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FDI's impact on renewable energy in transitional markets: A panel threshold regression analysis

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ABSTRACT

The study investigated the influence of foreign direct investment (FDI) on renewable energy usage in transitional markets. Specifically, the study explored the minimum threshold level above which FDI begins to significantly enhance the use of renewable energy in transitional markets. This study used a dynamic panel threshold regression approach, with panel data spanning from 2004 to 2019. FDI equal to or exceeding a threshold of 44.13% of GDP (gross domestic product) had a significant enhancing influence on the usage of renewable energy (Model 1). Model 2 indicates that FDI exceeding or equal to a threshold value of 51.63% of GDP enhanced renewable energy consumption significantly. The results agree that higher levels of FDI, equal to or higher than the threshold levels, promote the use of renewable energy. The study indicates that foreign direct investment is a critical component in improving renewable energy consumption. Transitional markets need to develop and implement FDI inflow and retention enhancement policies to improve renewable energy usage. Policies aimed at encouraging financial development, total revenue, and human capital development should also be implemented by transitional markets to spur renewable energy consumption.

Contribution/ Originality: This study investigates the minimum threshold level of FDI above which FDI significantly enhances renewable energy consumption in transitional markets. Using a dynamic panel regression model also captures the endogeneity nature of renewable energy data. The exclusive focus on transitional markets makes this study unique.

1. INTRODUCTION

According to Shafie, Mahlia, Masjuki, and Andriyana (2011), energy is critical in meeting everyday needs, not only of the people but also of the industry, in terms of supporting transportation, manufacturing, and agricultural activities that spur economic growth. The challenge that the economy faces is that the extraction and usage of energy lead to environmental degradation, pollution, and consequently reduce life expectancy, as argued (Walter & Ugelow, 1979). Nor and Hassan Mohamud (2024) then noted that switching to renewable energy is a viable solution to these environmentally related problems, in a way which offers a reliable, sustainable and environmentally friendly option. Foreign direct investment facilitates the transition from non-renewable to renewable energy sources by providing technology, capital, and expertise to develop the renewable energy sector (Nor & Hassan Mohamud, 2024). Consistent with Adjei-Mantey and Adams (2023) the contrasting theoretical views on the environmental influence of foreign direct investment makes this subject a very contested area for a long time.

Empirical literature also shows that the findings on the FDI-renewable energy usage nexus are quite divergent, inconsistent, and mixed. Some empirical research supports the idea that FDI leads to a surge in renewable energy usage, while others support the notion that FDI reduces renewable energy usage. Some studies suggest that the relationship between these two variables follows a U-shape, whereas others confirm the neutrality hypothesis. The lack of agreement among empirical researchers indicates that studying FDI's impact on renewable energy remains a fertile area for further research. These empirical studies also exhibit some methodological shortcomings. Firstly, they often ignore the endogeneity aspect of the data and the influence of the lagged value of renewable energy usage on current renewable energy consumption. None of these studies focus on transitional markets, which are an important economic bloc in the first twenty years of the twenty-first century. They also overlook threshold analysis, a superior econometric method that helps policymakers develop and implement effective policies.

Contribution to literature: Four ways this paper contributes to the literature are described below. It uses a dynamic panel threshold regression approach that accounts for the dynamic nature of renewable energy usage and the endogeneity problem. It is the only study on the FDI-renewable energy usage nexus available that exclusively focuses on transitional markets. To the best of the author's knowledge, it is the first study to investigate threshold levels of FDI necessary to significantly lead to renewable energy usage in transitional markets. This study employed a panel threshold estimation approach, a unique econometric methodology because it estimates the endogenous regressor, employs a forward orthogonal transformation method to eliminate country fixed effects, and combines both cross-sectional and time series data into a panel threshold data analysis.

Section 2 focuses on theoretical and empirical literature. The research methodology is described in Section 3, while the presentation, discussion, and explanation of research results are in Section 4. The conclusion is in Section 5.

2. LITERATURE REVIEW

A few theoretical rationales on the FDI-environment nexus are available. The efficiency effect argues that FDI inflows are associated with positive externalities such as managerial skills, marketing skills, physical capital, and technology transfer, all of which enhance energy efficiency and industry competitiveness (Adjei-Mantey & Adams, 2023). According to Comin and Mestieri (2014), FDI from developed economies characterized by strict environmental laws provides the host country with energy-efficient and clean technology, which reduces the overreliance on non-renewable energy sources. The transfer of foreign capital enables the host country to adopt both clean and efficient technology and management practices, thereby helping to improve environmental standards. The augmentation effect suggests that inflows of FDI increase investment levels in the host country, thereby promoting economic growth, social welfare, and the implementation of clean energy investment strategies. This view was supported by Sarkodie, Adams, and Leirvik (2020).

The negative environmental quality effect argues that the influx of FDI inflow into developing nations from developed countries leads to pollution and environmental degradation (Walter & Ugelow, 1979). To reduce production costs, multinational firms from developed nations relocate to developing countries whose weak environmental laws do not deter the operations of polluting industries and dirty machinery (Adjei-Mantey & Adams, 2023). The same study noted that the dirty operations of multinational firms in developing countries disregard the environmental quality consequences, thereby contributing to a gradual decline in long-term economic development in host nations.

Empirical research has produced findings that are quite conflicting, mixed, and divergent, to say the least. Employing the general methods of moments (GMM) methodology and sectoral panel data, Adjei-Mantey and Adams (2023) investigated the nexus between FDI-renewable energy and emissions of carbon dioxide in Sub-Saharan Africa (SSA). The study noted that the use of renewable energy was negatively affected by the inflow of FDI.

Sarkodie et al. (2020) used the dynamic heterogeneous estimation approach with panel data (1990-2017) to estimate the interlinkage between FDI and renewable energy in averting climate change issues in SSA nations. The study found that FDI exacerbated climate change, while FDI triggered renewable energy reduced the negative effects and impact of climate change in SSA. Using cross cross-sectional ARDL approach with annual time series data (1996-2019), Mehmood (2022) studied the linkage between FDI and renewable energy in India, Bangladesh and Sri Lanka. Complementary term (renewable energy and FDI), carbon emissions by a significant margin.

Dossou et al. (2023) explored the relationship between the quality of governance, renewable energy development, and foreign direct investment (FDI) in Sub-Saharan Africa (SSA), employing the panel corrected standard error approach with data spanning from 1996 to 2020. The inflow of FDI had a significant positive impact on renewable energy development in SSA. Improved governance quality also substantially increased renewable energy development. Additionally, renewable energy development was further enhanced by the complementarity between FDI and governance quality in SSA.

Wang, Ye, Zeng, and Zhang (2024) studied the influence of FDI on carbon emission reduction and energy conservation in China using the two-stage least squares and dynamic threshold effect. Their study showed that renewable energy and its positive influence on green innovation had a significant enhancing effect on FDI-linked carbon emissions reduction. Carbon emission reduction and energy conservation were found to have been improved by the inflow of FDI. Employing autoregressive distributive lag (ARDL) with quarterly time series data (1990-2018), Udemba and Philip (2022) examined the interrelationship between urbanization, FDI and renewable energy in Indonesia The ARDL approach noted the existence of a negative correlation between FDI, urbanization, and renewable energy in Indonesia. Both renewable energy and FDI played positive and influential roles in environmental development in Indonesia. Using ARDL approach with time series data (1971-2014), Dey and Islam (2023) explored the influence of energy consumption on FDI in Bangladesh. The study confirmed that FDI has a deleterious effect on energy usage in both the short and long term. It also noted that energy usage has contributed to increased FDI in Bangladesh.

Kang et al. (2021) studied the influence of FDI on renewable energy in South East Asia using panel data (1990-2019) analysis. A negative effect of FDI on renewable energy was found to be significant in South East Asian countries (India, Bangladesh, Sri Lanka, Pakistan). Employing the GMM approach with panel data spanning from 1997 to 2021, Mogota and Djekonbe (2022) examined the FDI, economic growth and renewable energy nexus in SSA. Studies have shown that FDI enables renewable energy to have a positive influence on economic growth in SSA. Akbulaev (2023) investigated the causality between FDI, renewable energy, and carbon emissions in Germany, France, and Italy using the Toda-Yamamoto methodology with panel data spanning from 1971 to 2021. No correlation was found between FDI, renewable energy, and carbon emissions in Italy and Germany, whereas FDI in Italy increased carbon emissions.

Murshed, Elheddad, Ahmed, Bassim, and Than (2022) studied the nexus between FDI, ecological footprints and renewable energy in Bangladesh using ARDL with time series data (1972-2015). The study observed that FDI increased the level of renewable electricity output and reduced pollution levels in Bangladesh. Employing the dynamic GMM and system GMM estimators, Muhammad, Khan, Khan, and Khan (2021) examined the relationship between FDI, renewable energy, economic growth, natural resources and environmental degradation in developing, global, developed and BRICS nations. Their study used panel data (1991-2018). Environmental degradation was reduced in developed nations, as expected, because of their strict environmental laws, whilst FDI exacerbated environmental degradation in developing and BRICS countries.

Elheddad, Alfar, Haloub, Sharma, and Gomes (2022) studied renewable energy, climate change and FDI in Bangladesh using quantile regression approach. FDI promoted non-renewable energy use hence increasing pollution levels in the economy. FDI's deleterious impact on renewable energy usage was significant whilst an enhancing influence of FDI on carbon emissions in Bangladesh was observed. Tan and Uprasen (2022) examined the nexus between renewable energy and FDI in BRICS nations using the GMM approach with panel data spanning between

1990 and 2015. FDI reduced renewable energy usage when environmental laws were used as a moderating variable. On the other hand, FDI increased levels of renewable energy when environmental law strictness exceeds the threshold level.

Nadia and Seema (2016) explored the impact of FDI on renewable energy usage in developing nations using panel data (1985-2012) analysis. FDI enhanced usage of renewable energy in developing countries. Using sectoral data, service FDI and mining FDI reduced energy consumption, while service FDI increased the use of renewable energy in developing countries. Tan and Uprasen (2022) noted that when regulatory standards fall below a certain threshold, renewable energy consumption is negatively affected by FDI inflows. Conversely, when regulation exceeds this threshold, FDI positively influences the use of renewable energy. A long run relationship connecting renewable energy usage and FDI was observed in a study done by Tariq et al. (2023) whilst Lee (2013) found that no relationship existed between renewable energy consumption and FDI.

3. RESEARCH METHODOLOGY

3.1. Sample Data and Variables

Panel data (2004-2019) used was extracted from the World Development Indicators, a database known for its reliability and easy access. The period was ideal because of data availability considerations among the countries involved, and the timeframe was selected carefully because it was within this period that the majority of transitional markets experienced rapid economic growth and development, foreign direct investment inflows, and financial sector growth. The transitional economies included in this study are South Africa, Singapore, Turkey, Thailand, the Republic of Korea, the Philippines, Peru, Malaysia, Mexico, India, Indonesia, the Czech Republic, Colombia, China, Brazil, and Argentina. This research focused on transitional markets because they are an economic grouping that experienced rapid FDI inflow growth, attracted by high levels of financial markets, political reforms, economic growth, and market liberalization during the period under study, consistent with the context Cavusgil, Ghauri, and Akcal (2013). The reasons why these transitional economies were selected for this study are due to the availability of data.

Renewable energy consumption is the dependent variable. Renewable energy usage, as a ratio of total energy usage, is abbreviated as RENEW, and electricity production from hydroelectric sources (percentage of total) is abbreviated as HYDRO. FDI is the independent variable and is measured by net FDI as a ratio of GDP (gross domestic product). The choice of the proxies for both the dependent and independent variables is consistent to earlier empirical work done by Murshed et al. (2022); Kang et al. (2021); Udemba and Philip (2022); Wang et al. (2024); Mehmood (2022); Sarkodie et al. (2020) and Dossou et al. (2023). Control variables used in this study include urbanization, economic growth, tax revenue, financial development, human capital development and trade openness, consistent with earlier studies such as Nadia and Seema (2016); Muhammad et al. (2021); Dey and Islam (2023); Kang et al. (2021); Mogota and Djekonbe (2022) and Murshed et al. (2022).

3.2. Specification of the General Model

Equation 1 presents the renewable energy usage function.

$$REC = f(FDI, FIN, TR, HCD, OPEN, URBAN, GROWTH) \quad (1)$$

Where REC stands for renewable energy consumption, FDI is foreign direct investment, FIN represents financial development, urbanization is abbreviated as URBAN, and total revenue is denoted by TR. HCD refers to human capital development, OPEN is an abbreviation for trade openness, and GROWTH signifies economic growth. The following paragraphs describe the influence of control variables on renewable energy consumption from a theoretical literature perspective.

Aye and Edoja (2017) argued that strong and efficient financial markets are in a better position to make available financial investment necessary for the promotion of clean energy projects. Domestic credit by financial sector ratio

proxied financial development in this study. Economic growth spurs the usage of all forms of energy (renewable and non-renewable) in an energy consumption-reliant economy (Nindi & Odhiambo, 2014). GDP per capita proxies economic growth. Consistent with Tsaurai (2019), educated and skilled people (human capital development) often have the financial capacity to purchase the latest technological gadgets that are more energy-efficient. On another note, large-scale production activities and industrialization, driven by high levels of developed human capital, necessitate the use of more energy (renewable and non-renewable). The expectation is that the influence of human capital development (measured by the human capital development index) on renewable energy is bidirectional.

Trade openness allows firms to purchase cheaper but more energy-efficient related technology from across the globe (Grossman & Krueger, 1991). On the contrary, trade openness enhances firms' expansion and growth as companies can now easily and cost-efficiently access the necessary raw materials, technology and human capital skills required in their production processes (Rasiah, Guptan, & Habibullah, 2018). Exports of goods and services ratio proxied trade openness in this paper. Renewable energy consumption is expected to be influenced by trade openness either way.

According to Labeaga and Labandeira (2020), environmentally linked taxes lead to a cleaner environment as more firms are compelled to use renewable energy. The same study argued that taxes related to the environment improve air quality and trigger increases in prices that reduce the uptake of environmentally harmful products. Tax revenue was measured by the tax revenue to GDP ratio in this study. The study therefore expects tax revenue to increase renewable energy consumption. Urbanization leads to an increase and greater concentration of economic activities in urban and peri-urban areas, thereby spurring energy consumption (both renewable and non-renewable). To meet the increased energy demand resulting from urbanization, more cities, firms, and individuals tend to rely more on non-renewable energy sources (Fang, Gozgor, Mahalik, Mallick, & Padhan, 2022). Urban population to total population ratio was used to measure urbanization in this study. The expectation, therefore, is that urbanization reduces the usage of renewable energy.

The panel threshold regression approach as per the Kremer, Bick, and Nautz (2013) modified model was employed. The main reason Kremer et al. (2013) used the panel threshold regression model is because it addresses endogeneity, captures the dynamic nature of renewable energy consumption data, and combines both cross-sectional and time series data into a panel threshold data analysis. It employed the forward orthogonal transformation method to eliminate country fixed effects and estimate the endogenous regressor. All these aspects were ignored by the majority of existing panel threshold regression models. The study is based on the theoretical premise that a minimum threshold level of FDI must be attained before significant renewable energy usage occurs in the host country. Equations 1 and 2 are modified in line with the Kremer et al. (2013) model, considering this study's key variables.

$$RENEW_{it} = \mu_i + \beta_1 RENEW_{it-1} + \beta_2 FDI_{it} I(FDI_{it} \geq \gamma) + \delta_i I(FDI_{it} \geq \gamma) + \beta_3 FDI_{it} I(FDI_{it} < \gamma) + \varphi z_{it} + \varepsilon_{it} \quad (1)$$

$$HYDRO_{it} = \mu_i + \beta_1 HYDRO_{it-1} + \beta_2 FDI_{it} I(FDI_{it} \geq \gamma) + \delta_i I(FDI_{it} \geq \gamma) + \beta_3 FDI_{it} I(FDI_{it} < \gamma) + \varphi z_{it} + \varepsilon_{it} \quad (2)$$

FDI to GDP ratio for country i at time t is represented by FDI_{it}, $RENEW_{it}$ is renewable energy consumption to total energy consumption ratio for country i at time t whilst $HYDRO_{it}$ stands for hydroelectric electricity consumption as a percentage of the total for country i at time t, μ_i stands for a specific country fixed effect; φz_{it} is control variables, γ is the threshold level, β_1 to β_3 stands for slope coefficients. δ_i is the regime intercepts that takes into the bias (between dependent variable and any control variable (Bick, 2010). The only endogenous variables variable are $HYDRO_{it-1}$ and $RENEW_{it-1}$.The study employs GMM estimators to address the endogeneity problem.

The first stage in estimating threshold levels is individual country-specific fixed effects (Kremer et al., 2013). The standard within transformation employed by Hansen (1999) is fraught with some deficiencies hence, this study uses a forward orthogonal deviations transformation which do away with serial correlation transformative error terms. Matemilola, Bany-Ariffin, and Azman-Saini (2016) noted that the approach assists in addressing the endogeneity

problem by ensuring that the error term and control variables are uncorrelated. The determination of slope coefficients using the GMM methodology follows immediately after threshold value estimation.

4. RESULTS DISCUSSION

Table 1 presents the results of the mean variable analysis for the period from 2004 to 2019.

Table 1. Mean of main variables by country (2004-2019).

Countries	RENEW	FDI	FIN	TR	HCD	OPEN	URBAN	GROWTH
South Africa	8.73	1.31	124.79	23.71	0.67	54.58	62.98	6 415.49
Singapore	0.59	21.10	107.46	12.97	0.91	367.50	100.00	48 806.28
Turkey	13.34	1.81	50.36	17.68	0.77	51.77	71.59	9 557.13
Thailand	22.46	2.62	127.13	15.42	0.74	128.36	44.32	5 235.29
Republic of Korea	1.84	0.89	131.05	13.97	0.90	83.76	81.62	24 821.17
Philippines	31.44	1.67	34.77	12.74	0.69	67.64	45.97	2 364.58
Peru	31.58	4.26	33.44	15.16	0.75	49.61	76.61	5 236.84
Malaysia	3.37	3.33	112.84	14.18	0.79	158.44	71.62	9 073.76
Mexico	9.65	2.73	26.20	10.89	0.77	64.72	78.25	9 136.01
India	36.92	1.82	48.22	10.83	0.60	46.23	31.55	1 384.11
Indonesia	32.64	1.89	32.20	11.29	0.69	48.86	50.78	2 915.32
Czech Republic	11.83	4.45	44.56	14.55	0.88	136.91	73.48	19 082.84
Colombia	30.71	4.13	37.25	13.81	0.74	37.27	78.46	5 872.81
China	13.79	2.97	131.99	9.53	0.73	48.75	50.97	5 696.75
Brazil	45.59	3.19	52.85	13.79	0.76	25.81	84.74	9 011.37
Argentina	9.21	2.00	13.62	12.29	0.82	33.27	91.00	10 837.01
Overall mean	18.98	3.76	69.30	13.93	0.76	87.72	68.37	10 965.42

Thailand, the Philippines, Peru, India, Indonesia, Colombia, and Brazil are the seven nations whose mean renewable energy figures surpassed the overall mean renewable energy consumption of 18.98% of total energy consumption. Considering the extent of deviation of means from the overall mean, outliers include South Africa, Singapore, the Republic of Korea, the Philippines, Peru, Malaysia, India, Indonesia, Colombia, and Brazil. The Czech Republic, Singapore, Peru, and Colombia's mean values of FDI inflows exceeded the overall mean value of 3.76% of GDP. Singapore and the Republic of Korea are outliers regarding the net FDI ratio because their mean net FDI ratio falls the furthest from the overall mean FDI ratio of 3.76% of GDP.

Countries characterized by a mean financial development (domestic credit to the private sector) that surpasses the overall mean value of 69.30% of GDP include South Africa, Singapore, the Republic of Korea, Thailand, Malaysia, and China. These countries form an outlier group. Argentina and Mexico are considered outliers due to the observed mean deviations. Countries where the mean tax revenue collected exceeds the overall mean tax revenue of 13.93% of GDP include Malaysia, the Republic of Korea, Turkey, South Africa, Thailand, Peru, and the Czech Republic. South Africa is an outlier, as its mean tax revenue collected significantly exceeds the overall mean of 13.93% of GDP.

Countries with mean urbanization values below the overall mean urbanization-to-total population ratio of 68.37% are South Africa, Thailand, the Philippines, India, Indonesia, and China. The remaining countries have mean urbanization values that exceed the overall mean. Singapore, Indonesia, the Republic of Korea, the Philippines, Thailand, India, China, Brazil, and Argentina are outliers due to their mean urbanization values' deviation from the overall mean. Singapore (US$48,806.28), the Republic of Korea (US$24,821.17), and the Czech Republic (US$19,082.84) have mean GDP per capita (growth) that surpasses the overall mean GDP per capita of US$10,965.42. Outliers include Singapore, the Czech Republic, the Philippines, India, Indonesia, and the Republic of Korea, for the same reasons related to their deviation from the overall mean value of economic growth. All the values were translated to logarithms before main data analysis was performed to reduce of extreme or outlier values identified, in support of Hair, Black, Babin, and Anderson (2014).

Singapore, the Czech Republic, the Republic of Korea, Malaysia, Mexico, Turkey, and Argentina have a mean human capital development that surpasses the overall mean value of 0.76. The Republic of Korea, Singapore, India, and the Czech Republic are identified as outliers. Only four countries have a mean trade openness that exceeds the overall mean value of 87.72% of GDP. These countries include Singapore (367.50% of GDP), Thailand (128.36% of GDP), Malaysia (158.44% of GDP), and the Czech Republic (136.91% of GDP). They are also considered outliers due to their significant deviation from the overall mean value of trade openness.

The dynamic panel threshold regression results (see Table 2).

Table 2. Panel threshold findings.

Variable	Model 1: Renew= f(FDI, initial, controls)			Model 2: Hydro= f(FDI, initial, controls)		
Threshold estimate	44.13%.	C.I.[5.27%-98.11%]		51.63%.	C.I.[2.16%-87.92%]	
	Coefficient	Standard error	T statistic	Coefficient	Standard error	T statistic
β_1 -Initial	0.1734*	0.0899	1.9288	0.2300***	0.0572	4.0210
β_2	0.2176***	0.0514	4.2335	0.4117***	0.0927	4.4412
$\boldsymbol{\beta_3}$	0.3672**	0.1601	2.2936	0.1473	0.1364	1.0799
δ_i	1.1113	0.9723	1.1430	1.1278	0.9856	1.1443
FIN	0.2462**	0.1132	2.1749	0.4563***	0.1005	4.5403
TR	0.084***	0.0311	2.7010	0.0719	0.5431	0.1324
HCD	0.1453***	0.0477	3.0461	0.1987**	0.0562	3.5356
OPEN	0.1999	0.3164	0.6318	0.0356	0.4287	0.0830
URBAN	-0.3786	0.2562	-1.4778	-0.1793	0.2483	-0.7221
GROWTH	-0.1833***	0.0328	-5.5884	-0.3374	0.7329	-0.4604

The lag of renewable energy significantly enhanced renewable energy usage, consistent with Sadorsky (2010), in both models.

In model 1, the β_2 is 0.2176 and is significant at 1% level whilst $\boldsymbol{\beta_3}$ co-efficient is significant at 5%. FDI levels less than threshold of 44.13% of GDP significantly improved renewable energy consumption whilst FDI which is equal or surpassed threshold level of 44.13% of GDP more significantly enhanced usage of renewable energy in transitional markets. In model 2, β_2 co-efficient is 0.4117, significant at 1% whilst $\boldsymbol{\beta_3}$ co-efficient (0.1473) is non-significant at all levels. This means that FDI at levels below threshold value of 51.63% of GDP insignificantly improved the usage of hydroelectric power. On the other hand, FDI equal and greater than threshold value of 51.63% of the total significantly improved hydroelectric power usage. This agreed with Adjei-Mantey and Adams (2023), who argued that FDI inflow increases investment levels into the host country hence spurring economic growth, social welfare and implementation of clean energy investment strategies. More recent empirical work arrived at similar results (Dossou et al., 2023; Murshed et al., 2022; Tan & Uprasen, 2022).

In both models, financial development significantly increased renewable energy consumption, in line with a theoretical argument that states that strong and efficient financial markets are better positioned to provide the financial investments necessary for the promotion of clean energy (Aye & Edoja, 2017). While tax revenue significantly enhanced renewable energy consumption in model 1, model 2 indicates that renewable energy usage was not significantly improved by tax revenue. The results are consistent with Labeaga and Labandeira (2020)'s argument that taxes related to the environment improve the quality of air and trigger an increase in prices that reduce the consumption of environmentally harmful products.

Renewable energy consumption was significantly improved by human capital development in both models, in line with an argument put forward by Tsaurai (2019) that educated and skilled people, in most instances, have the financial capacity to purchase the latest technological gadgets that are more energy-efficient. Trade openness's positive impact on renewable energy use was non-significant in both models, resonating with Grossman and Krueger (1991), who noted that cheaper but more energy-efficient related technology from across the globe is purchased easily if trade openness is high.

Urbanization negatively influenced renewable energy consumption in an insignificant manner (Models 1 and 2). The results generally agree with Fang et al. (2022), whose study noted that more cities, firms and individuals are forced to lean more towards non-renewable energy consumption to meet the increased demand of energy consumption in response to urbanization. Whilst economic growth's significant negative effect on renewable energy usage was evident (Model 1), Model 2 shows that renewable energy consumption non-significantly reduced the usage of renewable energy. Such results agree with Nindi and Odhiambo (2014), who explained that economic growth encourages the use of non-renewable energy more than renewable sources of energy.

5. CONCLUSION

This study employed a dynamic panel threshold regression approach, analyzing panel data from 2004 to 2019 to examine FDI's impact on renewable energy usage in transitional markets. Specifically, it identified the minimum threshold level above which FDI significantly enhances renewable energy utilization in these markets. Theoretical literature highlights both positive and negative externalities on the environment resulting from increased FDI inflow. Empirical studies indicate that FDI can either reduce or increase renewable energy use, with some research suggesting no significant relationship, and others indicating a non-linear correlation between renewable energy use and FDI. This ambiguity prompted further investigation. FDI equal to or exceeding a threshold of 44.13% of GDP has a significant positive impact on renewable energy usage (Model 1). Model 2 shows that FDI surpassing a threshold of 51.63% of GDP significantly enhances renewable energy consumption. The findings suggest that higher levels of FDI, at or above these thresholds, promote renewable energy utilization. Transitional markets should develop and implement policies aimed at attracting and retaining FDI to boost renewable energy use. Future research should explore the channels through which FDI influences renewable energy adoption in transitional markets.

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