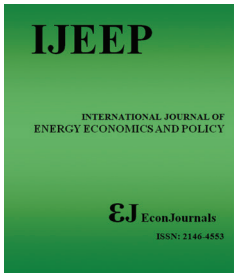

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The Role of Renewable Energy Consumption in Targeting Debt Sustainability in African and MENA Region Countries

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ABSTRACT

The primary aim of this study was to explore the impact of renewable energy consumption on debt sustainability in African and Middle East and North African (MENA) countries. Other objectives were to be investigated including foreign direct investment net inflows' effects on those countries' public debt, besides the relationship between carbon dioxide emissions and their public debt. The Fixed Effects Regression Model for Panel data analysis was employed through the utilization of different variables data of 21 countries in Africa and MENA regions, covering the period from 1999 to 2021. The conducted regression analysis incorporated central government debt as a dependent variable, and carbon dioxide emissions, FDI net inflows, the government effectiveness index, credit to the private sector, and renewable energy consumption as explanatory variables. The results revealed the existence of direct significant relationship between renewable energy consumption and central government debt, suggesting that reducing public debt leads to lower utilization of renewable energy. This could imply that going for the objective of debt sustainability requires the prevention of the wide utilization of renewable and clean energy. However, this impact could be overcome or lessened or even mitigated if it is aligned with the presence of highly effective governments and stimulated by FDINI oriented towards climate change mitigation since Green foreign direct investment inflows promotes the sustainable development and debt sustainability specifically with the presence of inverse relationship between the latest variables and central government debt. One recommendation from this research is that attracting FDI that promotes sustainable development within the context of effective governments can reduce government debt and should be explored for attaining the main objective without harming the ecological system or causing environmental degradation.

Keywords: Public Debt, Renewable Energy, Sustainability, and Governments' Effectiveness
JEL Classifications: H63, O13, O23, Q28, Q56, Q20

1. INTRODUCTION

1.1. Background

The problem of climate change has drawn extensive attention from most governments worldwide. According to Akam et al. (2021), most countries' desire for economic growth has increased carbon dioxide emissions through expanded manufacturing activities that have accelerated global warming trends. A major factor that influences global economic growth is readily available and cost-effective energy. While carbon energy sources such as coal are readily available, their damaging effect on the environment influences the need to seek carbon-free alternative sources and reduce air pollution, such as nuclear energy (Akalin et al., 2021; Sadiq et al., 2022). Economic growth is also closely linked with government debt, which influences investment in key sectors such as health, education, and energy that have a long-term effect on the economy. The MENA region countries have long struggled with managing their national debts, which have hindered sustainable development efforts. Specifically, as Akam et al. (2021) pointed out that MENA is one of the most indebted regions in the world, with space and additional social spending being limited in most countries by the public debt levels. Particular examples can be pointed to countries such as Lebanon, which defaulted on its debt in March 2020 after failing to meet its interest payments on a 1.2bn

Eurobond. The country's debt level is almost 175% of GDP (Daher Alshammary et al., 2020). According to the IMF, the percentage point rise in public debts in MENA countries between 2019 and 2021 is as indicated in Figure 1.

Figure 1 reveals that MENA and low-income countries (LIC) in Africa depict the highest public debts in the world, suggesting the need to seek sustainable ways to address the problem. Amidst these challenges, renewable energy sources present themselves as a potential solution to address both environmental and economic concerns.

Although Africa is a minor carbon emitter, it has depicted significant increase in energy demand from 91 to 163 terawatt-hours from 2010 to 2020, with the values in 2040 expected to reach 463 terawatt-hours (Aladejare, 2023). The trend implies an increased risk of significant carbon emission if renewable energy consumption is not encouraged in the African countries. Studies in Sub-Saharan Africa have shown that while public debt can encourage renewable energy consumption, the success significantly depends on the quality of governance to ensure the external debts are effectively used (Onuoha, 2023). Moreover, high debt challenges among African countries were shown in Figure 2.

Renewable energy sources can help these developing countries diversify their energy portfolios, reducing their greenhouse emissions and enhancing energy security (Hashemizadeh et al., 2021; Qamruzzaman et al., 2022). The trend is because the rise in gross public debt can be directly connected to energy consumption in most countries, specifically, non-renewable conventional energy sources. As the population continues to grow in the MENA region, with a projected increase of 2% per year, energy demands will continue to rise, and non-renewable energy sources will not provide a sustainable way of addressing the high energy demand (Kalu et al., 2020). As such, it can be considered that investments in renewable energy can be leveraged to reduce energy spending and, in turn, reduce public debt levels.

1.2. Problem Statement

The problem explored in this study involves the high costs of clean energy programs, which limit the ability of developing countries to transition to renewable energy. Studies like that of Efthimiadis and Tsintzos (2023) indicate that when developing countries are affected by overlapping crises, such as high food costs, COVID-19, and rising energy costs, it becomes challenging for the governments to prioritize climate-related investments. These views are supported by Kalu et al. (2020), showing that most developing countries seek debt to finance energy programs to expand their economies and improve the rate of urbanization. Similarly, other authors have elaborated that increasing public debt boosts renewable energy consumption in some countries but reduces in other countries (Jianhua, 2022; Olawuyi, 2021). Therefore, this study helps to explore the inconclusive results on the topic, focusing on the context of African and MENA countries.

1.3. Aim and Objectives

The primary aim of this study is to examine the impact of renewable energy consumption on the public debt of African and

Figure 1: General public gross debt as percentage of GDP in the MENA region between 2019 and 2021 (IMF, 2022)

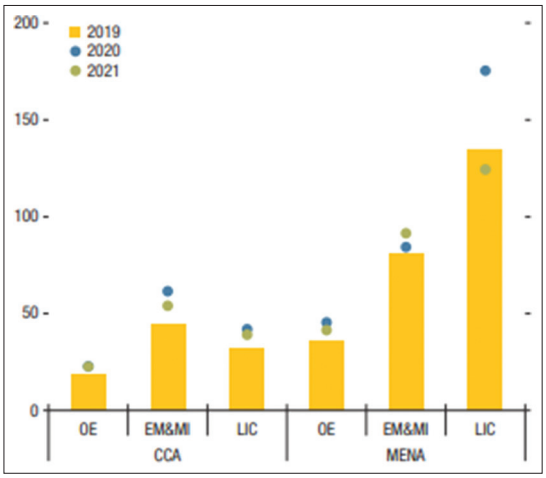
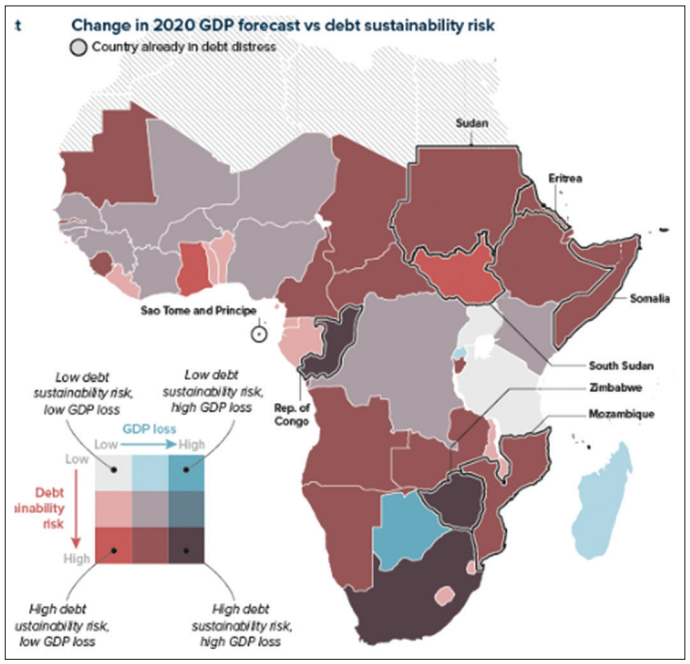


Figure 2: High debt sustainability risk and GDP loss in many African countries (Oxford Analytica, 2023)



MENA countries. The specific objectives include:

- To investigate the relationship between carbon emissions and central government debt
- To explore the effect of foreign direct investments net inflows on central government debt
- To analyze the impact of the presence of effective governments in curbing central governments' debts.

1.4. Significance of the Study

The findings of this study will aid policymakers in understanding the strategies related to renewable energy that can be employed to curb the continuous acceleration in public debt. Specifically, the current research will show how carbon emissions and renewable energy consumption correlate with public debt, revealing the policies needed to manage the debt (Kim et al., 2017). Moreover, this research will help foreign investors to grasp the benefit of

investing in renewable energy to lower the public debt of African and MENA region countries as long as they work on promoting their degree of effectiveness. In this respect, the current study can be used to persuade more foreign investors to venture into the renewable energy sector of developing countries that are guided by better government effectiveness index.

1.5. Rationale for Choosing the MENA Region and African Countries

The choice of the MENA region in the current context can be justified by several factors. One of them is its heavy reliance on fossil fuels, which has led to energy dependency, thus leaving the countries susceptible to price fluctuations and supply disruptions (Saadaoui, 2022; Tagliapietra, 2019). Moreover, existing studies reveal that MENA and African countries depict the highest public debts as a proportion of the GDP, which, when combined with high political risk and low institutional quality, damages their economic development (Arezki, 2020; Soh et al., 2021). The countries present an economic relevance in the current context, as their economies face challenges related to public debt management. The MENA region also presents unique and specific problems and opportunities related to using foreign direct investment in ways that can lead to reduced public debt, a topic that has previously not been studied extensively. As such, the study of this region can fill critical gaps in the literature and provide valuable insights for policymakers and researchers.

2. LITERATURE REVIEW

2.1. Theoretical Framework

One theory used to support this research is the sustainable development theory. The theory, which has gained widespread application over the years, emphasizes the need to balance social, economic, and environmental objectives to enhance long-term sustainability (Shi et al., 2019). In the current context, the study can draw on it to explore how promoting renewable energy consumption can contribute to sustainable development by addressing debt challenges and environmental concerns. Another relevant theory is the energy transition theory. It focuses on transforming energy consumption from traditional fossil fuels to renewable energy sources to achieve sustainable development (Bhuiyan et al., 2021). For this research, the concept can be critical in analyzing the factors influencing the transition to renewable energy sources in the African and MENA regions, such as policy measures, economic incentives, and technological advancements. Hence, the theory can assist in understanding sustainable energy adoption in various countries and how this can be facilitated specifically in the African and MENA regions. The environmental economics theory can also be utilized in the current context. It is focused on the most cost-effective means of allocation, protection, and use of the natural resources (Klepacka, 2019). Through this, the theory explores the economic consequences of environmental issues like climate change and pollution (Li et al., 2015). The theory is crucial for this research in assessing the economic benefits of adopting renewable energy in the African and MENA regions to reduce environmental externalities and improve resource efficiency. In light of the theories presented, the current study finds the environmental economics theory the most suited for the study. The justification of the theory is due to its focus on both the economic and environmental aspects of energy sources, which forms the basis of the current study.

2.2. Relationship between Renewable Energy Consumption and Government Debt

The connection between renewable energy consumption and government debt is multifaceted and has drawn mixed views from researchers. Specifically, Mammadli et al. (2021) analyzed the drivers of public debt growth by focusing on natural resources, sustainability, and development. The findings indicate that the promotion of renewable energy consumption could have the effect of cost savings, energy efficiency, and reduced dependence on the importation of fossil fuels. In other words, the explanations by the researchers seem to point out that renewable energy consumption can lead to reductions in public debts arising from energy cost savings. Consistent views to those of Mammadli et al. (2021) were also expressed by De Deus et al. (2022), who studied the transitions in green economies by adopting a case study methodology. The study's outcomes revealed that renewable energy consumption has the effect of both cost savings and increased government revenues, which lowers reliance on borrowing, thus potentially reducing government debt. De Deus et al. (2022) carried out a detailed case study analysis, thus improving results' reliability. However, the evidence pointed out by Daher Alshammary et al. (2020) presents some levels of inconsistencies with those of Mammadli et al. (2021) and De Deus et al. (2022). According to Daher Alshammary et al. (2020), initial capital investments in green energy production are too high and may require government borrowing to fund such ambitious projects. The views were supported by other researchers, such as Karim et al. (2023) and Raouf (2022), who observed that increasing public debt has a positive effect on renewable energy usage. That is, a significant reduction in public debt due to investments in renewable energy sources may not be realized. Despite the differences in available evidence, it can be argued that renewable energy sources offer opportunities for countries to achieve sustainable development and reduce public debts over time.

2.3. Effect of Foreign Direct Investment (FDI) on Government Debt

FDI has been noted to have a positive impact on reducing government debt. Mammadli et al. (2021) studied the drivers of public debt growth through a case study analysis and observed that FDI could lead to economic growth through increased revenues and tax revenues to the government. In other words, FDI increases revenues available to the government, alleviating borrowing pressures and reducing government debt. Consistent observations have also been obtained by Onafowora and Owoye (2019), who conducted a case study analysis focused on the Caribbean region. After making a wide range of observations, the authors concluded that FDI leads to the inflow of foreign currency into a country, thus strengthening the country's foreign exchange reserves and reducing the risk of currency crises. The observations imply that FDI can enhance a country's sustainability, making it easier for the government to service foreign debts; the result is that government debts will be reduced. However, these assertions are inconsistent with those of Iammarino (2018). Iammarino (2018) asserts that

overreliance on FDI inflows can make countries financially vulnerable, especially if investments are short-term and volatile. From the evidence pointed out, FDI in the areas of renewable energy in the MENA region can spur economic growth and reduce vulnerability. However, such investments must be controlled to minimize overreliance, which can roll back the gains made.

2.4. Relationship between Carbon Emissions, Economic Growth, and Public Debt

The relationships between carbon emissions, economic growth, and public debt present a complex and multifaceted correlation to various researchers. Specifically, the study by Kalu et al. (2020) focused on the dynamics of energy consumption and economic growth by carrying out a case study on SSA countries. The evidence pointed out that as economies grow, carbon emissions tend to increase due to industrialization and overreliance on fossil fuels. However, at some point, as countries' revenues increase, they generate income to invest in renewable energy sources, hence reducing carbon emissions and further strengthening the economy. The correlation has also been further explained by Efthimiadis and Tsintzos (2023); managing costs related to carbon emissions, such as infrastructure damage, extreme weather events, and negative health impacts, can increase public debts for developing countries. Put simply, the evidence seems to suggest that carbon emissions in MENA countries are currently high due to increasing industrialization, which boosts public debt in managing the effects of increased emissions. However, the debts are expected to subside as the region increases investments in renewable energy sources. Sadiq et al. (2022) focused on a case study of BRICS countries and concluded that economic growth enhances government revenues, thus reducing the public debt. The findings imply that for MENA countries to continue to advance economically, they will need to reduce overreliance on fossil fuels.

2.5. Relationship between Government Effective Index and Public Debt

Existing studies have also explored how the quality of public services, policy effectiveness, civil service, and institutions affect debt management practices. Specifically, Liu et al. (2017) elaborate that governments with higher government effectiveness index scores generally have effective fiscal policies, showcasing efficient government debt management and reducing public debt. The findings imply that more effective governments also lower negative economic factors, such as corruption and revenue losses, lessening reliance on borrowings. In the same manner, an empirical study carried out by Ekouala Makala (2022) focusing on CEMAC countries also revealed that a higher government effectiveness index also leads to sound debt policies due to more transparency and accountability in the management of public resources, minimizing the risk of unsustainable debt accumulation. Other studies, e.g., Butkus and Seputiene (2018), and Wiredu et al. (2023), also show that countries with low institutional quality do not attract foreign investment, which hinders the government's ability to decrease public debt. As per the studies by Liu et al. (2017) and Ekouala Makala (2022), it can be argued that to reduce public debt, MENA should improve their government effectiveness in public resource management, including investments in renewable energy if such investments are to result into direct economic benefits. The argument can further be connected to the assertions of Daher Alshammary et al. (2022) that countries that exercise greater fiscal discipline, including better fiscal planning and expenditure prioritization, generally experience lower reliance on debt financing. In light of this evidence, the high public debt in MENA countries can be attributed to poor policies, which increase overreliance on non-renewable energy sources, thus further exacerbating government debt.

2.6. Research Gaps

The first research gap is that although studies on the relationship between renewable energy consumption and government debt have been conducted, there is lack of analysis in the African and MENA context. The gap was addressed in this study by considering 21 countries in Africa and MENA regions to give detailed insights into the topic. The second research gap is that existing studies have only focused on how FDI influences foreign exchange rates but not on how domestic credit to the private sector can be used to boost renewable energy consumption to decrease public debt.

3. METHODOLOGY

3.1. Research Model and Statistical Technique

3.1.1. Description of the variables

In this study, the researchers have quantified and greatly specified the impact of the environmental sustainability proxy variable in the presence of highly effective governments and accompanied by foreign direct investment net inflows on the African and MENA region countries' public debt. Targeting escalated higher renewable energy consumption ratios accompanied by higher levels of foreign direct investments net inflows could furtherly aid the governments and specifically in the developing economies in achieving public debt sustainability. Data was collected from twenty-one countries in the African and MENA regions, with the variables covering the years from 1999 to 2021. The complete list of variables' detailed descriptions is presented in (Table 1) which are underpinned by and stemmed from a group of definitions provided by the International Monetary Fund and the World Bank Metadata glossary which provides various definitions that can be utilized as tools which researchers and scholars can employ through their analysis.

3.1.2. Data collection

For the aim of conducting a *Fixed Effects Regression Model for Panel Data Analysis* needed for identifying and assessing the impact of renewable energy consumption on debt sustainability in African and Middle East and North African (MENA) countries, beside other sub-aims namely; exploring the relationship between carbon emissions and central government debt; the effect of foreign direct investments net inflows on central government debt, beside the impact of the presence of effective governments in curbing central governments' debts, data was collected from nine twenty-one countries in Africa and MENA region for the incorporated variables during the period from 1999 to 2021. The data collection phase relied on gathering secondary data from a group of sources namely; World Bank Data, Our World in Data, and the International Monetary Fund (IMF) data-mapper that provides data on Central Governments' Debts branching from the Global Debt Database (GDD) which resulted from a multiyear investigative process that

started with the October 2016 Fiscal Monitor comprising data of 190 advanced economies, emerging market economies and low-income countries, dating back to 1950.

3.1.3. The descriptive analysis

Before the methodology and analysis, summary statistics are presented in (Table 2). The summary of Statistical Measurements is presented to illustrate the Descriptive Analysis of the various Variables.

3.2. Unit Root Test (Testing for Stationarity)

Economic theory is concerned with studying the equilibrium relationships between the variables being studied. Accordingly applied econometrics assume that these variables are stable in mean and variance. However, this assumption was made without testing it. Since often the assumption of data stability is unfulfilled, recent new trends in econometrics are concerned primarily with testing for non-stationarity.

By conducting the Panel Unit Root Test for testing stationarity (Table 3), and by using Levin et al. (2002), Breitung's (2001), Im et al. (2003), Fisher's ADF, Fisher's PP, and Hadri's (2000) tests, the researchers obtained the following results:

From analyzing the previous results, it is clear that this study's variables are all non-stationary in the level form by most of the tests, even *FDINI* and *GEI* are non-stationary in the level form using *Breitung* and *Hadri* unit root tests. This necessitates taking the first differences to convert them into stationary ones. The researchers performed a stationarity test for the first differences in these series. After taking the first differences and conducting those unit root tests again, these variables were transformed into stationary ones where the P-values are shown to be <0.05. This leads the researchers to reject the null hypothesis in favor of the alternative hypothesis which states that the time series of t this study's variables are stationary when taking the first differences. Also, the opposite is convenient for the *Hadri Test*.

The researcher can justify the elaboration of the unit root test and its applicability for this study by taking account of Lee and Strazicich's (2013) explanation that the measure is a stochastic trend that is crucial in showing an unpredictable systematic pattern. In its simplest form, the measure is crucial to testing stationarity in a time series and observing the unit causes of non-stationarity. In the same manner, Enders and Lee (2012) explain that, despite debates concerning the power of unit root tests, the usual findings in economics are that most time series have unit roots. Therefore, the measurement is an important macroeconomic series that influences the outcomes of the correlation of this study's various variables. Generally, the economic measure mostly considers whether the mean and the variance change over time.

Meanwhile, Pesaran's (2012) findings show that a time series is stationary in circumstances where its statistical properties do not vary with time. The importance of the identification is that it allows the study to demonstrate where the non-stationarity comes from. Therefore, to accurately observe the correlations, the generation of data must come from a random normal sample. In essence, the

Table 1: Description of dependent and explanatory variables included in the applied econometric model

The variable	The original term	Description of the variable
$CGGDP_{it}$	Central Government Debt as a percentage of GDP	Debt is the entire stock of direct government fixed-term contractual obligations to others outstanding on a particular date. It includes domestic and foreign liabilities such as currency and money deposits, securities other than shares, and loans. It is the gross amount of government liabilities reduced by the amount of equity and financial derivatives held by the government. Because debt is a stock rather than a flow, it is measured as of a given date, usually the last day of the fiscal year.
COE_KT_{it}	Carbon dioxide emissions	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.
$FDINI_{it}$	Foreign direct investment net inflows (% of GDP)	Foreign direct investment are the net inflows of investment to acquire a lasting management interest (10% or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. This series shows net inflows (new investment inflows less disinvestment) in the reporting economy from foreign investors, and is divided by GDP.
GEI_{it}	Government Effectiveness Index	The government effectiveness index is a ranking developed by the World Bank Group. It measures the quality of public services, civil service, policy formulation and implementation, and the credibility of a government's commitment to improving or maintaining these aspects.
$PCGDP_{it}$	Total credit given to the private sector as a percentage of GDP	Domestic credit to private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises. The financial corporations include monetary authorities and deposit money banks, as well as other financial corporations where data are available (including corporations that do not accept transferable deposits but do incur such liabilities as time and savings deposits).
$RECPT_{it}$	Renewable energy consumption (% of total final energy consumption)	Renewable energy consumption is the share of renewable energy in total final energy consumption.

Table 2: Using different statistical measurements to illustrate the descriptive analysis of the different countries' variables

Variable	Descriptive statistics					
	Mean	Median	SD	Max.	Min.	Range
$CGGDP_{it}$	56.34379	46.12	39.72046	263.37	1.56	261.81
COE_KT_{-it}	86357.27	16115.00	135383.9	586398.0	153.0	586245.0
$FDINI_{it}$	3.685714	2.20	6.185670	40.20	−18.90	59.10
GEI_{it}	−0.327404	−0.52500	0.774501	2.260	−1.639	3.899
$PCGDP_{it}$	34.43323	23.60	30.95329	142.40	1.60	140.80
$RECPT_{it}$	43.89141	54.88	37.57644	96.04	0.00	96.04

Variable	Descriptive statistics				
	Skewness	Kurtosis	Jarque-Bera	Prob.	Comments
$CGGDP_{it}$	1.692080	7.056403	561.6272	0.00	Long Right-tail (Positive Skewness) and Leptokurtic, a zero Prob. value leads to the rejection of the null hypothesis of a normal distribution
COE_KT_{-it}	1.818972	5.385487	380.8692	0.00	Long Right-tail (Positive Skewness) and Leptokurtic, a zero Prob. value leads to the rejection of the null hypothesis of a normal distribution
$FDINI_{it}$	2.973423	15.92842	4075.496	0.00	Long Right-tail (Positive Skewness) and Leptokurtic, a zero Prob. value leads to the rejection of the null hypothesis of a normal distribution
GEI_{it}	0.699457	2.794256	40.23569	0.00	Slightly Right-tail (Positive Skewness) and Mesokurtic, a zero Prob. value leads to the rejection of the null hypothesis of a normal distribution
$PCGDP_{it}$	1.344930	4.319089	180.6287	0.00	Long Right-tail (Positive Skewness) and Leptokurtic, a high Prob. value leads to the acceptance of the null hypothesis of a normal distribution.
$RECPT_{it}$	0.010196	1.198763	65.30301	0.00	Normal Skewness and platykurtic, a zero Prob. value leads to the rejection of the null hypothesis of a normal distribution.

The researchers used the Jarque-Bera test to statistically measure the difference of the skewness and Kurtosis of the series with those from the Normal distribution. The Probability Value is the probability that a Jarque-Bera statistic exceeds (in absolute value) the observed value under the null hypothesis. (*), ((**, and (***) indicate significance at α = 1%, 5%, and 10% respectively

Table 3: Summary of the Panel Unit Root tests (Levin, Lin and Chu- Test - Im, Pesaran and Shin- Test - ADF- Fisher-Test) as applied to the Dependent and Explanatory Variables

The variables	Levin, Lin and Chu-test				Im, Pesaran and Shin- Test				ADF- Fisher-Test			
	Level		Diff		Level		Diff		Level		Diff	
CGGDP	C	0.41	C	−11.78*	C	1.65	C	−11.11*	C	39.56	C	204.07*
CCDP	C, t	0.58	C, t	−15.52*	C, t	3.97	C, t	−14.26*	C, t	18.08	C, t	294.41*
COE–KT	C	1.29	C	−15.62*	C	5.29	C	−13.89*	C	25.19	C	248.01*
COE–KT	C, t	−2.23	C, t	−12.20***	C, t	0.03	C, t	−11.40*	C, t	46.44	C, t	195.14*
FDINI	C	−5.78	C	−14.99	C	−7.11	C	−16.9	C	138.38	C	303.173
FDINI	C, t	−5.6	C, t	−12.34	C, t	−6.24	C, t	−14.73	C, t	121.22	C, t	240.49
GEI	C	−2.21	C	−21.94***	C	−3.42	C	−20.56	C	83.69	C	365.96
GEI	C, t	−3.25	C, t	−18.89	C, t	−4.35	C, t	−18.15	C, t	88.54	C, t	292.52
PCGDP	C	−1.24	C	−13.44*	c	2.68	C	−11.42*	c	24.9	C	203.55*
PCGDP	C, t	1.11	C, t	−11.16*	C, t	1.52	C, t	−8.44*	C, t	36.52	C, t	157.10*
RECPT	C	−1.54	C	−12.95**	C	1.93	C	−12.17*	C	52.25	C	220.40**
RECPT	C, t	−0.03	C, t	−10.75*	C, t	1.51	C, t	−11.08*	C, t	36.84	C, t	188.92*

(*), ((**, and (***) indicate that the variable is stationary at α = 1%, 5%, and 10% respectively. (c) refers to Individual Intercept and (c, t) refers to Individual intercept and trend

Table 4: Regression results

The explanatory variable	The resulted relationship	The coefficient	The degree of significance
COE_KT_{-it}	*Inverse*	−5.60E-05	*Insignificant*
$FDINI_{it}$	*Inverse*	−0.428636***	Significant at (∝=10%)
GEI_{it}	*Inverse*	−44.87996*	Significant at (∝=1%)
$PCGDP_{it}$	*Direct*	0.144981	*Insignificant*
$RECPT_{it}$	*Direct*	1.383790*	Significant at (∝=1%)

(*), ((**, and (***) indicate that the variables are significant at α = 1%, 5%, and 10% respectively

unit root test is crucial in better understanding this study's various determinants of financial performance. In addition, Hadri and Kurozumi' (2012) findings indicate that the unit root test is an important measure that helps the researchers to accept or reject this study's hypotheses. In this case, a greater value of the test statistic must be obtained in such a way that it is greater than the

provided critical values. Therefore, it is a crucial measure towards the realization of this study's aims and objectives.

3.3. The Methodology

Fixed Effects Panel Regression Model (FEM) has been conducted after applying Hausman Test for the aim of identifying and assessing the impact of the enlargement in renewable energy consumption as a percentage of total energy consumption - in the presence of highly effective governments and accompanied by the encouragement of foreign direct investment net inflows- on the African and MENA region countries' public debt. The probability value resulting from conducting Hausman Test was (P = 0.0001) which means that the *fixed Effects Panel Regression Model* should be chosen and not the *Random Effects Panel Regression Model.* Data was collected from twenty-one countries in the African and MENA regions, with the variables covering the years from 1999 to 2021. This can be presented as follows:

$$CGGDP_{it} = \beta_i + \beta_1 COE\_KT_{-it} + \beta_2 FDINI_{it} + \beta_3 GEI_{it} + \beta_4 PCGDP_{it} + \beta_5 RECPT_{it} + \varepsilon_{it}$$

Where i=1,……,n and t=1,……,T, are entity- specific intercepts that capture heterogeneities across countries.

4. THE REGRESSION RESULTS

According to the above results (Table 4), as expected, renewable energy consumption (% of total final energy consumption) ($RECPT_{it}$) has a high significant direct relationship with Central Government Debt as a percentage of GDP ($CGGDP_{it}$), this could imply that going for the objective of curbing the continuing increase in public debt will lead to the prevention of the wide utilization of renewable and clean energy. However, this is a very narrow vision because although there exists a direct relationship between *RECPT* and *CGGDP* but still this impact could be overcome or lessened or even mitigated if it is aligned with the presence of highly effective governments and stimulated by *FDINI* oriented towards climate change mitigation since Green foreign direct investment inflows promotes the sustainable development and debt sustainability specifically with the presence of inverse relationship between *FDINI* and *CGGDP* and the same is applies for the relationship between *GEI* and *CGGDP*. Thereby, the African and MENA region countries can promote their governments' debt sustainability and maintain their economic sustainability by working on the utilization of renewable sources of energy that preserves the ecological system within the framework of effective governments and the implementation of *FDINI* that incorporate the protection of the environment and ecological health into their investments. Consequently, African and MENA region countries should confront short-run challenges to enhance the quality and substance of their economies. Since almost every element of human life necessitates the use of energy and there is a continuous increase in the demand for energy, thereby targeting renewable energy sources through local energy consumption and foreign direct investment inflows within the context of effective governments could leap those countries to debt and economic sustainability on the long term without harming the ecological System.

5. CONCLUSION

The African and MENA region countries can foster their governments' debt sustainability and enhance their economic one by working on the employment of clean energy renewable sources that save the ecological system against perdition and devastation, without plunging their economies in a massive catastrophe of public debt that can hinder their economic development and sustainability. Consequently, those countries should give scrupulous attention that does not conflict with the adoption of a bundle of green effective governmental policies, for holding back the escalated trend of their central governments' debt, underpinned with a stream of *FDINI* that incorporate the protection of the environment and ecological health into their investments. Consequently, African and MENA region countries should confront short-run challenges to enhance the quality and substance of their economies by balancing between social, economic, and environmental objectives to enhance their long-term diverse ways of sustainability; renewable energy sources offer opportunities for African and MENA countries to achieve this sustainable development and reduce public debts over time as long as they are underpinned by capital investments in green energy production and effective government policies.

One of the limitations is the lack of a comparative analysis of various countries in MENA region and Africa to observe the disparities in the influence of public renewable energy consumption on public debt. The gathered evidence also relied on secondary sources with limited coverage, which could have led to potential biases in the results. As such, despite being relevant to the current study, the accuracy of some observations cannot be entirely ascertained. There is also the possibility of publication bias, where negative or non-significant observations could have been underrepresented in the literature. As a result, the overall observations could have been skewed. However, the limitations were overcome by considering a large sample size from 1999 to 2021 to ensure findings are generalizable to the regions considered for analysis.

Future studies should consider using interviews and focus group discussions to gather primary data to explain the different renewable energy areas where FDI can be channeled to ensure sustainable debt management. Moreover, case studies on successful models of using FDI to reduce government debt should also be considered to offer valuable lessons on the best practices for MENA countries. The current study revealed the government effectiveness index as significant in influencing public debt. As such, future studies should further explore specific governance practices to reduce public debt.

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