmental degradation in the MENA (Middle East and North African) region. Energy, 84, 382-389.
13. Al-Mulali, U., Solarin, S. A., & Ozturk, I. (2016). Investigating the presence of the environmental Kuznets curve (EKC) hypothesis in Kenya: an autoregressive distributed lag (ARDL) approach. Natural Hazards, 80(3), 1729–1747.
14. Alola, A. A., Bekun, F. V., & Sarkodie, S. A. (2019). Dynamic impact of trade policy, economic growth, fertility rate, renewable and non-renewable energy consumption on ecological footprint in Europe. Science of The Total Environment.
15. Asongu, S. A., Agboola, M. O., Alola, A. A., & Bekun, F. V. (2020). The criticality of growth, urbanization, electricity and fossil fuel consumption to environment sustainability in Africa. Science of The Total Environment, 136376.
16. Atems, B., & Hotaling, C. (2018). The effect of renewable and nonrenewable electricity generation on economic growth. Energy Policy, 112(October 2017), 111–118.
17. Aydin, C., Esen, Ö., & Aydin, R. (2019). Is the ecological footprint related to the Kuznets curve a real process or rationalizing the ecological consequences of the affluence? Evidence from PSTR approach. Ecological indicators, 98, 543-555.
18. Baloch, M. A., Mahmood, N., & Zhang, J. W. (2019). Effect of natural resources, renewable energy and economic development on CO2 emissions in BRICS countries. Science of The Total Environment, 678, 632-638.

19. Bélaïd, F., & Youssef, M. (2017). Environmental degradation, renewable and non-renewable electricity consumption, and economic growth: Assessing the evidence from Algeria. Energy Policy, 102(July 2016), 277–287.

20. Bello, M.O., Solarin, S. A., & Yen, Y. Y. (2018). The impact of electricity consumption on CO2 emission, carbon footprint, water footprint and ecological footprint: The role of hydropower in an emerging economy. Journal of Environmental Management, 219, 218–230.

21. BP. (2018). BP Statistical Review of World Energy, 1–56. https://doi.org/⟨http://www.bp.com/en/global/corporate/energy-economics/statistical-reviewof-world-energy/downloads.html ⟩

22. Carbon Dioxide Information Analysis Center (CDIAC) (2011) Ranking of the world's countries by 2011 per capita fossil-fuel CO2 emission rates. Research Institute for Environment, Energy and Economics. http://cdiac.ornl.gov/trends /emis/top2011.cap. Accessed Jan 2018.

23. Charfeddine, L., Al-malk, A. Y., & Al, K. (2018). Is it possible to improve environmental quality without reducing economic growth: Evidence from the Qatar economy. Renewable and Sustainable Energy Reviews, 82(July 2017), 25–39.

24. Danish & Wang, Z. (2019) Investigation of the ecological footprints driving factors: What we learn from the experience of emerging economies. Sustainable Cities and Society, 101626.

25. Danish, Baloch, M. A., Mahmood, N., & Zhang, J. W. (2019c). Effect of natural resources, renewable energy and economic development on CO 2 emissions in BRICS countries. Science of the Total Environment, 678, 632–638.

26. Danish, Hassan, S. T., Baloch, M. A., Mehmood, N., & Zhang, J. (2019b). Linking economic growth and ecological footprint through human capital and biocapacity. Sustainable Cities and Society, 101516.

27. Danish, Ulucak R, Khan SU-Din (2019a) Determinants of the ecological footprint: Role of renewable energy, natural resources, and urbanization, Sustainable Cities and Society (2019)

28. Danish, Z., & Wang, Z. (2019). Investigation of the ecological footprint's driving factors: What we learn from the experience of emerging economies. Sustainable Cities and Society, 49.

29. Destek, M. A., & Aslan, A. (2017). Renewable and non-renewable energy consumption and economic growth in emerging economies: Evidence from bootstrap panel causality. Renewable Energy, 111, 757–763. Destek, M. A., & Sarkodie, S. A. (2019). Investigation of environmental Kuznets curve for ecological footprint: the role of energy and financial development. Science of the Total Environment, 650, 2483-2489.

30. Destek, M. A., & 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. Journal of Cleaner Production, 242, 118537.

31. Dogan, E., Taspinar, N., & Gokmenoglu, K. K. (2019). Determinants of ecological footprint in MINT countries. Energy & Environment, 30(6), 1065-1086.

32. Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. Economic Modelling, 29(4), 1450–1460.

33. El Gawad, E. A. A., Lotfy, M. M., Sadooni, F. N., & Katheery, B. E. L. (2008). Assessment of the oil pollution extent in the offshore sediments, Abu Dhabi, UAE'. Australian Journal of Basic and Applied Sciences, 2(3), 561-574.

34. Feron, P., Cousins, A., Jiang, K., Zhai, R., Thiruvenkatachari, R., & Burnard, K. (2019). Towards Zero Emissions from Fossil Fuel Power Stations. International Journal of Greenhouse Gas Control, 87, 188-202.

35. Global Footprint Network (2010). https://www.footprintnetwork.org/our-work/ecological-footprint/(2017), Accessed 1st June 2010.

36. Global Footprint Network (2019). Global Footprint Network. https://www.footprintnetwork.org/our-work/ecological-footprint/(2019), Accessed 1st May 2019.

37. Gorus, M. S., & Aslan, M. (2019). Impacts of economic indicators on environmental degradation: Evidence from MENA countries. Renewable and Sustainable Energy Reviews, 103, 259-268.

38. Gorus, M. S., & Aydin, M. (2019). The relationship between energy consumption, economic growth, and CO2 emission in MENA countries: Causality analysis in the frequency domain. Energy, 168, 815–822.
39. Hassan, S. T., Xia, E., Khan, N. H., & Shah, S. M. A. (2019). Economic growth, natural resources, and ecological footprints: evidence from Pakistan. Environmental Science and Pollution Research, 26(3), 2929–2938.
40. Ibrahiem, D. M. (2020). Do technological innovations and financial development improve environmental quality in Egypt?. Environmental Science and Pollution Research, 1-13.
41. Joshua, U., & Bekun, F. V. (2020). The path to achieving environmental sustainability in South Africa: the role of coal consumption, economic expansion, pollutant emission, and total natural resources rent. Environmental Science and Pollution Research, 1-9.
42. Kao, C. & Chiang, M. H. (1999). On the estimation and inference of a cointegrated regression in panel data. Advances in Econometrics (Vol. 15).
43. Khan, A., Chenggang, Y., Xue Yi, W., Hussain, J., Sicen, L., & Bano, S. (2020). Examining the pollution haven, and environmental kuznets hypothesis for ecological footprints: an econometric analysis of China, India, and Pakistan. Journal of the Asia Pacific Economy, 1-21.
44. Khan, M. K., Khan, M. I., & Rehan, M. (2020). The relationship between energy consumption, economic growth and carbon dioxide emissions in Pakistan. Financial Innovation, 6(1), 1-13.
45. Khan, M. K., Teng, J. Z., Khan, M. I., & Khan, M. O. (2019). Impact of globalization, economic factors and energy consumption on CO2 emissions in Pakistan. Science of the Total Environment, 688, 424–436.
46. Kirikkaleli, D., Adedoyin, F. F., & Bekun, F. V. (2020). Nuclear energy consumption and economic growth in the UK: Evidence from wavelet coherence approach. Journal of Public Affairs, e2130.
47. Lin, D., Hanscom, L., Martindill, J., Borucke, M., Cohen, L., Galli, A., ... & Wackernagel, M. (2016). Working Guidebook to the National footprint accounts: 2016 edition. Oakland: Global Footprint Network. (Global Ecological Footprint Network footprintnetwork. org, Oakland, California, 2016).
48. Magazzino, C., Bekun, F. V., Etokakpan, M. U., & Uzuner, G. (2020). Modeling the dynamic Nexus among coal consumption, pollutant emissions and real income: empirical evidence from South Africa. Environmental Science and Pollution Research, 1-11.
49. Mark, N. C., & Sul, D. (2001). Nominal exchange rates and monetary fundamentals: evidence from a small post-Bretton Woods panel. Journal of international economics, 53(1), 29-52.
50. Mikayilov, J. I., Mukhtarov, S., Mammadov, J., & Azizov, M. (2019). Re-evaluating the environmental impacts of tourism: does EKC exist?. Environmental Science and Pollution Research, 1-14.
51. Murshed, M. (2020a). LPG consumption and environmental Kuznets curve hypothesis in South Asia: a time-series ARDL analysis with multiple structural breaks. Environmental Science and Pollution Research, 1-36.
52. Murshed, M. (2020b). An empirical analysis of the non-linear impacts of ICT-trade openness on renewable energy transition, energy efficiency, clean cooking fuel access and environmental sustainability in South Asia. Environmental Science and Pollution Research, 27(29), 36254-36281.
53. Murshed, M., & Dao, N. T. T. (2020). Revisiting the CO 2 emission-induced EKC hypothesis in South Asia: the role of Export Quality Improvement. GeoJournal, 1-29.
54. Murshed, M., Ali, S. R., & Banerjee, S. (2020a). Consumption of liquefied petroleum gas and the EKC hypothesis in South Asia: evidence from cross-sectionally dependent heterogeneous panel data with structural breaks. Energy, Ecology and Environment, 1-25.
55. Murshed, M., Chadni, M. H., & Ferdaus, J. (2020b). Does ICT trade facilitate renewable energy transition and environmental sustainability? Evidence from Bangladesh, India, Pakistan, Sri Lanka, Nepal and Maldives. Energy, Ecology and Environment, 1-26.
56. Nathaniel, S. P. (2019). Modelling urbanization, trade flow, economic growth and energy consumption with regards to the environment in Nigeria. GeoJournal, 1-15.
57. Nathaniel, S. P. (2020). Ecological footprint, energy use, trade, and urbanization linkage in Indonesia. GeoJournal, 1-14.

58. Nathaniel, S. P., & Bekun, F. V. (2020). Electricity consumption, urbanization, and economic growth in Nigeria: New insights from combined cointegration amidst structural breaks. Journal of Public Affairs.

59. Nathaniel, S. P., & Iheonu, C. I. (2019). Carbon dioxide abatement in Africa: The role of renewable and non-renewable energy consumption. Science of The Total Environment, 679, 337-345.

60. Nathaniel, S. P., Nwulu, N., Bekun, F. (2020a). Natural resource, globalization, urbanization, human capital, and environmental degradation in Latin American and Caribbean countries. Environ-mental Science and Pollution Research, https://doi.org/10.1007/s11356-020-10850-9

61. Nathaniel, S., Nwodo, O., Adediran, A., Sharma, G., Shah, M., and Adeleye, N. (2019). "Ecological footprint, urbanization, and energy consumption in South Africa: including the excluded", Environ-mental Science and Pollution Research, 26(6), 27168-27179.

62. Nathaniel, S., Nwodo, O., Sharma, G., & Shah, M. (2020b). Renewable energy, urbanization, and ecological footprint linkage in CIVETS. Environmental Science and Pollution Research, 1-14.

63. Nkengfack, H., & Fotio, H. K. (2019). Energy consumption, economic growth and carbon emissions: Evidence from the top three emitters in Africa. Modern Economy, 10(1), 52-71.

64. Ozcan, B., Tzeremes, P. G., & Tzeremes, N. G. (2020). Energy consumption, economic growth and environmental degradation in OECD countries. Economic Modelling, 84(September 2018), 203–213.

65. Pata, U. K. (2020). Renewable and non-renewable energy consumption, economic complexity, CO 2 emissions, and ecological footprint in the USA: testing the EKC hypothesis with a structural break. Environmental Science and Pollution Research, 1-16.

66. Pedroni, P. (2000). Fully modified OLS for heterogeneous cointegrated panels. Advances in econometrics, 15, 93-130.

67. Pedroni, P., (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. Oxf. B Econ. Stat. 61, 653–670.

68. Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. Journal of applied econometrics, 22(2), 265-312.

69. Rawazik, W., & Carroll, M. (2009). Complexity in quality assurance in a rapidly growing free economic environment: A UAE case study. Quality in Higher Education, 15(1), 79-83.

70. Saidi, H., El Montasser, G., & Ajmi, N. (2018). Renewable Energy, Quality of Institutions and Economic growth in MENA countries: a panel cointegration approach. Munich Personal RePEc Archive, 84055.

71. Sarkodie, S. A., & Adams, S. (2018). Renewable energy, nuclear energy, and environmental pollution: Accounting for political institutional quality in South Africa. Science of the Total Environment, 643, 1590–1601.

72. 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. Renewable Energy.

73. Soto, R., & Haouas, I. (2012). Has the UAE escaped the oil curse?. Understanding and Avoiding the Oil Curse in Resource-Rich Arab Economies, 373-420.

74. Tugcu, C. T., Ozturk, I., & Aslan, A. (2012). Renewable and non-renewable energy consumption and economic growth relationship revisited: Evidence from G7 countries. Energy Economics, 34(6), 1942–1950.

75. Udi, J., Bekun, F.V., Adedoyin, F.F., 2020. Modeling the nexus between coal consumption, FDI inflow and economic expansion : does industrialization matter in South Africa ? Environ. Sci. Pollut. Res.

76. Ulucak, R., & Khan, S. U. D. (2020). Determinants of the ecological footprint: Role of renewable energy, natural resources, and urbanization. Sustainable Cities and Society, 54, 101996.

77. United States Department of Energy (2011) International reserves. Archived from the original on 2011-05-13. Retrieved 2011-05-13.

78. Vélez-Henao, J. A. (2020). Does urbanization boost environmental impacts in Colombia? An extended STIRPAT–LCA approach. Quality & Quantity, 1-16.

79. Wadström, C., Wittberg, E., Uddin, G. S., & Jayasekera, R. (2019). Role of renewable energy on industrial output in Canada. Energy Economics, 81, 626–638.
80. Wang, J., & Dong, K. (2019). What drives environmental degradation? Evidence from 14 Sub-Saharan African countries. Science of the Total Environment, 656, 165–173.
81. Wang, Q., Su, M., Li, R., & Ponce, P. (2019). The effects of energy prices, urbanization and economic growth on energy consumption per capita in 186 countries. Journal of Cleaner Production, 225, 1017–1032.
82. Wang, Z., Ahmed, Z., Zhang, B., & Wang, B. (2019). The nexus between urbanization, road infrastructure, and transport energy demand: empirical evidence from Pakistan. Environmental Science and Pollution Research, 26(34), 34884-34895.
83. World Bank (2016) World Bank Annual Report. http://worldbank.org/annualreport.
84. World Bank (2019). World Bank Development Indicators database (online) available at https://data.worldbank.org/ Accessed date 24.12.2019.
85. World Bank. (2018). World Development Indicators. Retrieved from http://data.worldbank.org/data-catalog/world-development-indicators.
86. Wu, Y., Shen, L., Zhang, Y., Shuai, C., Yan, H., Lou, Y., & Ye, G. (2019). A new panel for analyzing the impact factors on carbon emission: A regional perspective in China. Ecological Indicators, 97, 260-268.

Appendices

Lists of abbreviations

Acronyms	Meanings
MENA	Middle East and North Africa
CSD	Cross-sectional dependence
EFP	Ecological footprint
NRR	Natural resource rent
DOLS	Dynamic ordinary least squares
PCSE	panel-correlated standard errors
DH	Dumitrescu and Hurlin
FMOLS	Fully modified ordinary least squares
EKC	Environmental Kuznets Curve
SDGs	Sustainable development goals
URB	Urbanization
RE	Renewable energy
SSA	sub-Saharan Africa
CIPS	Cross-sectionally augmented IPS
CADF	Cross-sectionally augmented ADF

Source: Author's compilation.