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# Understanding Energy Poverty Through the Perspective of Trade Openness and Foreign Direct Investment: An Empirical Case for Selected Latin American Countries[1]

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## Abstract

Energy poverty (EP) is still one of the critical problems for many countries. For this purpose, we try to assess whether trade openness (TO) and foreign direct investment (FDI) are associated with EP for the panel sample of Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru, spanning the period 1992-2020. The panel vector autoregression (PVAR) estimation results indicate that economic growth, TO, and FDI inflow reduce EP by increasing access to electricity in these countries. Further, PVAR Granger causality findings show feedback causality linkage between EP and TO, EP and FDI inflow, economic growth and TO, and economic growth and FDI inflow. Moreover, the outcomes indicate that a bidirectional causality exists from economic growth to EP and from TO to FDI inflow.

**Keywords:** Energy Poverty, Access to Electricity, Trade Openness, Foreign Direct Investment, Economic Globalization

**JEL Code:** F64, Q01, P18

## 1. Introduction

Energy has comprehensive impacts on society. On one side, it makes it possible to meet basic human needs; they also promote production, income, and employment in the agriculture, manufacturing, trade, mining, and service sectors.

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[1] This study is an extended version of the paper titled **"**Understanding Energy Poverty through the Perspective of Trade Openness and Foreign Direct Investment: The Case of Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru**"** presented at the Eurasian Conference on Economics, Finance and Entrepreneurship (ECONEFE'22) held in Belgrade, Serbia on 7-10 September 2022.

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In addition, access to energy resources, vital for achieving the Millennium Development Goals (MDGs), promotes society's overall well-being (Masud et al., 2007). However, although remarkable technological improvement occurs in technology global society, EP remains essential for many developing countries. On this point, there are many arguments on the definition and concept of EP.

Relevant literature is conceptualized in the scope of different approaches. According to the technological threshold view, EP refers to the case of using predominantly traditional energy sources and being deprived of modern energy services. In contrast, the physical threshold approach emphasizes the importance of insufficient energy consumption that is necessary to meet basic needs. Furthermore, according to the economic threshold approach, EP refers to the inability to reach the required income level to meet the necessary energy consumption (González-Eguino, 2015). Moreover, World Economic Forum (2010) defines EP as "*the lack of access to sustainable modern energy services and products.*" Concerning this, the United Nations (UN) intents to *"ensure access to affordable, reliable, sustainable and modern energy for all."* (United Nations, 2015) in the context of sustainable development.

Next to the concept of EP, another critical point is clarifying the indicators of EP. Based on these, it is accepted by multilateral international institutions that there are two leading indicators for EP. First, access to electricity and modern cooking fuels (mainly access to clean fuels and technologies for cooking) are accepted as the leading indicators of EP (Sovacool, 2013). As an essential indicator of EP, access to electricity is the share of the population with access to electricity in a given period or geographical area in the total population (OECD, 2019). According to the World Bank (2022), access to electricity represents a country's most apparent and undistorted state of EP. In this respect, access to electricity is the cornerstone of the nations' global socioeconomic development, poverty reduction, and prosperity (Salite et al., 2021). Hence, from these points of view, there is a strong line between EP and access to electricity (Shyu, 2014; Shyu, 2022; Raghutla & Chittedi, 2022). Thus, based on outlined above, in this study, access to electricity refers to EP.

Practically, the recent data shows dramatic outcomes in terms of EP. Nearly 1 million people have no access to electricity worldwide, and more than 2 billion will still rely on conventional cooking fuels. Several factors affect access to favorable electricity consumption, including high energy prices, income distribution, the structure of energy infrastructure, and the composition of energy use (Henry et al., 2021; Koomson & Danquah, 2021). In addition, environmental degradation related to climate change and lack of food and shelter also cause EP (Mohsin et al., 2022).

To date, in this framework, researchers have tried to explore the determinants of EP. Mostly, economic growth (Acharya & Sadath, 2019; Doğanalp et al., 2021; Adom et al., 2021; Amin et al., 2020; Raghutla & Chittedi, 2022),

income inequality (Igawa & Managi, 2022; Couharde & Mouhoud, 2020; Nguyen & Nasir, 2021; Dong et al., 2022), renewable energy (Judson et al., 2019; Wang et al., 2022; Hamed & Peric, 2020; Biernat-Jarka et al., 2021; Zhao, Dong, Dong, and Shahbaz, 2022), energy efficiency (Boemi & Papadopoulos, 2019; Damigos et al., 2021; Al-Tal et al., 2021; Chien et al., 2022; Li et al., 2021), and foreign aid (Munyanyi & Churchill, 2022; Foo et al., 2021) are considered as main factors. However, few studies have focused on examining the effect of economic globalization[4] on EP. Namely, the heterogeneous impacts of economic globalization on EP are ignored.

TO and FDI have different aspects in terms of affecting EP. Economic globalization allows countries to enhance technological innovation to reduce energy prices and costs (Zhao, Ramzan, Sengupta, Sharma, Shahzad, and Cui, 2022). Hence from the optimistic view, it is expected that globalization is negatively associated with EP. The need to explore economic globalization and EP follows from current empirical evidence on whether TO and FDI affect EP. As World Bank (2021) mentioned, nearly 759 million people have no access to electricity, and most of these people live where regional conflicts occur. Furthermore, the Covid-19 pandemic has accelerated the EP and, this leads to moving away from sustainable development goals.

Many scholars have considered different explanations for this issue based on the majority of indicators for investigating EP. However, this manuscript examines how TO and FDI could affect EP by using access to electricity as a proxy for it for the panel sample of Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru, spanning the period 1992-2020. There are two main reasons to select this country's group. Firstly, although these countries have made some progress in access to electricity, EP is still a crucial issue. Secondly, these countries have experienced an important liberalization process in terms of integration into the world economy for a long time. Hence, the impact of TO and FDI may be determined more precisely in these countries.

This study contributes to the existing literature on TO, FDI, and EP nexus. First, to the best of the authors' knowledge, this is the first study that analyses the impacts of TO and FDI on EP in selected Latin American countries (Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru). There are two critical reasons for selecting these country groups as our panel sample. First, while considerable progress has been made in reducing EP, particularly regarding access to electricity, a significant number of individuals still need this basic necessity. According to Our World in Data (2024a), approximately 761 million people worldwide do not have access to electricity, with around 2.645 million living in the countries included in our panel sample. Second, these countries have experienced noteworthy economic

[4] Economic globalization represents the spread of international trade, finance, and investment. It mainly comprises TO, FDI, and portfolio investment (Shangquan, 2000; Barbieri & Reuveny, 2005; Dreher, 2006; Gygli et al., 2019). Therefore, in some parts of the paper, we prefer to use economic globalization, referring TO and FDI inflow to emphasize the importance of the subject.

globalization, especially in terms of TO and FDI inflows. Therefore, the association between EP, TO, and FDI inflow becomes a debating topic in understanding how economic globalization influences EP in Latin American countries.

Second, our paper applies the PVAR estimation technique to reveal the relationship between TO, FDI, and EP instead of traditional panel approaches. We employ this method due to the benefits from its advantages of timing analysis and panel model analysis.

The remaining parts of the study are structured as follows; Section 2 summarizes the relevant empirical literature. Section 3 describes data attributes and the method. Section 4 represents and discusses the main findings. Finally, section 5 concludes with policy recommendations.

## 2. Literature Review

Although several factors affect EP in the 21st century, there is no common idea about the determinants of EP. However, nowadays, the globalization process is closely linked with access to modern energy. However, the existing literature is concentrated on studies that have examined the microeconomic and macroeconomic determinants of EP by proxying different indicators. Moreover, the first strand of the relevant literature mainly focuses on the relationship between economic growth and EP. For instance, Al-mulali et al. (2014) researched the association between renewable and non-renewable electricity consumption and economic growth for a panel sample of 18 Latin American countries using data covering the period 1980-2010. The authors' empirical findings show that renewable and non-renewable electricity consumption contributes to economic growth. Moreover, there is two-way causality among variables. Acharya & Sadath (2019) used the household survey data for the period 2004-2005 and 2011-2012 in India to reveal the relationship between economic development and EP. The authors calculated a multidimensional energy poverty index (EPI) to measure EP. Their empirical findings show a negative relationship between economic development and EP. Also, they indicate that education has a substantional effect on EP compared to economic development. Onuonga (2020) employed the autoregressive distributed lag (ARDL) estimation technique to study the role of access to electricity and remittances in economic growth in Kenya over the period 1987-2018. The empirical findings reveal that access to electricity and remittances positively influence economic growth and there is a one-way causality running from economic growth to access to electricity. Doğanalp et al. (2021) examined the empirical relationship between EP and economic growth for the BRICS countries spanning over the period 2001-2018. Using PVAR, the fully modified ordinary least square (FMOLS), and dynamic ordinary least square (DOLS) estimations techniques. Access to clean fuels and technologies for cooking was used as a proxy for EP. The empirical results indicate that EP does not influence economic growth but positively impacts inflation. Similarly, Raghutla & Chittedi (2022) analyzed the impact of EP (by using access to electricity as a proxy) on economic growth for the

BRICS countries by using data from 1990-2018. According to the panel modelling estimation technique, EP positively impacts economic development. Besides, panel causality tests confirm that in the short-run, there is a one-way causality relationship running from economic development to EP. Adom et al. (2021) studied the impact of EP and renewable energy on economic development in Africa and Ghana. The real price of electricity and expenditure share on electricity was included in the model as a proxy for EP in their study. The empirical findings documented that EP negatively affects economic growth, human capital, life expectancy, level of employment, and mobile phone subscription. However, it positively influences poverty, income inequality, sanitation risk, and the risk of drinking unsafe water. Amin et al. (2020) investigated the effect of EP measured by access to electricity on economic development between 1995 and 2017 with panel data for seven South Asian countries. According to the ARDL results, EP negatively affects economic development in these countries.

The second strand of the relevant literature deals with the relationship among financial development, FDI, TO, and EP. Alshubiri et al. (2021) investigated the relationship between financial depth, FDI, and energy consumption (green and non-green) for the 14 OPEC countries over the period 1990 and 2015. The empirical results indicate a negative association between FDI and access to renewable electricity, whereas TO has no significant effect. Asngar (2022) employed pooled OLS, fixed effects, and system generalized method of moments (GMM) as estimation methodologies to reveal the potential association between financial development and EP using access to electricity as a proxy from 1997 to 2018 for the panel of 45 countries in sub-Saharan Africa (SSA). The empirical model's results indicate that financial development reduces EP through increasing access to electricity. Asuamah (2016) examined the relationship between financial development and electricity consumption in Ghana from 1970 to 2011 using ARDL and Granger causality test estimation techniques. The ARDL findings show that there is no statistically significant relationship between financial development and electricity consumption both in the short and long run; the Granger causality test result indicates the existence of a two-way relationship between financial development and electricity consumption. Similarly, Atchike et al. (2020) researched the relationship between FDI, electricity consumption, and economic growth in Benin, covering the period 1980-2014. They found a long-run relationship between variables and one-way causality running from electricity consumption to economic growth and FDI. D'amelio et al. (2016) investigated the role of multinational enterprises' FDI on access to electricity in 83 home countries and 15 host countries in SSA over the period 2005 and 2011. They find that FDI positively affect access to electricity in developing countries-notably, FDI inflow is caused by less developed countries with poor institutional quality. Duan & Guo (2021) researched the impact of financial development and TO on electricity consumption in the 31 Chinese provinces covering the period 2004-2018. The spatial econometric approach and PVAR model results show that while financial development promotes an increase in electricity consumption, TO has a negative effect on electricity consumption. The empirical results of the study put forward by Murshed (2018) for selected South Asian countries spanning the period 2000 and

2017 express that TO stimulates access to clean energy sources and primary energy-use efficiency. In another study, Muthusamy & Negi (2020) tried to observe the dynamic associations between FDI inflow and social development indicators, including access to electricity in India, across 1993-1994 to 2017-2018. The results confirmed that FDI positively influences access to electricity in the long run.

In a study by Rafindadi & Ozturk (2016), the impact of financial development, TO, and economic growth on electricity consumption was investigated in the case of Japan using annual data covered from 1970 to 2012. The authors reported that financial development, TO, and economic growth have a positive effect on electricity consumption in the long run. Using the data from Ghana between 1960 and 2018, Anarfo et al. (2021) assessed the possible promoting effect of access to electricity on FDI. Outcomes from the study prove that access to electricity promotes the inflow of FDI in a given period. Obeng et al. (2008) empirically assess the relationship between Ghana's photovoltaic (PV) rural electrification and EP. The authors compose energy-poverty index scores (EPISs) by using principal component analysis (PCA), concluding that accessing solar PV has a negative impact on EP. Liu et al. (2019) examined the influence of energy embodied in exports of vertical specialization in the construction sector on EP in 40 countries. They conducted an empirical analysis using the modified energy development index (EDI). The energy embodied in exports of vertical trade denotes the size of EP in the construction sector affected by vertical trade. The empirical findings represent that the energy embodied in exports of vertical specialization in the construction sector has increased in 19 countries; in contrast, it has decreased in 21 countries.

In a recent study, Zhao, Ramzan, Sengupta, Sharma, Shahzad, and Cui (2022) explored the relationship between bilateral trade, globalization, bureaucratic quality, and EP using cross-sectional autoregressive distributed lag (CS-ARDL) and common correlated effects generalized method of moments (CCE-GMM) methodologies for the in 27 EU countries over the period 2000 and 2019. The authors used the energy expenses of quartile one and access to clean fuels and technology for cooking as a proxy for EP. The results of this study show that bilateral trade increases access to clean fuels and energy prices. However, economic globalization hurts the poorest people in Europe through rising energy costs and hampering access to fuel. Mohsin et al. (2022) investigated the impact of financial development on EP in Latin America data ranging from 1995 to 2015 by utilizing the entropy method and PCA analysis. The authors composed the EPI by performing the entropy method to use as an EP indicator. The empirical results indicate that lower financial development causes increasing EP. The analysis conducted by Koomson & Danquah (2021) that focuses on the influence of financial inclusion on EP in Ghana evidenced that financial inclusion negatively affects EP. Nguea et al. (2022) scrutinized whether FDI affects access to electricity for a panel sample of 36 African countries from 2000-2017. The authors' analysis results indicate that FDI positively affects access to electricity. Tariq et al. (2023) used the ARDL estimation technique to determine the effect of FDI, globalization, and economic growth on renewable electricity consumption for the panel sample of

Belt and Road Initiative (BRI) countries using data spanning the period 2000-2020. They reported that there is a positive relationship between FDI and renewable electricity consumption in the long run. Likewise, Aluko et al. (2023) documented that FDI positively impacts access to electricity in 36 African countries.

To sum up, from the above brief review of the relevant literature, there is a very scarce empirical literature investigating the impact of TO and FDI separately on EP.

## 3. Methodology

This research investigates the impact of TO and FDI on EP in Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru from the period of 1992 to 2020. Unfortunately, the accessibility of the data constrained the selection of the time. Access to electricity has been used as an indicator of EP inspired by the studies of Pereira et al. (2010); Pereira et al. (2011); Kaygusuz (2011); González-Eguino (2015); Njiru & Letema (2018); Acharya & Sadath (2019); Aigheyisi & Oligbi (2020); Amin et al. (2020); Raghutla & Chittedi (2022). Nevertheless, we utilized the share of the sum of export and import over GDP representing TO and the share of FDI net inflow over GDP. Also, we included gross domestic per capita representing economic growth as a control variable and an important determinant of EP, as mentioned above. Table 1 shows the variables of the study, describing their units of measure as well as sources.

**Table 1.** Definition of Variables

| Variable | Symbol | Definition | Units of measure | Source |
|---|---|---|---|---|
| Energy Poverty | EP | Access to electricity | % of Total Population | World Bank (2022) |
| Economic Growth | GDP | Gross domestic product per capita | Constant 2015 US$ | World Bank (2022) |
| Trade Openness | TO | Sum of exports and imports of goods and services | % of GDP | World Bank (2022) |
| Foreign Direct Investment | FDI | Net inflow | % of GDP | World Bank (2022) |

**Source:** Authors' compilation.

We constructed a model to evaluate the impact of TO and FDI on EP in selected countries, presented in Equation 1.

$$EP_{it} = f(GDP_{it}, TO_{it}, FDI_{it}) \quad (1)$$

In Eq. [1], EP stands for energy poverty proxied by access to electricity of population. GDP represents economic growth; TO and FDI denote trade openness and foreign direct investment net inflow, respectively. The variables in Table 1 are

raw data used directly from the databases. The first version of our empirical model [1] is converted into a semi-logarithmic[5] form as follows:

$$lnEP_{it} = \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnTO_{it} + \beta_3 FDI_{it} + u_{it} \quad (2)$$

In Eq. [2], $\beta_1$, $\beta_2$, and $\beta_3$ are elasticities of economic growth, TO, and FDI respectively, and $u_{it}$ is the error of the model.

**Cross-Sectional Dependence (CSD) and Slope Homogeneity**

If the CSD is ignored in the panel data methodology, the empirical findings will be inconsistent (Destek, 2020). For this purpose, we perform Breusch & Pagan's (1980) LM, Pesaran's (2004) CD and $CD_{LM}$ tests, and Pesaran et al. (2008)'s $LM_{adj}$ test to check the presence of the CSD. Next to the CSD test, The second step of the empirical analysis is to examine the stationarity properties of the series. Thus, we applied Pesaran & Yamagata's (2008) Delta ($\tilde{\Delta}$) test to check the slope homogeneity.

**Panel Unit Root Test**

The results of the CSD are crucial to determine which unit root test should be applied. If the CSD exists among variables, it requires using second-generation panel unit root tests, which are robust to CSD. In the presence of CSD, the stationarity properties of the series are researched by employing cross-sectionally augmented IPS (CIPS) unit root tests developes by Pesaran (2007). The general form of the CIPS unit root test can be written as below:

$$CIPS = \frac{1}{N}\sum_{i=1}^{N} t_i(N,T) \quad (3)$$

where $t_i(N,T)$ denotes the statistics of cross-sectional augmented Dickey-Fuller (CADF) regression in the period of *t* (El Menyari, 2021).

**Panel Cointegration Test**

In order to explore the presence of a relationship between variables, it is necessary to apply the panel cointegration test. However, deciding which cointegration test is appropriate depends on whether the CSD exists across variables. Due to the presence of CSD in our model, we employed the Durbin-Hausman (D-H) cointegration test provided by Westerlund (2008), one of the second-generation panel cointegration tests. This test allows for CSD and has two statistics as group statistics and panel statistics. While the group statistics is used to test the cointegration relationship between the series if the panel is heterogeneous,

[5] Due to the negative values of FDI, we could not convert it into the logarithmic form.

the panel statistic is used to reveal the cointegration relationship between the series in the case of the homogeneous panel (Bayar & Ozturk, 2018).

### PVAR Specification

To determine the dynamic relationship among variables, this study performs the PVAR technique developed by Love & Zicchino (2006). This technique is superior to the traditional VAR model because it conjoins the traditional VAR approach, which holds all variables in the system as endogenous and panel data, which allows unobserved individual heterogeneity (Tiwari, 2011). Moreover, PVAR establishes the model as a multivariable technique by capturing each endogenous variable as a function of the lag value of all endogenous variables (Hu & Zheng, 2021). In addition, PVAR is allowed to be used in case of shocks occurring within a unit and over time. Besides, this method does not distinguish between variables as dependent or independent, and all variables are threatened as endogenous (Azam et al., 2021). The current paper applies the PVAR estimation strategy because variables have a complex and intertwined relationship. Hence, it is crucial to select the appropriate technique that makes it possible to investigate two-way relationships among variables that have potentially intricate links. In other words, theoretical bases on the association between EP, economic growth, TO, and FDI offer some framework. However, in the era of globalization, it is important to investigate the possible two-way relationships among those variables. Therefore, PVAR allows us to estimate the model by considering all variables as dependent and independent.

The PVAR model is constructed as follows (Tiwari, 2011):

$$Z_{it} = \gamma_0 + \gamma_1 Z_{it-1} + \gamma_2 z_{it-2} + \mu_i + d_{c,t} + u_{it} \quad (4)$$

where $Z_{it}$ represents the vectors of endogenous variables (EP, GDP, TO, and FDI), $\gamma_0$ denotes the matrix of country-specific fixed effects. Also, $\gamma_1$ and $\gamma_2$ represent matrix polinom in the lag operator, and it indicates the vector determining the country-specific effects in this regression. In Eq. [4] $d_{c,t}$ denotes the dummy varible of country which is valid for a specific period and $u_{it}$ is the residual vector (Tiwari, 2011; Charfeddine & Kahia, 2019).

## 4. Findings

### Preliminary Tests Results

Our empirical analysis starts with the test of the CSD and slope homogeneity among variables. The results of the CSD and slope homogeneity are reported in Table 2.

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**Table 2.** CSD and Slope Homogeneity Test Results

| **CSD tests** | **lnEP** | **lnGDP** | **lnTO** | **FDI** | **Model** |
|---|---|---|---|---|---|
| **LM** | 55.08 [0.000] | 39.65 [0.000] | 183.4 [0.000] | 331.7 [0.000] | 410.074 [0.000] |
| **$CD_{LM}$** | 5.67 [0.000] | 4.117 [0.000] | 10.2 [0.000] | 18.02 [0.000] | 60.035 [0.000] |
| **CD** | 24.674 [0.000] | 24.590 [0.000] | 24.636 [0.007] | 20.984 [0.000] | 20.069 [0.000] |
| **$LM_{adj}$** | 15.01 [0.000] | 7.904 [0.000] | 74.8 [0.000] | 144.0 [0.000] | 22.628 [0.000] |
| **Slope Homogeneity** | **lnEP** | **lnGDP** | **lnTO** | **FDI** | **Model** |
| Delta ($\tilde{\Delta}$) | 33.772 [0.000] | 28.284 [0.000] | 13.290 [0.000] | 2.394 [0.000] | 11.701 [0.000] |
| Delta $(\tilde{\Delta})_{adj}$ | 35.667 [0.000] | 29.871 [0.000] | 14.036 [0.000] | 2.528 [0.000] | 12.862 [0.000] |

**Note:** Numbers in brackets denote p-values.
**Source:** Authors' compilation.

Table 2 confirms that the null hypothesis of no CSD among variables is firmly rejected at the 1% significance level. Besides, slope homogeneity findings indicate the slope heterogeneity among series at the 1% significance level. In the presence of CSD between variables, the first generation panel root test can not be reliable. Thus, in the case of CSD, it is required to perform second-generation panel unit root tests (Baloch et al., 2021). Therefore, we use the CIPS unit root test as a second-generation panel unit root test which is reliable against CSD and slope heterogeneity. The CIPS unit root test results for all series are documented in Table 3.

**Table 3.** The CIPS Unit Root Test Results

| **Variables** | **lnEP** | **lnGDP** | **lnTO** | **FDI** |
|---|---|---|---|---|
| **CIPS (Level)** | -1.243 | -0.580 | -1.119 | -1.10 |
| **CIPS (First Differences)** | -5.816*** | -4.128*** | -4.196*** | -6.190*** |
| **Order of Integration** | I(1) | I(1) | I(1) | I(1) |

**Source:** Authors' compilation.
**Note:** Asterisk *** indicates a significance level at 1%. Critical values for the CIPS unit root test are -2.18, -2.33, and -2.64 at 10%, 5%, and 1% level, respectively.

From the results of the CIPS unit root test in Table 3, it is obtained that all variables have a unit root process at the level, but they become stationary after taking the first difference. Hence, our results prove that all variables are integrated with first-order [I(1)]. However, since all the variables are integrated with first-order, exploring the long-run relationship across all the variables is required. In order to reveal the potential long-run association among EP, economic growth, TO, and FDI, we apply the D-H cointegration test. The cointegration test results are highlighted in Table 4.

**Table 4.** Panel Cointegration Test Results

| Specification | D-H Cointegration Test | |
|---|---|---|
| | Statistics | p-value |
| DH_Panel | 40.099*** | 0.000 |
| DH_Group | 54.390*** | 0.000 |

**Note:** Asterisk *** indicates a significance level at 1%.
**Source:** Authors' compilation.

The results of the D-H cointegration test in Table 4 show that the null hypothesis of no cointegration could be rejected at a 1% significance level. It means that EP, economic growth, TO, and FDI inflow are cointegrated and move together in the long run.

## PVAR Results

Before estimating the parameters by using the PVAR technique, the appropriate lag length should be determined. The results of the lag lenght criteria are reported in Table 5.

**Table 5.** Results of Lag Selection Criteria

| Lag | CD | J | Jp value | MBIC | MAIC | MQIC |
|---|---|---|---|---|---|---|
| 1 | 0.999997 | 67.93591 | 0.3446974 | -257.274 | -60.06409 | -140.1393 |
| 2 | 0.9999958 | 51.72262 | 0.3306138 | -192.1848 | -44.27738 | -104.3338 |
| 3 | 0.9999963 | 40.09536 | 0.1540651 | -122.5096 | -23.90464 | -63.94225 |
| 4 | 0.9999965 | 17.36416 | 0.3624191 | -63.93831 | -14.64584 | -34. 65464 |

**Note:** CD means the overall coefficient of determination, and J is Hansen's J statistics. MBIC, MAIC, and MQIC represent the Modified version of Bayesian Information Criterion, Modified version of Akaike Information Criterion, and Modified version of Hannan and Quinn Information Criterion, respectively.
**Source:** Authors' compilation.

According to Table 5, the optimal lag length is chosen as one because all information criteria are the highest in lag 1. After deciding the optimal lag length, we estimated the parameters by performing PVAR based on the GMM equation. The PVAR regression results are offered in Table 6.

**Table 6.** Panel VAR Regression Results

| Response of | Response to | | | |
|---|---|---|---|---|
| | lnEP | lnGDP | lnTO | FDI |

| | | | | |
|---|---|---|---|---|
| **lnEP$_{(t-1)}$** | -0.126 | 0.003* | 0.079*** | 2.270** |
| **lnGDP$_{(t-1)}$** | 0.188** | 0.080 | 1.062*** | -8.414 |
| **lnTO$_{(t-1)}$** | 0.106*** | 0.052** | 0.242*** | 1.195*** |
| **FDI$_{(t-1)}$** | 0.005** | 0.068* | 0.006 | 0.212*** |

**Note:** Asterisks *,**, and *** denote significance level at 10%, 5%, and 1%, respectively. **Test of overidentifying restriction:** Hansen's J chi2(96) = 90.938979 (p = 0.627).
**Source:** Authors' compilation.

There are four models in PVAR. We can summarize the findings of PVAR as follows:

(i) Firstly, the findings reported in Table 6 show that economic growth, TO, and FDI positively affect EP (access to electricity). In other words, economic growth and economic globalization increase access to electricity and causes reducing EP. The estimated coefficients pointed out that an increase of 1% in gross domestic per capita raises access to electricity by 0.188%. An increase of 1% in TO promotes access to electricity by 0.106%, and a 1 unit increase in net FDI inflow increases access to electricity by 0.5%.

(ii) Secondly, the findings reported in Table 6 show that EP (access to electricity), TO, and FDI inflow positively impact economic growth. For example, an increase of 1% in EP (access to electricity) and TO raise economic growth by 0.003% and 0.052%, respectively, and a 1 unit increase in net FDI inflow increases economic growth by 6.8%.

(iii) Thirdly, the findings reported in Table 6 present that EP (access to electricity) and economic growth have a positive impact on TO. For instance, if access to electricity and economic growth increase by 1%, TO increases by 0.079% and 1.062%, respectively.

(iv) Lastly, the findings reported in Table 6 indicate that EP (access to electricity) and TO positively influence FDI inflow. If access to electricity and TO increase by 1%, FDI inflow rises by 0.022 units and 0.011 units, respectively.

We also employ the fully modified ordinary least square (FMOLS) and dynamic ordinary least square (DOLS) estimation tehcniques to provide robustness check. The robustness check results are shown in Table 7.

**Table 7.** Robustness Check Results

| Variables | FMOLS | DOLS |
|---|---|---|
| **lnGDP** | 0.093* | 0.456*** |
| **lnTO** | 0.053*** | 0.125*** |
| **FDI** | 0.093*** | 0.002* |

**Note:** Asterisks * and *** denote significance level at 10% and 1%, respectively.
**Source:** Authors' compilation.

The robust analysis with panel FMOLS and DOLS also confirms the outcomes of the PVAR that economic growth, TO, and FDI inflow positively affect EP (access to electricity). Namely, these indicators decrease EP through increasing

access to electricity in Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru.

### Panel VAR Granger Causality Test Results

After determining signs of the parameters, we try to determine whether there is any causality relationship among variables in the long run. To find out the causality associations between EP, economic growth, TO, and FDI inflow, we utilized the PVAR Granger causality (Wald) test. The results of the PVAR Granger Causality (Wald) test are illustrated in Table 8.

**Table 8.** PVAR Granger causality Wald Test Results

| Causal direction → | lnEP | lnGDP | lnTO | FDI |
|---|---|---|---|---|
| **lnEP** | - | 0.004 | 37.645*** | 4.037** |
| **lnGDP** | 11.933*** | - | 28.092*** | 27.504*** |
| **lnTO** | 29.680*** | 4.077** | - | 18.584*** |
| **FDI** | 6.703** | 3.295* | 0.517 | - |

**Note:** Asterisks *, **, and *** illustrate significance level at 10%, 5%, and 1%, respectively.
**Source:** Authors' compilation.

The results demonstrate that there is a feedback causality relationship between EP and TO, EP and FDI inflow, economic growth and TO, and economic growth and FDI inflow. In addition, the outcomes indicate a single-way linkage exists from economic growth to EP and from TO to FDI inflow in selected countries for a given period (see Graph 1).

**Graph 1.** Graphical View of the Causality Relationship

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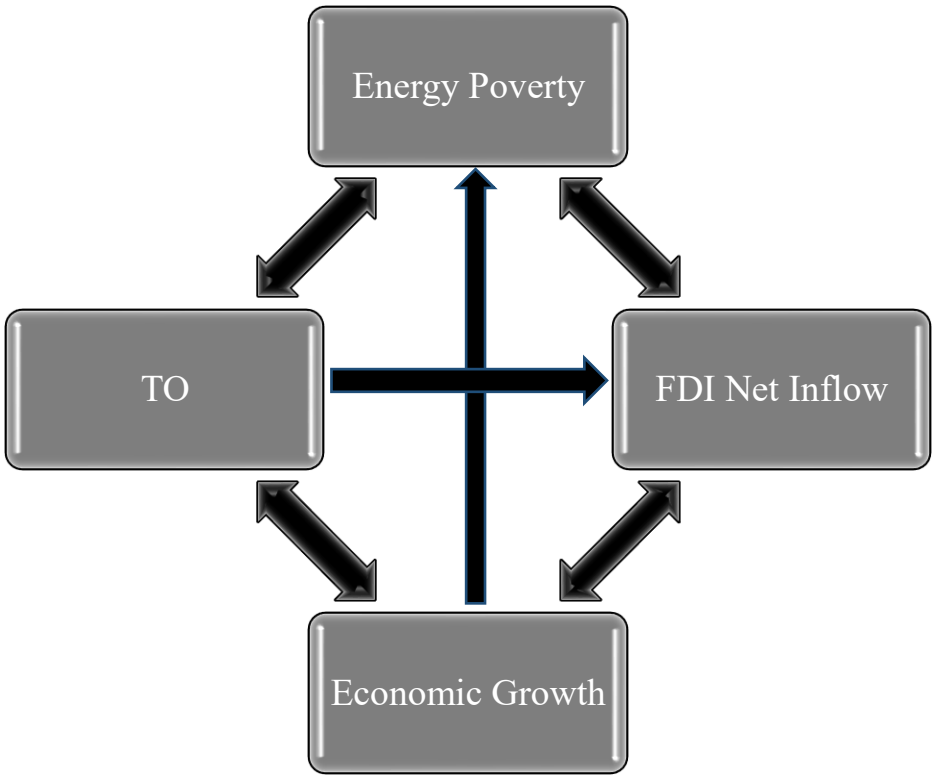


**Source:** Authors' compilation.

Our empirical findings on the nexus between economic growth and EP (access to electricity) are in line with the study of Al-mulali et al. (2014) for the case of Latin American countries, Acharya & Sadath (2019) for India, Raghutla & Chittedi (2022) for BRICS, and Onuonga (2020) for Kenya. The positive association between economic growth and access to electricity can be explained from two sides. On the first side, along with economic growth, individuals can get opportunities to access electricity. In other words, economic growth stimulates access to electricity from different sources. On the second side, access to electricity as renewable energy plays a crucial role in enhancing economic growth. It contributes to energy saving and productivity, which positively influences economic growth.

Besides, our findings support the results of the studies conducted by Rafindadi & Ozturk (2016), Murshed (2018), and Zhao, Ramzan, Sengupta, Sharma, Shahzad, and Cui (2022), who asserted the positive association between TO and access to clean energy. The positive effect of TO on access to electricity may cause similar reasons for FDI. Less developed and developing countries face significant budget constraints in achieving clean energy sources. Therefore, trade liberalization encourages countries to adopt clean energy technology (Murshed, 2018). Moreover, TO may reduce the cost of access to clean energy and technology in less developed and developing countries.

Finally, there is a positive relationship between FDI inflow and access to electricity. This result is consistent with studies by Muthusamy & Negi (2020), Nguea et al. (2022), Tariq et al. (2023), Anarfo et al. (2021), and Aluko et al. (2023). The contributing effect of FDI on access to electricity may arise for some reasons. For example, foreign capital stimulates the electricity sector in the host economy through technological improvement and capital accumulation. Besides foreign investment, external funds may be used to finance the electricity sector by building electricity infrastructure. As FDI increases, the supply of electricity rises as well, and it feeds the host economies' industries (Nguea et al., 2022).

The countries in our panel sample have experienced significant TO and FDI development to integrate with the world economy. The trade (% of GDP) increase from 79.5%, 46.7%, 71%, 38.5%, 71.3%, 121.8%, and 29.5% to 108.0%, 67.8%, 112.7%, 88.4%, 115.3% 95.9%, and 57.3% from 1990 to 2022 in Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru, respectively (World Bank, 2022). Moreover, net inflow FDI over GDP has risen from 3.15%, 0.88%, 1.01%, 0.07%, 2.11%, and 0.16% to 4.72%, 3.41%, 2.66%, 8.26%, 3.45%, and 4.47% over 1990-2022 in Belize, Honduras, Mexico, Nicaragua, Panama, and Peru, respectively, and decline from 0.56% to -0.03% in Bolivia during the same period (Our World in Data, 2024b).

## 5. Conclusions and Policy Implications

### Conclusions

Globalization's impacts on the countries' socioeconomic development keep its popularity among political-economy debates. The mainstream opinions strongly say that globalization offers various opportunities for developing countries to benefit from international economic relations. Based on this view, it is supposed that developing countries can enhance their economic, social, and political development process through capturing the opportunities which occur thanks to globalization. In contrast, some approaches have doubts about the impact of globalization on the developing countries' development path. According to these views, globalization weakens developing countries against developed countries. For example, EP is one of the busy topics regarding economic globalization's impact on development. Yet, even though the UN aims to reduce EP all over the world in terms of sustainable development goals (SDGs), there are millions of people combating EP. Hence, the development economics and international political economics literature strive to widen the alternative perspective for understanding EP.

This paper investigates the impact of TO and FDI on EP for the panel sample of Belize, Bolivia, Honduras, Mexico, Nicaragua, Panama, and Peru, capturing the

period between 1992 and 2020. To empirically support our hypothesis, several econometric methodologies are performed (CSD, slope homogeneity, panel unit root, panel cointegration, PVAR, FMOLS, DOLS, and PVAR Granger causality analysis). The panel cointegration test results verify the long-run relationship between variables. Moreover, the PVAR estimation outcomes illustrate that economic growth, TO, and FDI inflow positively affect access to electricity. Namely, economic growth and economic globalization have a decreasing effect on EP by increasing access to electricity. The robustness of the findings is also assured with the FMOLS and DOLS. In addition to this the PVAR Granger causality test results indicate two-way causality relationship between EP and TO, EP and FDI inflow, economic growth and TO, and economic growth and FDI inflow. In addition, the outcomes indicate a single-way linkage exists from economic growth to EP and from TO to FDI inflow.

**Policy Implications**

Based on empirical outcomes, we propose some policy implications for policymakers in regards to reducing EP as follows:

(i) Economic growth is essential in reducing EP in Latin American countries. Hence, policymakers should strive to sustain economic growth in terms of access to electricity.

(ii) TO and FDI inflow contribute to decreasing EP by increasing access to electricity. These results mean that if these countries integrate into the world economy, they can obtain trade and investment opportunities to reduce EP. Thus, policymakers should make an effort to attract FDI to improve new technologies that facilitate access to electricity and strengthen trade relationships with their partners to obtain alternative energy resources, particularly in access to electricity.

We should mention that it is not feasible and possible to capture all determinants of EP within the restrictions of a single perspective. Although the present paper tries to fill the literature gap, we have some limitations, like many scientific studies. Firstly, we consider the impact of TO and FDI. But future studies should also consider the impact of financial development. Secondly, in this paper, access to electricity has been used as an indicator of EP. Therefore, it is necessary to extend the scope of EP by examining different indicators. Thirdly, further studies can work with a large number of developing countries once the data is available and can also observe the impact of technology as an infrastructure quality. Finally, based on data availability, our paper suits the panel data estimation technique. When data is updated to estimate country-specific variables, future studies may focus on the association between economic globalization and EP by incorporating an estimation strategy that provides country-specific results for Latin American countries.

## REFERENCES

Acharya, R. H., & Sadath, A. C. (2019). Energy poverty and economic development: Household-level evidence from India. *Energy and Buildings*, *183*, 785-791. https://doi.org/10.1016/j.enbuild.2018.11.047

Adom, P. K., Amuakwa-Mensah, F., Agradi, M. P., & Nsabimana, A. (2021). Energy poverty, development outcomes, and transition to green energy. *Renewable Energy*, *178*, 1337-1352. https://doi.org/10.1016/j.renene.2021.06.120

Aigheyisi, O. S., & Oligbi, B. O. (2020). Energy poverty and economic development in Nigeria: Empirical Analysis. *KIU Interdisciplinary Journal of Humanities and Social Sciences*, *1(2)*, 183-193.

Al-Mulali, U., Fereidouni, H. G., & Lee, J. Y. (2014). Electricity consumption from renewable and non-renewable sources and economic growth: Evidence from Latin American countries. *Renewable and Sustainable Energy Reviews, 30*, 290-298. http://dx.doi.org/10.1016/j.rser.2013.10.006

Alshubiri, F., Elheddad, M., Jamil, S. A., & Djellouli, N. (2021). The impacts of financial depth and foreign direct investment on the green and non-green energy consumption of OPEC members. *SN Business & Economics, 1(77)*, 1-29. https://doi.org/10.1007/s43546-021-00075-4

Al-Tal, R., Murshed, M., Ahmad, P., Alfar, A. J. K., Bassim, M., Elheddad, M., Nurmakhanova, M., & Mahmood, H. (2021). The non-linear effects of energy efficiency gains on the incidence of energy poverty. *Sustainability, 13,* 11055. https://doi.org/10.3390/su131911055

Aluko, O. A., Opoku, E. E. O., Ibrahim, M., & Kufuor, N. K. (2023). Put on the light! Foreign direct investment, governance and access to electricity. *Energy Economics*, *119*, 106563. https://doi.org/10.1016/j.eneco.2023.106563

Amin, A., Liu, Y., Yu, J., Chandio, A. A., Rasool, S. F., Luo, J., & Zaman, S. (2020). How does energy poverty affect economic development? A panel data analysis of South Asian countries. *Environmental Science and Pollution Research*, *27*, 31623-31635. https://doi.org/10.1007/s11356-020-09173-6

Anarfo, E. B., Agoba, A. M., Sare, Y. A., & Gameti, D. K. (2021). Energy access and foreign direct investment in an emerging market: The Ghanaian perspective. *International Journal of Energy Sector Management*, *15(5)*, 969-986. DOI: 10.1108/IJESM-09-2020-0011

Asngar, T. M. (2022). Does financial development improve access to electricity in sub-Saharan Africa?. *SN Business & Economics*, *2(146)*, 1-18. https://doi.org/10.1007/s43546-022-00324-0

Asuamah, S. Y. (2016). Modelling financial development and electricity consumption nexus for Ghana. *MPRA Paper 70097*. University Library of Munich, Germany. https://mpra.ub.uni-muenchen.de/70097/

Atchike, D. W., Zhao, Z. Y., & Bao, G. (2020). The relationship between electricity consumption, foreign direct investment and economic growth: Case of Benin. *International Journal of Energy Economics and Policy*, *10(4)*, 507-515.

Azam, A., Rafiq, M., Shafique, M., Yuan, J., & Salem, S. (2021). Human Development Index, ICT, and Renewable Energy-Growth Nexus for Sustainable Development: A Novel PVAR Analysis. *Frontiers in Energy Research, 9.* 760758. doi: 10.3389/fenrg.2021.760758

Baloch, M. A., Ozturk, I., Bekun, F. V., & Khan, D. (2021). Modeling the dynamic linkage between financial development, energy innovation, and environmental quality: Does globalization matter?. *Business Strategy and the Environment*, *30*, 176-184. https://doi.org/10.1002/bse.2615

Barbieri, K., & Reuveny, R. (2005). Economic globalization and civil war. *The Journal of Politics*, *67(4)*, 1228-1247.

Bayar, Y., & Ozturk, O. F. (2018). Impact of foreign direct investment inflows on tax revenues in OECD countries: A panel cointegration and causality analysis. *Theoretical & Applied Economics*, *25*, 31-40.

Biernat-Jarka, A., Trębska, P., & Jarka, S. (2021). The role of renewable energy sources in alleviating energy poverty in households in Poland. *Energies, 14*, 2957. https://doi.org/10.3390/en14102957

Boemi, S. N., & Papadopoulos, A. M. (2019). Energy poverty and energy efficiency improvements: A longitudinal approach of the Hellenic households. *Energy and Buildings*, *197*, 242-250. https://doi.org/10.1016/j.enbuild.2019.05.027

Breusch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. *The Review of Economic Studies*, *47*, 239-253.

Charfeddine, L., & Kahia, M. (2019). Impact of renewable energy consumption and financial development on CO2 emissions and economic growth in the MENA region: a panel vector autoregressive (PVAR) analysis. *Renewable Energy*, *139*, 198-213. https://doi.org/10.1016/j.renene.2019.01.010

Chien, F., Hsu, C. C., Zhang, Y., Tran, T. D., & Li, L. (2022). Assessing the impact of green fiscal policies and energy poverty on energy efficiency. *Environmental Science and Pollution Research*, *29*, 4363-4374. https://doi.org/10.1007/s11356-021-15854-7

Couharde, C., & Mouhoud, S. (2020). Fossil fuel subsidies, income inequality, and poverty: Evidence from developing countries. *Journal of Economic Surveys*, *34(5)*, 981-1006. doi: 10.1111/joes.12384

D'Amelio, M., Garrone, P., & Piscitello, L. (2016). Can multinational enterprises light up developing countries? Evidences from the access to electricity in

sub-Saharan Africa. *World Development*, *88*, 12-32. http://dx.doi.org/10.1016/j.worlddev.2016.06.018

Damigos, D., Kaliampakou, C., Balaskas, A., & Papada, L. (2021). Does energy poverty affect energy efficiency investment decisions? First evidence from a stated choice experiment. *Energies*, *14*, 1698. https://doi.org/10.3390/en14061698

Destek, M. A. (2020). Investigation on the role of economic, social, and political globalization on environment: Evidence from CEECs. *Environmental Science and Pollution Research*, 27, 33601-33614. https://doi.org/10.1007/s11356-019-04698-x

Doğanalp, N., Ozsolak, B., & Aslan, A. (2021). The effects of energy poverty on economic growth: A panel data analysis for BRICS countries. *Environmental Science and Pollution Research*, *28*, 50167-50178. https://doi.org/10.1007/s11356-021-14185-x

Dong, K., Dou, Y., & Jiang, Q. (2022). Income inequality, energy poverty, and energy efficiency: Who cause who and how?. *Technological Forecasting and Social Change*, *179*, 121622. https://doi.org/10.1016/j.techfore.2022.121622

Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. *Applied Economics*, *38*, 1091-1110. DOI: 10.1080/00036840500392078

Duan, R., & Guo, P. (2021). Electricity consumption in China: The effects of financial development and trade openness. *Sustainability*, *13*, 10206. https://doi.org/10.3390/su131810206

El Menyari, Y. (2021). The effects of international tourism, electricity consumption, and economic growth on CO2 emissions in North Africa. *Environmental Science and Pollution Research*, *28*, 44028-44038. https://doi.org/10.1007/s11356-021-13818-5

Foo, N., Lean, H. H., & Salim, R. (2021). Energy Poverty and the Impact of Wellbeing in ASEAN under China's Foreign Aid. *USAEE Working Paper No. 21-523*. http://dx.doi.org/10.2139/ssrn.3918379

González-Eguino, M. (2015). Energy poverty: An overview. *Renewable and Sustainable Energy Reviews*, *47*, 377-385. https://doi.org/10.1016/j.rser.2015.03.013

Gygli, S., Haelg, F., Potrafke, N., & Sturm, J. E. (2019). The KOF globalisation index-revisited. *The Review of International Organizations*, *14*, 543-574. https://doi.org/10.1007/s11558-019-09344-2

Hamed, T. A., & Peric, K. (2020). The role of renewable energy resources in alleviating energy poverty in Palestine. *Renewable Energy Focus*, *35*, 97-107. https://doi.org/10.1016/j.ref.2020.09.006

Henry, C. L., Baker, J. S., Shaw, B. K., Kondash, A. J., Leiva, B., Castellanos, E., Wade, C. M., Lord, B., Houtven, G. V., & Redmon, J. H. (2021). How will renewable energy development goals affect energy poverty in Guatemala?.

*Energy Economics*, *104*. 105665. https://doi.org/10.1016/j.eneco.2021.105665

Hu, Y., & Zheng, J. (2021). Is green credit a good tool to achieve "double carbon" goal? Based on coupling coordination model and PVAR model. *Sustainability, 13*, 14074. https://doi.org/10.3390/su132414074

Igawa, M., & Managi, S. (2022). Energy poverty and income inequality: An economic analysis of 37 countries. *Applied Energy*, *306*, 118076. https://doi.org/10.1016/j.apenergy.2021.118076

Judson, E., Zirakbash, F., Nygaard, A., & Spinney, A. (2019). Renewable energy retrofitting and energy poverty in low-income households. *Research Report for United Housing Cooperative,* 1-56.

Kaygusuz, K. (2011). Energy services and energy poverty for sustainable rural development. *Renewable and Sustainable Energy Reviews*, *15*, 936-947. doi:10.1016/j.rser.2010.11.003

Koomson, I., & Danquah, M. (2021). Financial inclusion and energy poverty: Empirical evidence from Ghana. *Energy Economics*, *94*, 105085. https://doi.org/10.1016/j.eneco.2020.105085

Li, W., Chien, F., Hsu, C. C., Zhang, Y., Nawaz, M. A., Iqbal, S., & Mohsin, M. (2021). Nexus between energy poverty and energy efficiency: Estimating the long-run dynamics. *Resources Policy*, *72*, 102063. https://doi.org/10.1016/j.resourpol.2021.102063

Liu, B., Zhang, L., Liu, C., Wang, D., Sun, J., Luther, M., & Xu, Y. (2019). Measuring energy poverty based on energy embodied in exports of vertical specialisation trade in the construction sector. *Energy and Buildings*, *196*, 157-168. https://doi.org/10.1016/j.enbuild.2019.05.022

Love, I., & Zicchino, L. (2006). Financial development and dynamic investment behavior: Evidence from panel VAR. *The Quarterly Review of Economics and Finance*, *46(2)*, 190-210. https://doi.org/10.1016/j.qref.2005.11.007

Masud, J., Sharan, D., & Lohani, B. N. (2007). Energy for all: Addressing the energy, environment, and poverty nexus in Asia. *Asian Development Bank Publication Stock No. 041207.*

Mohsin, M., Taghizadeh-Hesary, F., & Shahbaz, M. (2022). Nexus between financial development and energy poverty in Latin America. *Energy Policy*, *165*, 112925. https://doi.org/10.1016/j.enpol.2022.112925

Munyanyi, M. E., & Churchill, S. A. (2022). Foreign aid and energy poverty: Sub-national evidence from Senegal. *Energy Economics*, *108*, 105899. https://doi.org/10.1016/j.eneco.2022.105899

Murshed, M. (2018). Does improvement in trade openness facilitate renewable energy transition? Evidence from selected South Asian economies. *South Asia Economic Journal*, *19(2)*, 151-170. DOI: 10.1177/1391561418794691

Muthusamy, D. A., & Negi, R. (2020). Does foreign direct investment induces societal development in India. *GATR Journal of Finance and Banking Review*, *5(1)*, 32-38.

Nguea, S. M., Kaguendo, U. V. E., & Noumba, I. (2022). Are growth effects of foreign capital significant for increasing access to electricity in Africa?. *Energy Policy*, *168*, 113129. https://doi.org/10.1016/j.enpol.2022.113129

Nguyen, C. P., & Nasir, M. A. (2021). An inquiry into the nexus between energy poverty and income inequality in the light of global evidence. *Energy Economics*, *99*, 105289. https://doi.org/10.1016/j.eneco.2021.105289

Njiru, C. W., & Letema, S. C. (2018). Energy poverty and its implication on standard of living in Kirinyaga, Kenya. *Journal of Energy*, 1-12. https://doi.org/10.1155/2018/3196567

Obeng, G. Y., Evers, H. D., Akuffo, F. O., Braimah, I., & Brew-Hammond, A. (2008). Solar photovoltaic electrification and rural energy-poverty in Ghana. *Energy for Sustainable Development*, *XII(1)*, 19-30.

OECD (2019). *Sustainable results in development: Using the SDGs for shared results and impact*. OECD Publishing: Paris. https://doi.org/10.1787/368cf8b4-en

Onuonga, S. M. (2020). Economic growth, electricity access, and remittances in Kenya. *Management and Economics Research Journal*, *6(2)*, 1-13. https://doi.org/10.18639/MERJ.2020.1100554

Our World in Data (2024a). Number of people without access to electricity. Calculated by Our World in Data based on the World Bank.

Our World in Data (2024b). Data adapted from Data compiled from multiple sources by World Bank. Retrieved from https://ourworldindata.org/grapher/foreign-direct-investment-net-inflows-as-share-of-gdp

Pereira, M. G., Freitas, M. A. V., & Da Silva, N. F. (2010). Rural electrification and energy poverty: Empirical evidences from Brazil. *Renewable and Sustainable Energy Reviews*, *14*, 1229-1240. doi:10.1016/j.rser.2009.12.013

Pereira, M. G., Freitas, M. A. V., & Da Silva, N. F. (2011). The challenge of energy poverty: Brazilian case study. *Energy Policy*, *39(1)*, 167-175. https://doi.org/10.1016/j.enpol.2010.09.025

Pesaran, M. H. (2004). General diagnostic tests for cross section dependence in panels. *IZA Discussion Paper No. 1240*. Institute for the Study of Labor (IZA).

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of Applied Econometrics*, *22*, 265-312.

Pesaran, M. H., Ullah, A., & Yamagata, T. (2008). A bias-adjusted LM test of error cross-section independence. *The Econometrics Journal*, *11*, 105-127. doi: 10.1111/j.1368-423X.2007.00227.x

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, *142*, 50-93. doi:10.1016/j.jeconom.2007.05.010

Rafindadi, A. A., & Ozturk, I. (2016). Effects of financial development, economic growth and trade on electricity consumption: Evidence from post-Fukushima Japan. *Renewable and Sustainable Energy Reviews*, *54*, 1073-1084. http://dx.doi.org/10.1016/j.rser.2015.10.023

Raghutla, C., & Chittedi, K. R. (2022). Energy poverty and economic development: Evidence from BRICS economies. *Environmental Science and Pollution Research*, *29*, 9707-9721. https://doi.org/10.1007/s11356-021-16174-6

Salite, D., Kirshner, J., Cotton, M., Howe, L., Cuamba, B., Feijó, J., & Macome, A. Z. (2021). Electricity access in Mozambique: A critical policy analysis of investment, service reliability and social sustainability. *Energy Research & Social Science*, *78*, 102123. https://doi.org/10.1016/j.erss.2021.102123

Shangquan, G. (2000). Economic globalization: Trends, risks and risk prevention. *Economic & Social Affairs, CDP Backround Paper No. 1*, 1-8.

Sovacool, B. K. (2013). Energy access and energy security in Asia and the Pacific. *ADB Economics Working Paper Series No. 383.*

Shyu, C. W. (2014). Ensuring access to electricity and minimum basic electricity needs as a goal for the post-MDG development agenda after 2015. *Energy for Sustainable Development*, *19*, 29-38. http://dx.doi.org/10.1016/j.esd.2013.11.005

Shyu, C. W. (2022). Energy poverty alleviation in Southeast Asian countries: Policy implications for improving access to electricity. *Journal of Asian Public Policy*, *15(1)*, 97-121. https://doi.org/10.1080/17516234.2020.1770426

Tariq, G., Sun, H., Fernandez-Gamiz, U., Mansoor, S., Pasha, A. A., Ali, S., & Khan, M. S. (2023). Effects of globalization, foreign direct investment and economic growth on renewable electricity consumption. *Heliyon*, 9, e14635. https://doi.org/10.1016/j.heliyon.2023.e14635

Tiwari, A. K. (2011). Comparative performance of renewable and nonrenewable energy source on economic growth and CO2 emissions of Europe and Eurasian countries: A PVAR approach. *Economics Bulletin, 31(3)*, 2356-2372.

United Nations (2015). Goal 7-Ensure Access to Affordable, Reliable, Sustainable and Modern Energy for All. [Retrieved 2022-09-05] Available at: https://www.un.org/en/chronicle/article/goal-7-ensure-access-affordable-reliable-sustainable-and-modern-energy-all#:~:text=SDG%207%E2%80%94to%20%E2%80%9Censure%20access,statement%20of%20the%20goal%20itself

Wang, W., Xiao, W., & Bai, C. (2022). Can renewable energy technology innovation alleviate energy poverty? Perspective from the marketization level. *Technology in Society*, *68*, 101933. https://doi.org/10.1016/j.techsoc.2022.101933

Westerlund, J. (2008). Panel cointegration tests of the Fisher effect. *Journal of Applied Econometrics*, *23*, 193-233. DOI: 10.1002/jae.967

World Bank (2021). Report: Universal Access to Sustainable Energy Will Remain Elusive Without Addressing Inequalities. [Retrieved 2022-08-04] Available at: https://www.worldbank.org/en/news/press-release/2021/06/07/report-universal-access-to-sustainable-energy-will-remain-elusive-without-addressing-inequalities#:~:text=Since%202010%2C%20more%20than%20a,fragile%20and%20conflict%2Daffected%20settings

World Bank (2022). World Development Indicator. [Retrieved 2022-08-05] Available at: https://data.worldbank.org/

World Economic Forum (2010). Energy Poverty Action.

Zhao, J., Dong, K., Dong, X., & Shahbaz, M. (2022). How renewable energy alleviate energy poverty? A global analysis. *Renewable Energy*, *186*, 299-311. https://doi.org/10.1016/j.renene.2022.01.005

Zhao, X., Ramzan, M., Sengupta, T., Sharma, G. D., Shahzad, U., & Cui, L. (2022). Impacts of bilateral trade on energy affordability and accessibility across Europe: Does economic globalization reduce energy poverty?. *Energy and Buildings*, *262*, 112023. https://doi.org/10.1016/j.enbuild.2022.112023