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HOW DO CONSUMING ALTERNATIVE ENERGY SOURCES AND REMITTANCE INFLOWS IMPACT EGYPT'S ECOLOGICAL FOOTPRINT?

ALTERNATİF ENERJİ KAYNAKLARININ TÜKETİMİ VE İŞÇİ DÖVİZ GİRDİLERİ MISIR'IN EKOLOJİK AYAK İZİNİ NASIL ETKİLİYOR?

Alper KARASOY[1]

Öz

Bu araştırmada, -(yanıcı ve yanıcı olmayan) alternatif enerji tüketimi ve işçi dövizleri de dâhil olmak üzere- çevresel bozulmanın belirleyicilerinin Mısır'daki Ekolojik Ayak İzi'ni nasıl etkilediği 1977-2014 dönemi için incelenmektedir. Seçilmiş olan değişkenler arasında eş-bütünleşme olduğu teyit edildikten sonra uzun ve kısa dönem katsayıları, gecikmesi dağıtılmış otoregresif model yöntemiyle tahmin edilmiştir. Uzun dönem sonuçlarına göre Mısır'da Çevresel Kuznets Eğrisi Hipotezi geçerli değildir; çünkü gelirin Ekolojik Ayak İzi üzerinde U-tipi bir etkiye sahip olduğu bulunmuştur. Bunun yanında fosil yakıt tüketimi ve finansal kalkınma, uzun dönemde, Ekolojik Ayak İzi'ni arttırmaktadır. Ek olarak, uzun dönemde, yanıcı olmayan alternatif enerji kullanımının Ekolojik Ayak İzi'ni etkilemediği; fakat yanıcı alternatif enerji tüketiminin ve ticari küreselleşmenin Ekolojik Ayak İzi'ni azalttığı tespit edilmiştir. Son olarak Mısır'a gönderilen işçi dövizlerinin hem kısa dönemde hem de uzun dönemde Mısır'ın Ekolojik Ayak İzi'ni arttırdığı gözlenmiştir. Bu bulgularla uyumlu olarak bazı politika önerileri ileri sürülmüştür.

Anahtar Kelime: Ekolojik Ayak İzi, Alternatif Enerji Tüketimi, İşçi Dövizleri, Zaman Serisi Analizi, Mısır.

Abstract

This research examines how the determinants of environmental degradation -including (combustible and non-combustible) alternative energy consumption and remittance inflows- impact Egypt's ecological footprint for the 1977-2014 period. After confirming the co-integration among the selected variables, the short-run and the long-run coefficients are estimated by the autoregressive distributed lag method. The long-term findings indicate that the environmental Kuznets curve hypothesis is not accepted for Egypt, as income has a U-shape impact on ecological footprint. Moreover, fossil-fuel consumption and financial development worsen ecological footprint in the long-run. In addition, while non-combustible alternative energy utilization does not significantly impact ecological footprint in Egypt, combustible alternative energy usage and trade globalization decrease it in the long-run. The results further reveal that remittance inflows to Egypt increase ecological footprint in both the short-run and the long-run. Pursuant to the findings, some policy conclusions and suggestions are propounded.

Keywords: Ecological Footprint, Alternative Energy Consumption, Remittance Inflows, Time Series Analysis, Egypt.

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Genişletilmiş Özet

Günümüzde sürdürülebilir kalkınma, ülkelerin çevresel performansını arttıracak ve enerji portföyünü zenginleştirecek alternatif politikalar ve çözümler üretmekten geçmektedir. Bu çerçevede, özellikle çevresel bozulmayla mücadelede, alternatif enerji kaynaklarının iyi bir şekilde analiz edilmesi ve incelemeye konu olan ülkenin ekonomisine ait spesifik özelliklerin de ön plana çıkarılabilmesi gerekmektedir. Bu çalışmada, Mısır ele alınarak kapsamlı bir çevresel sürdürülebilirlik göstergesi olan Ekolojik Ayak İzi'nin alternatif enerji kaynaklarından ve işçi döviz girdilerinden nasıl etkilendiği Çevresel Kuznets Eğrisi Hipotezi (ÇKEH) bağlamında ekonometrik olarak araştırılmıştır.

Bu çalışmanın giriş kısmında da bahsedildiği üzere, her ne kadar Mısırlı politika yapıcıları 2030 için belirledikleri hedeflerinde hem enerji hem de çevresel sürdürülebilirlik bağlamında çeşitli politikalar belirlemiş olsalar da bu politikalar kapsamında iki ana unsurun göz ardı edildiği görülmektedir: 1) Yanıcı olan alternatif enerji kaynaklarına (biyo-kütle ve artıklar gibi) gerekli önem verilmemiştir. Bu kaynaklar, Mısır'ın enerji üretim potansiyeli üzerinde anlamlı derecede etkili olabilecek alternatiflerdir (Abdelhady vd., 2014: 211; Said vd., 2013: 90). Ayrıca bu kaynaklar, alternatif enerji kaynakları arasında olduğu için, Mısır ekonomisinin hem enerji ihtiyacını karşılamakta hem de çevresel sürdürülebilirliğini dengelemekte kullanılabilir. 2) İşçi döviz girdileri: Mısır dışındaki ülkelerde çalışmakta olan Mısırlı işçiler tarafından gönderilen bu finansman kaynakları, Mısır ekonomisinde önemli bir yere sahiptir. Dünya Bankası verilerine göre, 2017 yılında Mısır'a gayrisafi yurt içi hasılasının (GSYİH) %10'undan fazlasına denk gelen miktarda işçi döviz girdisi transfer edilmiştir (World Bank, 2018). Literatür incelemesinde vurgulandığı üzere işçi döviz girdilerinin, enerji tüketimi ve çevresel performans üzerindeki etkileri başka ülkeler için ampirik olarak araştırılmıştır. Fakat bu girdilerin Mısır'ın sürdürülebilir kalkınması eksenindeki olası rolleri henüz ampirik olarak araştırılmamıştır. Bu araştırmanın ana amacı, 1977-2014 dönemi verilerini ve otoregresif gecikmesi dağıtılmış (ARDL) sınır testi yaklaşımını kullanarak alternatif enerji kaynaklarının ve işçi döviz girdilerinin Mısır'ın çevresel bozulmasına (Ekolojik Ayak İzi'ne) etkisini incelemektir.

İlgili literatür çerçevesinde oluşturulan modelde şu değişkenler yer almaktadır: (i) Gelir ve gelirin karesi. Bu değişkenlerin yardımıyla Mısır'da ÇKEH'nin uzun dönem geçerliliği sınanacaktır. (ii) Enerji tüketimi değişkenleri. Bu kapsamda üç farklı değişken dikkate alınmıştır. Bunlar; fosil yakıtları, yanıcı ve yanıcı olmayan alternatif enerji kaynaklarıdır. Bu değişkenler vasıtasıyla, yenilenemez ve alternatif enerji kaynaklarının, uzun ve kısa dönemlerde, Mısır'ın Ekolojik Ayak İzi'ni nasıl etkilediği tahmin edilmiş ve böylece kaynaklar arasında karşılaştırma yapma imkânı da mümkün kılınmıştır. (iii) Mısır ekonomisinin dış ticaret düzeyini gösteren ticari küreselleşme indeksi. (iv) Mısır'ın finansal kalkınma düzeyi ve (v) Mısır'a gönderilen işçi döviz girdileridir.

ARDL yaklaşımıyla uygulanan sınır testi sonucunda, modelde yer alan değişkenler arasında uzun dönemli bir ilişki olduğu tespit edilmiş ve sonrasında uzun ve kısa dönem katsayıları tahmin edilmiştir. Elde edilen tahmin sonuçları şu şekilde özetlenebilir: Birincisi, uzun dönemde Mısır'da ÇKEH geçerli değildir. Gelirin Ekolojik Ayak İzi üzerindeki etkisi, doğrusal olmayan, U-tipi bir etkidir. İkincisi, fosil yakıtları Mısır'ın uzun dönemde Ekolojik Ayak İzi'ni arttırırken yanıcı olmayan alternatif enerji kaynaklarının anlamlı bir etkiye sahip olmadığı; fakat yanıcı alternatif enerji kaynaklarının Ekolojik Ayak İzi'ni azalttığı bulunmuştur. Üçüncüsü, finansal gelişme uzun dönemde Mısır'ın çevresel sürdürülebilirliğini olumsuz etkilemektedir. Dördüncüsü, uzun dönemde ticari küreselleşme süreci Mısır'ın Ekolojik Ayak İzi'ni azaltmıştır. Son olarak işçi döviz girdilerinin hem kısa hem de uzun dönemlerde Mısır'ın çevresel sürdürülebilirliğini olumsuz etkilediği (Ekolojik Ayak İzi'ni arttırdığı) tespit edilmiştir.

Elde edilen sonuçlar, Mısır'ın uzun dönemde çevresel sürdürülebilirliğinin sağlanmasında yanıcı olan alternatif enerji kaynaklarının anlamlı bir potansiyele sahip olabileceğini göstermektedir. Ayrıca uzun dönemde işçi döviz girdilerinin, Mısır'ın çevresel performansını olumsuz etkilediği bulunmuştur. Bu kapsamda, yanıcı alternatif enerji kaynaklarının ve işçi döviz girdilerinin uzun dönem sürdürülebilir kalkınma politikaları kapsamında değerlendirilmesi gerektiği sonucuna ulaşılmıştır. Özellikle işçi döviz girdilerinin, uzun dönem sürdürülebilir kalkınma politikalarında finansman kaynağı olarak kullanılabilmesi için çeşitli düzenlemelerin yapılması, Mısır'ın çevresel performansını olumlu etkileyebilir. Böylece işçi döviz girdilerinin çevre üzerindeki olumsuz etkisi de sınırlanabilir. Çalışmanın sonuç kısmında elde edilen diğer bulgular bağlamında, ek politika önerileri de sunulmuştur.

INTRODUCTION[2]

Even though Egypt's economy experienced a 5.21% average growth rate for the 1977-2014 period, this experience came with its costs in terms of fossil-fuel energy dependency and environmental degradation. For the same period, Egypt's fossil-fuel utilization, as a percentage of total energy use, averaged almost 94%. Additionally, this dependence on fossil-fuels caused an increase in carbon emissions as well. In 2014, compared to the 1977 level, carbon dioxide (CO2) emissions went up almost by 478.4%. Also, in Egypt, the gap between ecological footprint which measures "the demand populations and activities place on the biosphere in a given year, given the prevailing technology and resource management of that year," and bio-capacity which shows "the amount of biologically productive land and sea area available to provide the ecosystem services that humanity consumes-our ecological budget or nature's regenerative capacity" (Borucke et al., 2013: 519) has been widening since 1977. In other words, as shortly defined by Lin et al. (2018), the demand on nature (footprint) exceeds the supply (bio-capacity) provided by nature; this also means there is a persistent ecolozgical deficit in Egypt (Global Footprint Network, 2018). Besides these environmental problems, Egypt's dependence on non-renewable energy sources also poses serious burdens on its economy as a result of the energy subsidization policies that have been followed. In the 2012-2013, 2013-2014, and 2014-2015 fiscal years, the subsidies for petroleum products were worth 120 billion Egyptian Pound (LE), 126.2 billion LE, and 100.3 billion LE, respectively (Sustainable Development Strategy- Egypt's Vision 2030 Second Pillar: Energy Overview of Current Situation, 2016). Further, these subsidies that were put in motion to protect the poor have not produced the intended consequences. For instance, in 2008, the most impoverished 40% of the population received merely 3% of subsidies for gasoline (Sdralevich et al., 2014). Partly because of high dependency on fossil fuels and demand hikes as a result of energy subsidies, Egypt had faced periodic electricity blackouts in three consecutive years beginning from 2012 (Abdulrahman and Huisingh, 2018).

To alleviate the aforementioned environmental and energy-related problems and to boost Egypt's economic growth rate at the same time, Egyptian officials have launched a series of goals that are called "the sustainable development strategy (SDS): Egypt vision 2030" ("The Sustainable Development Strategy (SDS): Egypt Vision 2030", 2016). These goals have some shortcomings which, if considered, may help to correctly identify and provide solutions to environmental problems in Egypt. First, in the SDS: Egypt vision 2030, there are no official 2020 and/or 2030 targets for boosting the share of renewables in the primary energy mix. Second, combustible renewable (alternative) energy sources (such as biomass and waste) are not considered as a potential option to increase renewable energy's share. There are studies which indicate that combustible alternative energy sources do have the potential to reduce environmental pollution and significantly contribute to energy mix in Egypt. For example, a study by Abdelhady et al. (2014) proposes that rice straw -a combustible energy source- can annually produce a net electric energy output of 2447 Gigawatt hours (GWh)/year and reduce CO2 emissions by 1.2 million tons. Further, another study by Said et al. (2013) assesses that combustible energy sources such as agricultural crops' residues, sewage sludge, municipal solid wastes, and animal wastes theoretically have the potential to produce 416.9 peta-joules (PJ) of energy, which is equivalent to 92.6% of total output obtained from all installed power plants in Egypt.

Another drawback of the SDS: Egypt vision 2030 is that the possible effects of remittance inflows on Egypt's economy and environment are not acknowledged. Egypt received 20 billion $ worth of remittances and ranked 6th among the top remittance receiving countries in 2017. Moreover, Egypt receives more remittances than foreign direct investments (FDI). To exemplify, in 2017, remittances and FDI to Egypt were equal to 10.06% and 3.14% of its GDP, respectively. In addition, for the 1977- 2014 period, average percentages for remittance inflows and FDI were 7.3% and 2.43%, respectively.

[2] In this section, the values regarding GDP, FDI, and remittances are based on the data from World Bank (2018); the facts about CO_2 emissions and ecological footprint are acquired from BP Statistical Review of World Energy (2017) and Global Footprint Network (2018), respectively. The documentation in relation to SDS–Egypt's vision 2030 can be downloaded from https://www.unescwa.org/
(Accessed on 30.06.2022).

Aforementioned gaps are not specific to policies or policy targets which are proposed in Egypt; they also exist in the relevant literature that investigates the drivers of environmental degradation. Especially for the case of Egypt, to the best of the author's knowledge, the study by El-Aasar and Hanafy (2018) is the only empirical work which takes renewable energy into account. However, the first constraint of their study is that they do not distinguish between the renewable energy types and do not consider non-renewable energy in their model. Another constraint is that the coefficients reported in their study seem problematic as most of them are almost zero. Lastly, the model proposed in that study, compared to this one, is rather parsimonious. By disaggregating energy consumption into three components, namely fossil-fuel, combustible, and non-combustible alternative energy, this study aims not only to compare and contrast the effects of these sources on ecological footprint, but also to provide new insights to policy makers in Egypt.

Another contribution of this study is to include remittance inflows in its model. Remittance inflows, as mentioned previously, constitute a significant aspect of the Egyptian economy. Moreover, although the relationships between remittance inflows and different economic and/or socio-economic indicators are well investigated, the impact of remittance inflows on environmental deterioration is investigated in only limited number of studies (see the "remittances-environment nexus" sub-section). Given that remittance inflows may be closely linked with some of the drivers of environmental pollution (such as growth and financial development), ignoring remittance inflows in the environmental degradation model, especially for a country such as Egypt which receives high amounts of remittances, may produce biased results. Additionally, the studies which are conducted at micro-level, mostly via surveys, indicate that remittance receiving households in Egypt spend remittances mostly to take care of their daily needs, essential expenses and consumption; also, a significant amount of remittances are spent on purchasing or building new apartments, on real estate, and on productive investments (Adams, 1991; Farid and El-Batrawy, 2015; Jureidini et al., 2010). Given these facts, it can be concluded that remittance inflows can boost demand in various sectors such as construction, trade, finance, and transportation; therefore, this can lead to more energy demand and environmental degradation (Rahman et al., 2019) in Egypt.

This study's other additional contributions can be stated as follows. First, instead of considering a one-dimensional environmental degradation indicator (in most cases, that is CO_2 emissions), this study considers a multi-dimensional, more inclusive and composite environmental degradation indicator, namely ecological footprint. Ecological footprint consists not only of carbon footprint, but also of cropland, grazing, fishing, forest, and infrastructure footprints as well (Borucke et al., 2013). As a result, ecological footprint seems to be a better indicator of environmental degradation than CO_2 emissions. To the best of the author's knowledge, there are not many studies conducted individually on Egypt which consider ecological footprint as an environmental degradation or pollution proxy. Only Al-Ayouty et al. (2017) consider 5 different environmental degradation indicators (CO_2 emissions, annual change in forest, consumption of ozone depleting substances, lack of access to improved water sources and sanitation facilities) in their models for the 1990-2013 period in Egypt. However, besides having a limited sample size due to their sample period, their study considers only three explanatory variables (income, technology, and clean manufacturing). Second, instead of utilizing imports and/or exports (usually as a ratio of output) to proxy for trade openness, this study considers a trade globalization index that incorporates the diversity of trading partners of Egypt, besides its export and import volumes. This index is more inclusive and can be a better trade proxy. In addition, trade openness cannot be considered as a mere volume of exports and imports; to consider openness, one should also acknowledge how much a country integrates into the world economy. For example, considering a country "open" by only examining its trade volume may be misleading, as this country can have a high volume of trading with only a limited number of partners. Last but not least, this study also considers financial development in its model, and to the extent of the author's knowledge, this study is one of the first studies to do that for the particular case of Egypt.

The rest of this study is structured in the following way. In the second section, theoretical, conceptual, and empirical background regarding the drivers of environmental degradation is briefly explained. The third section presents the model and data, and the fourth section summarizes the econometric methodology. The fifth section discusses the results. Finally, the last section concludes with policy suggestions.

1. CONCEPTUAL, THEORETICAL, AND EMPIRICAL BACKGROUND[3]

This section outlines the theoretical and empirical evidence regarding the determinants of environmental degradation. In first sub-section, income-environment link is discussed, and in the second sub-section, energy consumption is added to this nexus. In the following section 1.3, financial development-environmental performance nexus is summarized. Further, in section 1.4, the impact of trade on environmental pollution is outlined. Finally, in section 1.5, the impact of remittances on environmental degradation is summarily described.

1.1 Environment-Income Nexus

Income is taken to be a main determinant of environmental deterioration in the majority of empirical studies. Beginning from the pioneering studies by Grossman and Krueger (1991) and Panayotou (1993), its impact on environment is examined by validating the environmental Kuznets curve (EKC) hypothesis. In short, the EKC hypothesis is defined as income's ∩ shaped effect on environmental deterioration. In the first stages, as a consequence of subsistence economic activities, environmental degradation is rather small. However, more economic activities related to agriculture and resource extraction along with industrialization can cause resource depletion and waste generation (i.e., the demand on the environment- ecological footprint) to exceed resource regeneration capacity of the environment (i.e., the supply provided by the environment- bio-capacity). Later, at further stages of economic development, a structural shift towards information-intense service/technology sectors takes place. Taken together with raising environmental concerns, enforcement of stringent environmental standards, and modern technology, this structural shift can incrementally lead to a better environment (Panayotou, 1993). As a result of focusing on different countries or country groups, variables, models, and methods, the empirical studies which test the EKC hypothesis produced mixed results. Despite the fact that there are limited number of studies on the Egyptian case, they also yield conflicting results. Abdou and Atya (2013); El-Aasar and Hanafy (2018); Ibrahiem (2016), and Onafowora and Owoye (2014) do not confirm the EKC hypothesis, while Omri et al. (2015), and Ozturk et al. (2016) accept it. Besides, Shahbaz, Solarin, and Ozturk (2016) do not test the EKC hypothesis in Egypt because the variables that they selected are not co-integrated for Egypt's case. Lastly, the study by Al-Ayouty et al. (2017) validates the EKC hypothesis only for two environmental quality indicators (i.e., emissions and absence of access to clean water sources).

1.2. Environment-Energy Consumption-Income Nexus

Beyond being one of the potential drivers of growth, energy consumption is also considered to be a principal determinant of environmental degradation in the literature. Its relationship with growth is investigated through testing the validity of the feedback, the growth, the neutrality, and the conservation hypotheses. The feedback hypothesis refers to the bi-directional causality, whereas the neutrality hypothesis indicates the lack of causality between them. In addition, the growth hypothesis suggests a one-way causality running from energy use to growth, while the conservation hypothesis suggests that the causality runs in the reverse direction (Ozturk, 2010).

Instead of considering a single indicator for energy consumption, the recent studies usually distinguish among the different energy sources (fossil-fuel, nuclear, hydroelectricity, non-renewable, renewable, biomass, etc.) to observe (i) how different energy sources contribute to the environment and/or growth, and (ii) whether the energy policies followed have been successful, or what sort of energy policies would be more appropriate. In line with the expectations, many studies conclude that while alternative energy consumption limits pollution, consuming non-renewable energy induces it (Chen et al., 2019; de Souza et al., 2018; Ito, 2017; Jebli et al., 2016). Yet, based on the different indicators that they use for energy consumption, there are studies which reach different outcomes. Long et al. (2015) demonstrate that the consumption of hydro and nuclear powers does not impact emissions, and non-

[3] This review primarily surveys the studies on Egypt. More detailed reviews on environmental pollution and its determinants can be found in Mardani et al. (2019); Sarkodie and Strezov (2019); Shahbaz and Sinha (2019). For the income-energy nexus, Omri (2014) and Ozturk (2010) provide detailed surveys.

renewable energy consumption increases emissions. Dong et al. (2017) establish that the consumption of both renewable energy and natural gas decreases environmental pollution in BRICS (Brazil, Russia, India, China, and South Africa). The findings of Dong, Sun, Jiang, et al. (2018) indicate that consuming both renewable and nuclear energy reduces pollution, whereas the consumption of fossil-fuel worsens it. Contrary to the expectations, there also exist studies which find that alternative energy consumption, similar to the utilization of non-renewable energy, degrades the environmental conditions (Solarin et al., 2017), or does not increase pollution as much as the non-renewable energy sources (Karasoy, 2019), or does not (significantly) contribute to environmental degradation (Al-Mulali et al., 2015).

Although the number of studies that disaggregate energy consumption into different types, mainly based on the renewability of their sources, has been growing, studies that explicitly examine the impact of biomass usage on environmental deterioration are quite scant. In spite of that, the results produced by these studies almost uniformly suggest that as a combustible alternative energy source, biomass energy can help to curb environmental pollution (Bilgili et al., 2017; Katircioglu, 2015; Shahbaz et al., 2019). Only the study by Ahmed et al. (2016) shows that biomass energy utilization insignificantly impacts emissions in 24 European countries.

Regarding the case of Egypt, there is only one study (El-Aasar and Hanafy, 2018) that considers renewable energy consumption. Further, the author believes, there is no study on Egypt that considers biomass energy as an alternative energy source. This study fills this gap by not only considering both alternative and fossil-fuel consumption, but also by disaggregating alternative energy sources into combustible and non-combustible components. This approach allows to see which one of these alternative energy sources can better help to combat environmental degradation in Egypt.

1.3. Financial Development-Environment Nexus

In the literature, there is no clear consensus on the effect of financial development on the environment. Conceptually, financial development in a country can worsen the environment via the following channels: (i) by cutting financial costs and removing financial constraints, and this can encourage firms to carry out new projects and investments leading to more energy demand, (ii) by inducing households to purchase new items such as white goods and automobiles and/or real estate. Financial development, on the other hand, can also improve environmental conditions through: (i) attracting new FDI, thus encouraging more investments on research and development (R&D), (ii) giving the firms opportunities to adapt greener production techniques, and (iii) economies of scale that can enable large and medium sized firms to be more efficient (Halkos and Polemis, 2017: Shahbaz, Shahzad, et al., 2016: Tamazian et al., 2009)

There are no individual studies on Egypt which estimate the financial development's impact on environmental deterioration, namely ecological footprint. However, the study by Omri et al. (2015) on 12 MENA (the Middle East and North Africa) countries reports that financial development is not a significant determinant of carbon emissions in the particular case of Egypt. This study tries to fill this gap by employing a financial development indicator in its model.

1.4. Trade-Environment Nexus

As conceptually (Grossman and Krueger, 1991) and theoretically (Taylor et al., 2001) proposed, the impact of free trade on the environment is decided by the sum of three effects, namely scale, composition, and technique effects. The scale effect is expected to be positive because a country's involvement in trade increases its output, and increased output can result in more environmental degradation. The composition effect is partly related to the comparative advantages that a country has. If a country's comparative advantage is on less polluting products and/or services, then the composition effect is negative. Nonetheless, if this advantage is on pollution-intensive products, the composition effect can be positive. The technique effect should be negative because involvement in free trade can make the development and the transfer of newer and green technology possible (Grossman and Krueger, 1991). To sum up, based on the total of these effects, the impact of trade openness on environmental deterioration can be either negative, positive, or insignificant.

Studies which are on Egypt or report individual results on Egypt present different conclusions regarding the impact of trade on its environmental sustainability. Ozturk et al. (2016) establish that trade openness increases ecological footprint in Egypt. However, Omri et al. (2015) and Onafowora and Owoye (2014) find that trade openness does not contribute to CO_2 emissions, and El-Aasar and Hanafy (2018) support this finding for the greenhouse gas (GHG) emissions. Nonetheless, Ibrahiem (2016) finds the impact of trade openness on carbon emissions to be negative.

The empirical studies on the trade-environment nexus, as shown here, employ either trade ratio to GDP or nominal trade value. This study differentiates itself from these studies by employing a trade globalization index that includes trade volume and trade partner diversification. The multi-dimensionality of this index makes it a superior indicator (Gygli et al., 2019) and may give more insights to researchers and policy-makers.

1.5. Remittances-Environment Nexus

Rahman et al. (2019) conceptualize and empirically show that remittances are expected to increase both energy usage and environmental damage. Also, the majority of the empirical research supports this claim. For instance, Sahoo and Sethi (2022) find that remittances to India increase energy usage, and Rahman et al. (2021) support this finding for South Asian countries showing that remittances have causal link to remittances.

Moreover, Ahmad et al. (2019) reveal that remittance inflows to China increase its carbon emissions. Additionally, Li et al. (2021) partially confirm this finding for China showing that negative shocks to remittances decrease pollution. Karasoy (2021) affirms this finding for the Philippines by revealing that remittance inflows escalate environmental degradation. Further, for 97 countries, Yang et al. (2020) show that inflow of remittances to these countries increases carbon dioxide emissions. Lastly, Sharma et al. (2019) contradicts these findings by revealing that remittances sent to Nepal decrease long-run emissions.

While the majority of the studies show that remittances worsen environmental pollution, -as far as the author is concerned- the environmental impact of remittances sent to Egypt has not been examined. This research attempts to fill this gap.

2. MODEL AND DATA

As a result of data availability, this study considers the period 1977-2014[4]. The model is extended by including remittance inflows and by disaggregating alternative energy consumption into combustible and non-combustible components. This study considers the following model:

$$\ln EFI_t = \alpha_1 + \beta_1 \ln GDP_t + \beta_2 (\ln GDP_t)^2 + \beta_3 \ln FF_t + \beta_4 \ln NCAE_t + \beta_5 \ln CAE_t + \beta_6 \ln TG_t + \beta_7 \ln FD_t + \beta_8 \ln REM_t + u_t \quad (1)$$

In the analysis, annual time series are employed. Additionally, in Eq. (1), "ln" indicates that the time series in the model are used in their logarithmic forms. α and β show the coefficients that are to be estimated, and u_t is the error term. EFI is an environmental degradation indicator that is ecological footprint (global hectares per capita). GDP is income and shows gross domestic product per capita (constant 2010, US$), and the inclusion of GDP squared in the model makes it possible to test the EKC hypothesis. Given that the EKC is confirmed, then the estimated long-run coefficients of β_1 and β_2 should be significant and respectively have positive and negative signs. Unless these are confirmed, the EKC hypothesis is invalid in Egypt during the sample period. FF stands for fossil fuel consumption and shows oil consumption (million tons).

TG is a trade globalization index. This index is more inclusive than traditionally employed trade openness variable, which just shows imports and exports as a percentage of GDP, since this index also takes trade partner diversification into account. A higher index value for a country not only indicates a high level of trade volume, but also means it has more trading partners. FD is the development of the financial sectors showing domestic credit to private sector (% of GDP). REM shows the remittance inflows to Egypt (% of GDP). NCAE is non-combustible alternative energy consumption, and it includes

[4] Time series for CAE [combustible renewables and waste (% of total energy)] is available only up to 2014.

hydropower, geothermal, solar power, and nuclear energy[5] use as a percentage of total energy use. CAE is combustible alternative energy consumption, and it represents combustible renewables and waste (such as solid biomass, liquid biomass, biogas, industrial waste, and municipal waste) measured as a percentage of total energy use. Time series data for ecological footprint is obtained from the Global Footprint Network (2018) website. Time series for GDP per capita, financial development, (non-combustible and combustible) alternative energy consumption, and remittance inflows are collected from the World Development Indicators database (World Bank, 2018). Time series for fossil-fuel (oil) consumption is obtained from "the British Petroleum's" (BP) database(BP, 2017). Lastly, this study's foreign trade indicator, which is a trade globalization index, is a sub-index of KOF (Swiss Economic Institute) Economic Globalization Index (de facto) that is firstly calculated and compiled by Dreher (2006) and further updated by Gygli et al. (2019)[6].

2.1. Econometric Methodology

2.1.1. Unit-root tests

Before testing whether the variables in the model are co-integrated and estimating (short-term and long-term) coefficients, integration orders of the variables should be decided. This process is done by testing if the time series in consideration has a unit root. In this respect, this study utilizes the typical unit-root tests of Dickey and Fuller (ADF) (1979), Kwiatkowski et al. (KPSS) (1992), and Phillips and Perron (PP) (1988).

2.1.2. The ARDL method: Bounds testing procedure to co-integration and estimating the proposed model

This study employs the ARDL bounds testing procedure to co-integration that is put forward by Pesaran, Shin, and Smith (PSS) (2001). This approach has some advantages. First, in this approach, the regressors can have various orders of integration [i.e., they can be I(0) or I(1), but not I(2)]. Second, the ARDL procedure performs better in terms of efficiency and consistency for small sample sizes. Third, in this approach, independent variables can be endogenous. Finally, given that the co-integration exists, the short-term and long-run coefficients with regards to how regressors impact the regressand and can be estimated simultaneously (for more details, see Pesaran and Shin (1995) and Pesaran et al. (2001)). The ARDL version of Equation (1) can be presented by the following unrestricted-ECM (error correction model):

$$\Delta \ln EFI_t = \alpha_0 + \sum_{i=1}^{p} \alpha_{1i} \Delta \ln EFI_{t-i} + \sum_{i=0}^{q} \alpha_{2i} \Delta \ln GDP_{t-i} + \sum_{i=0}^{r} \alpha_{3i} \Delta (\ln GDP_{t-i})^2 + \sum_{i=0}^{h} \alpha_{4i} \Delta \ln FF_{t-i} + \sum_{i=0}^{s} \alpha_{5i} \Delta \ln NCAE_{t-i} + \sum_{i=0}^{u} \alpha_{6i} \Delta \ln CAE_{t-i} + \sum_{i=0}^{v} \alpha_{7i} \Delta \ln TG_{t-i} + \sum_{i=0}^{w} \alpha_{8i} \Delta \ln FD_{t-i} + \sum_{i=0}^{z} \alpha_{9i} \Delta \ln REM_{t-i} + \beta_1 \ln EFI_{t-1} + \beta_2 \ln GDP_{t-1} + \beta_3 (\ln GDP_{t-1})^2 + \beta_4 \ln FF_{t-1} + \beta_5 \ln NCAE_{t-1} + \beta_6 \ln CAE_{t-1} + \beta_7 \ln TG_{t-1} + \beta_8 \ln FD_{t-1} + \beta_9 \ln REM_{t-1} + \varepsilon_t \tag{2}$$

Where Δ is the difference operator, α_0 is the constant term, and ε_t is the (white-noise) error term. β_i parameters for $i=1,...,9$ represent the long-run coefficients. p, q, r, h, s, u, v, w, and z show the optimal lag lengths. The selection of optimal lag lengths is based on the Schwarz information criterion (SIC). In bounds F-test for co-integration, the existence of long-run association between the variables is tested via H_0: $\beta_1 = \ldots = \beta_9 = 0$ against the alternative H_1: $\beta_1 \neq \ldots \neq \beta_9 \neq 0$. Afterwards, the F-statistic is retrieved and compared to the lower bound (LB) and upper bound (UB) critical values which are gathered from Pesaran et al. (2001) for asymptotic sample sizes. If the F-statistic is higher than the UB critical values, the conclusion is that the time series in the model are co-integrated. In a similar manner, for robustness check, bounds t-test approach can also be utilized to confirm the co-integration. In bounds t-test approach, H_0: $\beta_1=0$ is tested against H_1: $\beta_1<0$. Similarly, if the calculated t-statistic has a higher

[5] Although nuclear energy is considered as a combustible energy source, it can be ignored in this study's setting because, currently, Egypt does not have any nuclear power plants.

[6] Trade globalization index used in this study is retrieved from KOF Swiss Economic Institute's website. https://www.kof.ethz.ch/en/forecasts-and-indicators/indicators/kof-globalisation-index.html (Accessed on 01.14.2019).

(absolute) value than the UB critical value which is provided by Pesaran et al. (2001), then it can be concluded that the co-integration exists. Besides the critical values that are provided by Pesaran et al. (2001), this study also uses the critical values for the finite samples that are calculated by Kripfganz and Schneider (2020) for both F- and t-tests. Kripfganz and Schneider (2020) claim that their critical values are more improved and more accurate for finite-samples and do not propose any restrictions on the number of variables that are included in the co-integrating equation [for more details, see Kripfganz and Schneider (2020)].

Subsequent to the co-integration analysis and estimation of the long-term effects, the following ECM is to be estimated to obtain the short-run estimates and the error correction term's (ECT) coefficient:

$$\Delta \ln EFI_t = \varphi_0 + \sum_{i=1}^{a} \varphi_{1i} \Delta \ln EFI_{t-i} + \sum_{i=0}^{b} \varphi_{2i} \Delta \ln GDP_{t-i} + \sum_{i=0}^{c} \varphi_{3i} \Delta (\ln GDP_{t-i})^2 + \sum_{i=0}^{d} \varphi_{4i} \Delta \ln FF_{t-i} + \sum_{i=0}^{e} \varphi_{5i} \Delta \ln NCAE_{t-i} + \sum_{i=0}^{f} \varphi_{6i} \Delta \ln CAE_{t-i} + \sum_{i=0}^{g} \varphi_{7i} \Delta \ln TG_{t-i} + \sum_{i=0}^{m} \varphi_{8i} \Delta \ln FD_{t-i} + \sum_{i=0}^{o} \varphi_{9i} \Delta \ln REM_{t-i} + \delta ECT_{t-1} + e_t \quad (3)$$

In Equation (3), Δ shows the first difference, φ_0 is a constant, and parameters φ_i for $i=1,...,9$ represent the short-run coefficients. a, b, c, d, e, f, g, m, and o present the optimal lag lengths. Moreover, the coefficient of the ECT (δ) shows how long it takes to reach the long-run equilibrium, given a short-term deviation. Also, the coefficient of the ECT should be significant and negative.

3. RESULTS AND DISCUSSION

Prior to examining whether the selected time series are co-integrated, their stationarity properties should be observed. The results of the ADF, PP, and KPSS tests are reported in Table 1. They imply that all the variables become stationary in their first differences. As all the time series in the model are *I(1)*, the existence of co-integration among them can be tested.

Table 1. ADF, PP, and KPSS Unit-root Tests Results

	ADF test		PP test		KPSS test
Variables	t-statistic	p-value	t-statistic	p-value	*LM*-statistic
lnEFI	-2.6532 (0)	0.2607	-2.7250 (1)	0.2330	0.1504**
lnGDP	-2.7371 (1)	0.2287	-2.4058 (3)	0.3707	0.1817**
lnFF	-2.8801 (0)	0.1802	-2.8106 (1)	0.2027	0.1930**
lnNCAE	-2.7209 (1)	0.2347	-1.9050 (1)	0.6318	0.3329***
lnCAE	-1.8542 (0)	0.6576	-1.8478 (1)	0.6609	0.1996**
lnTG	-2.5782 (0)	0.2918	-2.6414 (1)	0.2655	0.1261*
lnFD	-0.8122 (2)	0.9552	-0.8678 (2)	0.9492	0.3852***
lnREM	-2.2032 (0)	0.4739	-2.2032 (0)	0.4739	0.3071***
ΔlnEFI	-5.9034 (0)***	0.0000	-5.9045 (1)***	0.0000	0.0971
ΔlnGDP	-4.0536 (0)***	0.0033	-4.0993 (2)***	0.0029	0.2842
ΔlnFF	-3.5543 (0)**	0.0120	-3.5543 (0)**	0.0120	0.3078
ΔlnNCAE	-4.2596 (1)***	0.0019	-4.3741 (7)***	0.0014	0.2628
ΔlnCAE	-5.6781 (0)***	0.0000	-5.7067 (2)***	0.0000	0.3122
ΔlnTG	-6.7069 (0)***	0.0000	-6.7513 (3)***	0.0000	0.0616
ΔlnFD	-6.0033 (2)***	0.0000	-6.0473 (3)***	0.0000	0.3317
ΔlnREM	-5.8579 (0)***	0.0000	-6.1018 (8)***	0.0000	0.1043

Notes: Δ shows the 1st difference. ** and *** imply significance at 5% and 1% levels. Values in the parentheses show the selected lag-length and bandwidth for ADF and PP tests, respectively. SIC is employed for the ADF test's lag selection. Newey-West procedure is used for the PP test's bandwidth selection. For the KPSS test, quadratic spectral kernel estimation method is employed.
Test equations include trend and constant in levels and only constant in the first differences.
The ADF test critical values for constant & trend model specification: -4.2268 (1%), -3.5366 (5%).
The ADF test critical values for constant model specification: -3.6268 (1%), -2.9458 (5%).
The PP test critical values for constant & trend model specification: -4.2268 (1%), -3.5366 (5%).
The PP test critical values for constant model specification: -3.6267 (1%), -2.9458 (5%).
The KPSS test critical values for constant & trend model specification: 0.216 (1%), 0.146 (5%), 0.119 (10%).
The KPSS test critical values for constant model specification: 0.739 (1%), 0.463 (5%), 0.347 (10%).

The results for co-integration, namely the ARDL bounds F- and t-tests, are displayed in Table 2. The calculated F-statistic (5.3479) is higher than the 1% UB (asymptotic) critical value of PSS (2001) and is also higher than the 5% UB critical (finite) value calculated by Kripfganz and Schneider (2020). These results prove that the null hypothesis of no co-integration can be rejected. Moreover, in absolute values, the calculated t-statistic (-6.1621) exceeds the 1% UB critical values which are proposed by Kripfganz and Schneider (2020) and Pesaran et al. (2001). These results also show that the variables are co-integrated. Overall, both F-test and t-test show that the time series are co-integrated. In the next steps, the short-run (SR) and the long-run (LR) effects of income, income squared, fossil-fuel, (combustible and non-combustible) alternative energy consumption, trade globalization, financial development, and remittance inflows on ecological footprint can be estimated.

Table 2. Bounds Tests for Co-Integration

*F-statistic = 5.3479** / t-statistic = -6.1621**** n=38, k=8				
	%5		%1	
Optimal lags (1, 0, 1, 0, 0, 0, 1, 0, 1)	LB F-stat. / t-stat.	UB F-stat. / t-stat.	LB F-stat. / t-stat.	UB F-stat. / t-stat.
PSS (2001) *asymptotic* CVs	2.22 / -2.86	3.39 / -4.72	2.79 / -3.43	4.1 / -5.37
Kripfganz & Schneider (2020) *finite* CVs	2.709 / -2.861	4.294 / -4.718	3.844 / -3.643	5.914 / -5.721

Notes: ** and *** mean significance at 5% and 1% levels. n is the number of observations, and k shows the number of regressors. LB, UB: Lower-Bound, Upper-Bound. CVs: Critical values.

Table 3 reports the LR (panel 3A), the SR (panel 3B), and the diagnostic tests (panel 3C) results for the ARDL method. Panel 3A of Table 3 presents that the coefficients' signs for income and income squared are negative and positive. Moreover, these coefficients are significant. Contrary to the EKC hypothesis, this finding shows that income's impact on environmental degradation (ecological footprint) shows a U-shape pattern. In short, the EKC hypothesis is not validated in the LR in Egypt for the sample period. This finding agrees with the evidence shown by Abdou and Atya (2013); Arouri et al. (2012); El-Aasar and Hanafy (2018); Ibrahiem (2016); Onafowora and Owoye (2014), while it contradicts the findings of Omri et al. (2015) and partially agrees with the findings in Al-Ayouty et al. (2017) concerning the case of Egypt. The U-shape pattern may indicate that the policy makers in Egypt cannot solve the environmental degradation problem only by focusing on boosting the income levels. More comprehensive approaches should be defined and applied.

As expectedly, in the LR, the effect of fossil-fuel consumption on environmental degradation is positive. For instance, a 1% increase (decrease) in fossil-fuel consumption approximately corresponds to a 0.24% increase (decrease) in ecological footprint. However, the effect of non-combustible alternative energy consumption is negative but insignificant, and the impact of combustible alternative energy consumption is negative on environmental degradation in the LR. For example, a 1% increase in the share of combustible alternative energy (such as biomass and waste) in the total energy use, on average, can result in a 0.45% decrease in environmental degradation. The significant negative effect of combustible alternative energy use on the environmental pollution supports the results of Bilgili et al. (2017), Katircioglu (2015), and Shahbaz, Balsalobre-Lorente, et al. (2019) and contradicts the evidence provided by Ahmed et al. (2016). The finding which shows that the impact of non-combustible alternative energy (such as hydro, solar, and wind) consumption is insignificant agrees with the findings of Al-Mulali et al. (2015) and Long et al. (2015). The findings regarding the LR impact of energy use on environmental deterioration in Egypt provide important evidence that should not be overlooked when implementing policies. First, non-renewable energy sources should be substituted with alternative energy sources. Second, besides considering to improve its efficiency, the non-combustible alternative energy's share in the total mix should be raised so that its impact on the environment can turn out to be significant in Egypt. Last but not least, combustible alternative energy sources (biomass and waste) should be utilized, as they can be more effective than their non-combustible counterparts in combating environmental degradation in the LR in Egypt.

Trade globalization negatively affects Egypt's ecological footprint in the LR. To exemplify, a 1% increase (decrease) in trade globalization index, all else the same, can result in a 0.28% decrease (increase) in environmental degradation in Egypt in the LR. This result supports the evidence provided by Abdouli and Hammami (2018) and Ibrahiem (2016), yet disagrees with the results in El-Aasar and Hanafy (2018); Omri et al. (2015); and Ozturk et al. (2016) for the particular case of Egypt. This evidence indicates that environmental degradation can be curbed not only by increasing Egypt's trade volume, but also by increasing the number of Egypt's trading partners. This may accelerate the transfer of newer and environmentally friendly technology. This can be achieved by integrating the Egyptian economy more into the regional and/or global unions and organizations.

The developments in financial sectors aggravate ecological footprint in Egypt in the LR. A 1% positive (negative) change in domestic credit to private sector, ceteris paribus, corresponds to a 0.15% positive (negative) change on average in ecological footprint in Egypt. Nonetheless, this finding challenges the evidence in Al-Mulali, Solarin, and Ozturk (2016); de Souza et al. (2018); Omri et al. (2015). This finding indicates that financial sectors and instruments are utilized in a way that worsen the environmental conditions in Egypt in the LR. How financial resources are used should be re-considered in Egypt so that they can be employed to help reducing environmental deterioration in the LR.

Remittance inflows, as expected, damage the environment not only in the LR, but also in the SR as well (see Panel 3B in Table 3). Results indicate that a 1% increase in remittance inflows corresponds to a 0.09% increase in the LR (and to a 0.04% increase in the SR) in environmental degradation. This finding supports the expectations and results in the majority of studies summarized in this research, yet repudiates the findings in Sharma et al. (2019). Their findings, contrary to their expectations, show that remittances to Nepal decrease CO_2 emissions in the LR and do not (significantly) impact pollution in the SR. This is not the case for Egypt, as our findings show that remittances are harmful to the environment in both the LR and the SR. The error correction term's coefficient is, as it should be, significant and negative (see Panel 3B in Table 3).

Table 3's Panel 3C is dedicated to the diagnostics. And the results of these tests show that our model does not contain any econometric issues that would adversely affect our estimation results.

Table 3. ARDL Estimation Results

3A) LR results			
Regressors	Coefficient	t-statistic	p-value
lnGDP	-10.1371***	-3.6534	0.0013
$(\text{lnGDP})^2$	0.6667***	3.7239	0.0011
lnFF	0.2439**	2.5470	0.0177
lnNCAE	-0.0126	-0.1465	0.8847
lnCAE	-0.4451**	-2.3832	0.0254
lnTG	-0.2775***	-3.2223	0.0036
lnFD	0.1527***	3.1982	0.0039
lnREM	0.0939**	2.6401	0.0143
3B) SR results			
Regressors	Coefficient	t-statistic	p-value
Constant	34.8233***	8.0107	0.0000
$\Delta(\text{lnGDP})^2_t$	0.6542***	8.5041	0.0000
ΔlnTG_t	-0.0484	-1.3133	0.2015
ΔlnREM_t	0.0404**	2.3952	0.0248
ECT_{t-1}	-0.8921***	-8.0109	0.0000

3C) Diagnostics	test value	p-value
BG Serial Corr. LM	2.1613	0.3394
Ramsey functional form	2.1250	0.1584
J-B Normality	0.9653	0.6171
ARCH Heteroscedasticity	1.9565	0.3760
BPG Heterosced.	18.3506	0.1055
CUSUM/CUSUMSQ	Stable	Stable
R^2 / Adjusted R^2	0.9830 / 0.9746	
F-statistic	115.9371***	

Notes: ** and *** indicate significance at %5 and 1% levels, respectively. BG, BPG, and J-B are Breusch-Godfrey, Breusch-Pagan-Godfrey and Jarque–Bera, respectively. LR: Long-run, SR: Short-run.

CONCLUSION

This research studies the effects of income, income squared, fossil-fuel consumption, (combustible and non-combustible) alternative energy use, financial development, trade globalization, and remittance inflows on environmental degradation (ecological footprint) in Egypt for the 1977-2014 period. The long-run ARDL results show that the EKC hypothesis is not valid in Egypt because the impact of income on ecological footprint has a U-shaped pattern. Moreover, in the LR, the impacts of fossil-fuel use and financial development are positive, while the effects of consuming combustible alternative energy and trade globalization are negative on environmental degradation. Additionally, both the SR and the LR effects of remittance inflows on environmental degradation are positive showing that remittances to Egypt are harmful to its environment.

According to the findings, several policy suggestions can be put forward. First, energy subsidies should definitely be abandoned in Egypt because these subsidies impose a burden on the economy, crowd-out growth enhancing public spending, discourage private investment in energy sector, depress incentives to develop projects on alternative energy and/or energy efficient technologies, and can cause excessive consumption of various non-renewable energy sources (Bauer et al., 2013). By incrementally relinquishing non-renewable energy subsidies, investment in alternative energy sources would gain momentum, and their share in energy mix would eventually increase. Furthermore, remittance receiving households in Egypt would be forced to make more energy efficient choices when it comes to how to spend the remittances that they receive. This would also curb the negative impact of remittance inflows on environmental degradation.

Second, Egyptian authorities should not overlook the importance of combustible alternative energy sources in solving the environmental degradation problem. Our findings indicate that combustible alternative sources (such as biomass and waste) can significantly contribute to reducing pollution, compared to its non-combustible counterparts (such as hydro, wind, and solar) in the long-run. Combustible alternative energy sources should definitely be in Egypt's energy mix because non-combustible alternative energy sources, especially hydro, are utilized to a great degree in Egypt, and large scale projects on non-combustible alternative energy sources require high level of financing (Mansour, 2015). Biomass plants and projects may require lower level of financing, as they can also be executed at smaller scales. Also, granting credits with lower interest rates or loans for such projects may also limit the financial development's worsening effect on environmental pollution. Additionally, given that non-renewable energy subsidies are discarded, this can crowd-in the private sector to get involved in such projects. Last but not least, instead of substituting a non-renewable energy source (such as oil) with another non-renewable source (such as coal), Egyptian policymakers should mainly focus on deploying Egypt's alternative energy sources to increase Egypt's energy security. Relying on non-renewable sources, as our findings indicate, would just worsen the environment further in Egypt.

Third, non-combustible alternative energy sources do not significantly affect environmental deterioration in Egypt in the LR. This can happen due to the possibilities such as non-combustible alternative energy sources are not efficiently utilized and/or the consumption of these sources has not yet reached the desired levels. To overcome these problems, the *SDS: Egypt vision 2030* goals regarding the energy efficiency and increasing renewables' share in total electricity production should be strictly followed, and necessary changes to it should be implemented in detail to finance projects on energy efficiency and alternative energy.

Fourth, Egyptian officials should integrate the Egyptian economy into the world economy more not only by increasing Egypt's trade volume but also by diversifying its trading partners as well. In this respect, Egypt can have more trading partners by taking up more active roles in various unions and organizations (such as African Union). Also, the ties with the European Union (EU) should be strengthened up by following the EU standards and by increasing the relations with the EU countries. This would also help Egypt to find more funding to execute more projects on green technology and energy efficiency.

Finally, remittance inflows worsen the environmental conditions both in the SR and in the LR. This indicates that Egyptian policymakers should take necessary measures to limit Egyptian households' reliance on remittance inflows. This can be achieved by ensuring political and economic stability, democracy, and creating an investment friendly environment in Egypt. Such an approach can attract more foreign investments, create more job opportunities, and ultimately stop Egyptian workers from moving abroad. Further, investments in environmentally friendly or energy efficient projects by remittance receiving households should be encouraged and rewarded via reduced financial costs and tax incentives. As financial development and remittance inflows may also be closely linked, such a policy would also ease the financial constraints faced by these households.

Further research should focus on other developing countries that receive high amounts of remittances and examine whether remittance inflows have similar impacts on these countries' environments. Also, the potential of non-combustible alternative energy sources in combating the environmental problems in developing countries should also be investigated further. Lastly, newer methods which, for instance, consider asymmetric effects and/or causalities can be employed in future studies to examine the asymmetric linkages between environmental degradation and its drivers.

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Etik Beyan: *Bu çalışmada etik beyanı gerektirecek herhangi bir uygulama kullanılmamıştır. Aksi bir durumun tespiti halinde Beykent Üniversitesi Sosyal Bilimler Dergisinin hiçbir sorumluluğu olmayıp, tüm sorumluluk çalışmanın yazar(lar)ına aittir.*
Yazar Katkı Beyanı*:1. Yazarın katkı oranı %100'dür.*
Çıkar Beyanı*: Yazarlar arasında çıkar çatışması yoktur.*

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APPENDIX

Table A1. Descriptive statistics and correlation matrix

Descriptive statistics								
Variables	EFI	GDP	FF	NCAE	CAE	TG	FD	REM
Mean	1.575	1798.948	24.600	2.957	3.331	52.039	34.005	7.418
Median	1.507	1686.398	24.178	2.653	3.268	51.799	29.842	6.372
Maximum	2.024	2608.375	38.305	6.245	6.102	74.852	54.931	14.583
Minimum	1.094	1038.841	10.366	1.628	2.079	39.601	13.181	2.857
Std. Dev.	0.268	483.975	7.121	1.289	1.045	7.709	12.083	3.327
Skewness	0.218	0.3411	-0.104	1.379	0.959	0.618	0.4576	0.478
Kurtosis	2.162	1.989	2.596	3.9507	3.519	3.343	1.9993	2.021
Correlation matrix								
EFI	1							
GDP	0.969	1						
FF	0.961	0.967	1					
NCAE	-0.832	-0.822	-0.901	1				
CAE	-0.923	-0.908	-0.952	0.964	1			
TG	-0.166	-0.219	-0.225	0.078	0.090	1		
FD	0.496	0.479	0.466	-0.515	-0.585	-0.071	1	
REM	-0.573	-0.613	-0.573	0.478	0.549	0.328	-0.781	1

Figure A1. Graphs for the CUSUM and CUSUM of squares tests