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The Economic Impact of Renewable Energy Adoption on Regional Economies of MENA

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Abstract

Countries all over the world has turned their attention to the adoption of renewable energy from fossil particularly in MENA countries. Low-carbon energy sources are becoming more and more popular in the MENA and around the world as a means of halting climate change and fostering economic growth. It is critical to reduce emissions and stop producing electricity using antiquated energy sources. Therefore, a more sustainable future can be facilitated by technical breakthroughs, deregulated energy markets, and environmental challenges. The paper investigated the impact of renewable energy adoption on regional economies in MENA countries. The data was collected from five MENA countries from 2013 to 2022 as renewable energy consumption, inflation real interest rate, FDI were examined on GDP per capita in 19 MENA countries. It found that, there is no significant impact of RE on GDP per capita, while inflation had a negative effect. Interest rates and FDI also showed no significant relationship with GDP per capita.

Keywords: Renewable Energy, MENA, GDP per capita, real interest rate, FDI, inflation

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1. Introduction

Energy is one of the most fundamental needs that humanity must fulfil in the present day. Energy security has become increasingly crucial as a result of factors such as global industrialisation and rising living standards. According to Razi and Dincer (2022), fossil fuels, which are the primary source of energy in the world, are rapidly depleted and cause damage to the ecosystem. The over reliance on fossil fuels as a solution to the growing energy crisis on a worldwide scale is concerning and calls for prompt action. The current rate of exploitation of these sources indicates that they will run out of energy within the next 100 years at the latest. This implies that in order for fossil fuels to survive significantly longer than expected, the world's energy needs must be satisfied in a way that includes a much larger contribution from renewable energy sources.

A paradigm shift has occurred as a result of countries shifting their focus away from fossil fuel towards renewable energy. Renewable energy sources that produce low levels of carbon emission are gaining popularity all over the world as a source of combating climate change and at promoting economic prosperity (Sun et al. 2022). According to Masri (2023), many countries have been diversifying from fossil and have now directed their energies to renewables despite the problems that they encounter. Thus, the most consistent policies and decision-making procedure have been effective to minimize the effects of global warming and carbon emissions. From the utilization of renewable sources, one is able to enhance the conservation of resources, ecosystems and climate and hence, environmental sustainability (Charfeddine and Kahia 2019).

Energy Information Administration (2019) International Energy Outlook has it that renewable energy is the type of energy that is growing most rapidly in the world. The scale of the global consumption of renewable energy sources is rising by 3. Combined, they give 0% each year (Shahbaz et al. 2020). Renewable energy sources have the potential to displace fossil fuels as the dominant source of energy as renewable energy technology is becoming increasingly popular. According to Ellerbeck, (2023) the global shift to renewable energy saw a rise in 2023 and renewable energy sources are predicted to account for 35% of the total electricity generation by 2025 up from 29% in 2022. The study by Ram, Aghahosseini and Breyer (2020) stated that using renewable energy sources resulted in the creation of millions of jobs all over the world thus affecting economies of various countries in a positive manner. The expansion of employment opportunities has been benefiting both developed and emerging countries by as it has been contributing to increased wealth and economic progress.

Renewable energy projects benefit the economy since they employ rural labor, local suppliers and businesses, local shareholders, and local financial services (Kumar, 2018). As the proportion of people employed in various sectors of the economy rises, they are generating more employment opportunities for other people by utilizing their economics to support entertainment, leisure, restaurants, and other establishments. Communities have profited from remunerable energy installations establishing trust funds, which are used for investments in local economies using the money raised from the sale of power (Vo, and Vo, 2021). Moreover, Carbon dioxide emissions have decreased as a result of renewable energy initiatives, and awareness of climate change has increased (Elum, and Momodu, 2017). The study discovered negligible effects on local inhabitants, tourism, energy costs, and education. Quality of life, social bonds, and communities have improved (Elum, and Momodu, 2017). The findings further illustrated that, renewable energy initiatives are difficult to implement and dependent on local conditions. Their design, implementation, and forecasting require more thought and comprehension than other efforts. Numerous factors contribute to air and water pollution, as these include contaminated rain, discharged water from residential and industrial areas, and used oils and liquids that contain hazardous compounds and heavy metals such as mercury and lead (Singh et al. 2022). Poverty and social and economic growth are significantly hampered by the absence of access to contemporary energy sources, especially electricity (Cong et al. 2022). Under these conditions, decentralised renewable energy efforts including wind and solar power have the ability to provide electricity to people living in rural and remote locations. The study by Cong et al. (2022), initiatives centred on renewable energy could increase the accessibility of electricity in remote and rural places. Mhando, (2022) stated that solar household systems and mini-grids improved the availability of electricity in a number of economically disadvantaged countries. The growth of new renewable energy technologies, namely solar and micro-hydro systems, has boosted energy supply in Nepal's rural areas (Hermawati et al. 2023). In contrast, urbanization necessitates the expansion of energy infrastructure and the implementation of renewable energy projects. Urbanization and energy availability are highly connected (Zhao and Qamruzzaman, 2022). It was further stated that, renewable energy efforts can assist metropolitan areas meet their growing energy demands.

The MENA region has many natural resources for generating renewable energy, particularly solar, wind, biomass, and hydropower. For example, the region has been receiving the greatest proportion of solar radiation in the worldwide: for all MENA countries, the irradiance level exceeds 1800 kWh/m2/y, the highest level in the world (Kahia et al. 2017). Despite the region's tremendous renewable energy potential, their

exploitation remains fairly limited: Only one percent of the primary energy mix in the Middle East and North Africa region is comprised of renewable energy, whereas the global average is twenty percent.The MENA and the rest of the world still confront several challenges before green energy can be extensively adopted (Omri et al., 2021). Renewable energy is being promoted by policymakers in developing countries, particularly in the Middle East and North Africa (MENA), to expand their energy mix, reduce the risks associated with climate change, and prevent global warming by the Copenhagen Climate Agreement.

Despite its immense potential for solar and wind energy, the region continues to rely largely on fossil fuels, contributing to economic volatility and environmental damage. The major difficult is to assess how the transition to renewable energy sources will affect regional economics, particularly, GDP growth, job creation and household income. There is also need to investigate the socioeconomic impediments to widespread renewable energy adoption in MENA countries such as policy farmworkers, budgetary limits, to widespread renewable adoption and technology readiness. The lack of data the economic impact renewable energy adoption in regional economies particularly in MENA countries requires an examination that provides a comprehensive analysis on renewable projects for economy and regional economies. The economic implications of using renewable energy sources have been comprehensively studied in the existing literature, but the impact on the MENA region has been less studied. The current body of literature has not shed light on socioeconomic and topographical characteristics unique to a location that inflected household incomes. There is not much extant literature which has explored the impact of the investments in renewable energy sources on regional households' income, employment and GDP growth in the context of the countries belonging to the MENA region. Most studies concerning renewable energy have been centred on the two environmental impacts; here, GHG emissions and air quality (Mac Kinnon, Brouwer, and Samuelsen, 2018; Chen et al. 2023).

The development of the sector of energy in the world is currently progressing rapidly because of one reason or another. Although climate change is one of the strongest drivers, politicians and governments have concerned the affordable energy supply, energy security, and the access regime. The generation of low-carbon energy sources has been deemed necessary due to the Paris Agreement on sustainable development goals. According to the literature (Amri, et al. 2018) (Makhloufi, et al. 2021). The MENA region which includes North Africa and Middle East in particular possess a vast potential for the renewable energy especially the wind and solar energy. Several of the MENA region countries are situated in the solar belt, that is, an area where maximum insolation and maximum demand for electricity occur simultaneously. The social and economic status of the MENA region and international campaigns on climate change prompt the region's economies to seek green energy solutions. Amri, et al. 2018 Belaid, Boukrami, and Amine, 2021. As a result, being located in the MENA region which is significantly sensitive to climate change, the countries in the region become more and more vulnerable to climate change as they grow economically and as they urbanize. Despite the high level of influence of the renewable technology and use of energy efficient technologies, the overall level of emission has not been reduced in these countries. This limited uptake is attributed to a number of regional-specific problems such as lack of technical expertise and high initial costs (BARGAOUI, 2021). However, solar energy stands out as possible approach of improving environmental quality by supplying natural resources and developing the necessary technologies to properly harness them. (Awijen, et al., 2022) discovered that, various MENA countries has set a 2030 deadline for achieving the Sustainable Development Goals (SDGs) set by United Nations (UN).

These countries could host the construction for solar power projects due to environmental concerns and the region's ample solar energy potential. In a sample of 12 MENA nations, Kahia, Ben Jebli, and Belloumi (2019) examined the impacts of trade, FDI, economic development and investment flows, and the renewable energy use on carbon di oxide emissions. They found that FDI, renewable energy and trade all lower CO2 emissions, economic advancement impacts the environment. Prioritizing foreign direct investment, renewable energy along with international trade will help enhance environmental quality and encourages sustainable development in various regions. Dees and Autor (2018) studied the effect of growing the capacity of renewable energy sources on economic growth in the MENA in another study Except in Turkey, empirical research reveals that renewable energy investment has no negative impact on economic growth. The majority of estimates revealed no connection between the variables. The region has vast renewable energy potential, making it a cost-effective option to meet rising energy demand, which is predicted to average.

The MENA economic development has resulted in rural-urban drift, as economic activity shifts to urban hubs. Additionally, (Al-Marri, et al., 2018) argued that, despite its abundance of fossil fuels, Qatar is moving towards sustainability by reducing use and the increasing its use of sustainable energy. Qatar's energy consumption is reached using a combination of approaches to examine customer behaviour and attitudes energy efficiency and renewable energy. On the other hand, environmental education and understanding are important practices, but the subsidies on energy in Qatar employ economic infancy to confine the massive decrease in the consumption scale. Koomson and Danquah (2021) investigated the research topic of energy shortages and financial access in the country of Ghana located in the region. It proved that one of the main advantages of FI is the ability to decrease the energy gap which households experience, having renewable energy as one of the key indicators. In the same manner, the study by Addai et al. (2021) examined the banking services and lighting energy consumption in the rural regions of Ghana. The target groups of the Ghanaian rural households can purchase renewable sources of energy such as batteries, candles and power through mobile money. However, Aarakit et al., (2022) looked at the relationship between Solar Photovoltaic (PV) systems and financial access in Uganda. Therefore, this study found out that households' acceptance of solar PV systems improved by 3 percent based on the results of the analysis of a cross-sectional survey. 6% which is an improvement in each unit of Financial Inclusion. It was also established that mobile money influences the Ugandan communities' adoption of solar photovoltaics more than other factors.

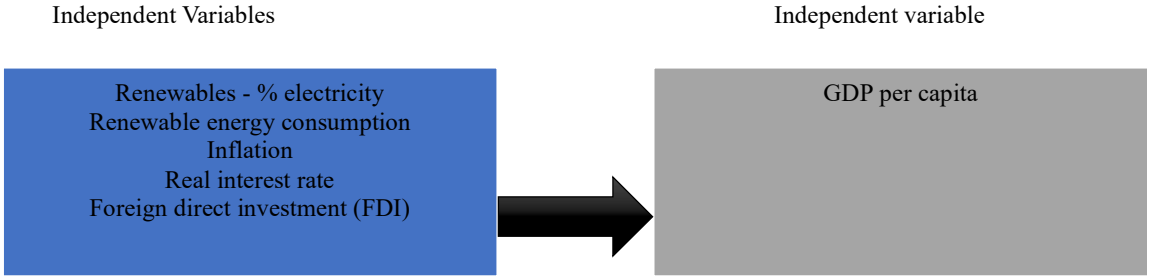
However, there is a gap concerning the economic effects of renewable energy in the literature, and more so the MENA region. In addition, there is often a lack of understanding concerning the impact of solar, wind, hydropower on different economic activity indicators. More comprehensive research on financial inclusion and renewable energy adoption is required to determine how financial services can help with the adoption of renewable energy technologies to increase economic resilience and growth in the MENA region. There has been no study available that has studied the impact of renewable energy adoption considering variables such as FDI, genuine interest, and inflation on GDP per capita in the regions of MENA. Therefore, the current research holds significance as it examines the impact of all these variables on the MENA countries. Therefore, the study aims to assess the impact of renewable energy adoption on regional economies of MENA countries. The key objective is tocomprehend the significance of renewable energy projects for economy and general population, and assess

the influence of renewable energy adoption on the GDP growth of MENA Region. The paper also investigates the impact of renewable energy adoption on Household Income in case of MENA Region.

2. Theoretical framework

Renewable energy adoption in the regional economies of MENA countries can be evaluated using Solo-Swan Model which is an importance growth economic model. The study by Aniket et al. (2018) argued that, Solo-Swan Growth Model aimed to explode the increase in labour growth, capital stock and most importantly technological advancement. In relation to the current topic, solar wind and power investments holds significance in re MENA region. MENA region possesses abundant renewable energy sources particular solar energy which can be used to diversify energy sources, reduce fossil consumption and helps in mitigating environmental impact all due to its geographical location. The study by Webb (2024) argued that Solo-Swan model prioritizes technological advancement as a growth engine. Advanced renewable energy technologies generate energy more efficiently and sustainably thesetechnologies help in improving quality and public health while also increasing economic output and labor productivity. Therefore, renewable energy complements the emphasis of the model on innovation and efficiency to drive economic growth. Adoption of renewable energy also help in promoting long-term economic development by reducing carbon emission and mitigating the climate change (Režný, and Bureš, 2019).

Conceptual framework



3. Methodology

This paper used quantitative techniques together with quantitative data to analyze the utilization of renewable energy for its economic effects. Quantitative methods are chosen to provide accurate and objective findings that are arrived at through calculations since they reflect the truth as confirmed by Bloomfield and Fisher (2019). It also allowed for investigating the correlations of different variables of the subject, which matters. In the case of the current research the quantitative method assists in generating factual data hence enabling the conduct of an econometric study that offers useful information and conclusion. The study used a secondary quantitative research approach since the analysis focused on the period between 2012 and 2022 and used several key economic indicators: the renewable energy consumption translated to the total final energy consumption, general inflation rate, real interest rate, FDI and GDP per capita growth rate. The variables provided a comprehensive view of the economic dynamics influenced by renewable adoption in the region. Data for this study was sourced from World Bank Indicators, and Our World in Data. The sources ensured reliability and accuracy of the data which proved to be critical for drawing valid conclusion. the collected data was then analysed using STATA as it handled large data sets and performed complex econometric analyses. STATA is used

to conduct regression analysis to determine the relationships between independent variables (renewable energy consumption as a percentage of a total final energy consumption, inflation, real interest rate, FDI) and the dependent variable (GDP per capita growth). Descriptive statistics provided an overview of the data, and correlation analysis examined the relationship between the variables. Regression models were then developed to quantify the impact of renewable energy sources on GDP per capita growth.

3.1 Variables Description

Renewable energy consumption	The percentage of renewable energy in total final energy consumed is known and renewable energy consumption (Jaradat, and Al-Tamimi, 2022).
Inflation	Inflation is defined as the rate of increase in the price of goods over certain period of time.
Real interest rate	The real interest can be described as a rate that has bene adjusted for inflation.
Foreign direct investment (FDI)	It is defined as a net investment made in roder to obtain a managerial ownership of a business in another economy. The payments balance involves equity capital, and other long-term capital along with short-term capital (Jaradat, and Al-Tamimi, 2022).
GDP per capita growth	The gross value added of all resident producers adding product taxes (subsidies excluded) that are not factored into output valuation divided by the population at midyear (Jaradat, and Al-Tamimi, 2022).

$$GDPGrowth - \beta_0 + \beta_1(FDINetInflows) + \beta_2(RealInterestRate) + \beta_3(Inflation) + \beta_4(Renewabable\ Energy\ Consumption) + \epsilon$$

B_0 = Constant (intercept)

$B_{1,}$ = FDI Net inflows

$B_{2,}$ = Real Interest Rate

B_3 = Inflation

B_4 = Renewable Energy Consumption

$B_{1,}$ $B_{2,}$ $B_{3,}$ and B_4 are the coefficient for the respective independent variables

The equation models show the relationship between GDP growth (independent variable) and FDI net inflows, real interest rate, inflation, and renewable energy consumption (dependent variables). Each coefficient β represents the expected change in GDP growth for a one-unit change in the corresponding independent holding other variables constant.

Hypotheses Development

4.1 Descriptive Statistics

Table 12: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
RE	180	4.335063	5.673989	0	22.98689
Inflation	180	9.070926	21.77802	-30.1997	150.0007
Interest	180	5.795228	8.429905	-18.8452	60.87671
FDI	180	1.768722	2.219574	-4.54159	11.45597
GDPperCapita	180	-0.00484	13.41026	-58.8498	150.4315

As per the table 2, the data set is of 180 observations was usedto analyze the impact of renewable energy of on the economies of MENA countries. Renewable Energy (RE) shows a mean of 4.335 with a standard deviation of 5.674 indicating a moderate variability and values ranging from 0 to 22.987. inflation has a high mean of 9.071 and a significant standard deviation of 21.778 suggesting significant variability and a range from -30.200 to 150.001, reflecting periods of both deflation and high inflation for the MENA countries. The interest rate averages at 5.795with a standard deviation of 8.430 indicating fluctuations between -18.845 and 60.877. FDI has a mean of 1.769 and a standard deviation of 2.220 with values ranging from -4.542 to 11.456 highlighting both inflows and outflows of FDI. GDP per capital presents an interesting case with a mean close to zero 0-.0048, but a large standard deviation of 13.410 and values ranging from -58.850 to 150.432, indicating wide economic disparities and extreme fluctuations in economic performance of MENA countries. Descriptive statistic shows diverse economic conditions represented in the dataset, revealing significant inconsistency across the variables. The variation of real interest rated highlighted the economy's diversity and influences the investments in renewable energy. Countries with high level of FDI may be able to advance their renewable energy objectives with the help of financial resources and international alliances. The GDP per capital were found to be negative this indicating that certain MENA countries may find it difficult to invest in and profit from renewable energy initiatives.

4.2 Correlation *analysis*

Table 13: Table of correlation analysis

Variables	GDPperCapita	FDI	Interest	Inflation	RE
GDPperCapita	1				
FDI	0.0167	1			
Interest	-0.0308	-0.2664*	1		
Inflation	-0.2177*	0.0519	-0.3346*	1	
RE	-0.014	0.0101	-0.0346	0.1119	1

As per the above table 3: GDP per capita shows weak correlations with other variables with the strongest being slightly negative with inflation (-0.2177*), indicating that higher inflation tends to associate with lower GDP per

capita. The relationship is statistically significant, as (MWAKANEMELA, 2013) revealed that, inflation negatively affects economic growth FDI demonstrates negative correlation with interest rates (-0.2664*), implying that higher interest rates are associated with lowers level of FDI. The negative correlation suggests the sensitivity of FDI to changes in the costs of borrowing. FDI also shows mentor positive correlation with GDP per capita (0.0167) and inflation (0.0519) although these relationships are not statistically significant indicating a minimal direct influence among the variables. Interest rates have a significant negative correlation with inflation (-0.3346*) indicating that higher interest rates are generally associated with lower inflation, showing a typical outcome of monetary policy interventions aimed to controlling inflation through increased borrowing costs. The significant relationships underscore the critical role of interest rates in microeconomic stability. RE exhibits very weak correlations with other variable, including GDP per capital (-.0.014), FDI (-0.010), interest rates (-0.0346) and inflation (0.1119) as none of these variables shows a correlation that statistically significant, suggesting that RE operates independently from these economic indicators within the scope of the dataset.

4.3 Diagnostic Tests

Table 14: Heteroskedeasticity table

Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model
H0: sigma(i)^2 = sigma^2 for all i
chi2 (18) = 63604.75
Prob>chi2 = 0.0000

Groupwise heteroscedasticity is a statistical technique that shows that the variability of error terms differs between groups in a fixed regression model with individual-specific intercepts to account for unobserved heterogeneity (Majid et al. 2017). Asper the above table 4: The Modified Wald Rest for groupwise heteroskedasticity indicates significant presence of heteroskedasticity in the fixed effect regression model. The null hypothesis (H0) in test posits that the variances across groups are equal (sigma(i)^2 = sigma^2 for all i). However, the chi-squared statistic (chi2 (18) = 63604.75 is extremely high, and the corresponding p-value (Prob>Chi2 = 0.000) is well below the conventional threshold of 0.05.the result leads to rejection of the of the null hypothesis, confirming that the variances are not equal across groups, thus indicating that heteroskedasticity exists in the model. Therefore, the presence of heteroskedasticity suggests that the error terms in the regression model do not have constant variance, which affect the efficiency of the estimators and lead to biased standard errors. It has implications for the for the validity for the inference drawn from the model. Heteroskedeasticity has the potential to underestimate standard errors, resulting in an increase t-statistics and a higher risk of rejecting the null hypothesis that there is no impact (type 1 error). The statement suggests that the economic indicators of the chosen MENA countries have a high level of heteroskedeasticity. As a result, different countries have quite different rates use of renewable energy, inflation real interest rates, and FDI.

Table 15: Autocorrelation

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
F (1, 17) = 0.032
Prob > F = 0.8596

As per the above table 5, the Wooldridge test for autocorrelation in panel data suggests the absence fir first-order autocorrelation in the model. The null hypothesis (H0) of the tests asserts that there is no first-auto correlation. The test statistic (F (1,17) = 0.032) is quite low, and the associated p-value (Prob > F = 0.8596) is significantly above the conventional significance threshold of 0.05. Consequently, it fails to reject the null hypothesis indicating that there is no evidence of the first-order autocorrelation in the panel data. The findings implies that the residuals from the regression model are not serially correlated which is the desirable property in the regression analysis. The lack of autocorrelation analysis suggests that the error terms are independent across periods, enhancing the reliability of the regression coefficients. It ensures that the estimators are efficient and the standard errors are not biased thereby supporting the validity of the statistical inferences drawn from the model.

Table 16: Cross-sectional dependence

Variable	CD-test	p-value	corr	abs(corr)
GDPperCapita	14.28	0	0.365	0.401
RE	12.55	0	0.321	0.498
Inflation	8.35	0	0.214	0.432
Interest	.	.	.	.
FDI	.	.	.	.

As per the table 6, there are significant decencies among the variables as indicated by the CD-test ad p-values. For the GDP per capita, the CD-statistic is 14.28 with a 0 p-value suggesting strong cross-sectional dependence. The correlation is 0.365 while the absolute correlation us 0.401 highlighting moderate interconnections with other variables. Renewable energy also exhibits substantial cross-sectional dependence with a CD-test statistic of 12.55 and 0 p-value. The correlation for the variables 0.321 and the absolute correlation notably higher at 0.498, indicating a stronger average relationship with others variables in the dataset. Inflation shows a CD-test statistic of 8.35 with a p-value 0 confirming significant cross-sectional dependence. The correlation for inflation is 0.214 with an absolute correlation of 0.432 pointing to moderate connections with other variables. The absence of data for interest rates and FDI in this tables suggests results for these variables. However, the significance cross-sectional dependencies identified for GDP per capita, RE, and inflation underscore interconnected nature of these economic indicators.

3.4 Regression

Table 17: Table of regression analysis

GDPperCapita	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
RE	0.0255021	0.1743551	0.15	0.884	-0.3162276	0.367232
Inflation	-0.1588562	0.0482163	-3.29	0.001	-0.2533585	-0.06435
Interest	-0.1862461	0.1283227	-1.45	0.147	-0.4377539	0.065262
FDI	-0.0073756	0.4598953	-0.02	0.987	-0.9087538	0.894003
_cons	2.417966	1.84981	1.31	0.191	-1.207595	6.043527

As per table 7, renewable energy shows a positive coefficient 0.0255 but the relationship is not statistically significant (p-value = 0.884). The 95% confidence interval ranges from -0.316 to 0.367 indicating a wide span

that crosses zero, further suggesting a lack of significant impact of RE on GDP per capita within this model. inflation presents negative and statistically significant relationship GDP per capita, with a GDP per capita with a coefficient of -0.158 and a p-value of 0.001. The 95% confidence interval ranges from -0.253 to -0.064, supporting the reliability of this negative association. The findings implies that higher inflation is associated with a decrease in GDP per capita highlighting inflation's negative impact on economic performance. Interest rates also exhibit a negative coefficient of -0.108but the relationship is not statistically significant (p-value = 0.147). The 95% confidence interval extends from -0.437 to -0.065, encompassing zero suggesting that within the model, interest rates do not have a significant direct effect on GDP per capita. FDI has a negligible coefficient of -0.007 and an extremely high p-value of 0.987 indicating no statistically significant relationship with GDP per capita. The confidence interval FDI ranges widely from -0.908 to 0.894 further underscoring the lack of impact within the analysis. The constant term has a positive coefficient of 2.417 but is not statistically significant (p-value = 0.191) with a confidence interval from -1.2077 to 6.043 as this indicates that the baseline level of GDP per capita when all independent variables are held at zero, is not precisely estimated within this model.

4. Discussion

The analysis of the intendent variables FDI, real interest rates inflation and renewable energy consumption on GDP per capita in MENA countries provide valuable insights into their countries dynamics. FDI was found to have a positive influence on GDP per capita indicating that its role on economic growth of MENA countries is not as significant. In this case Ebghaeı, (2023) stated that, FDI is one of the variables that contribute to economic progress, along with the introduction of new technology and expertise. The author found that, FDI has a positive and significant impact on GDP economic growth in the MENA region as the effect was found to be statistically significant indicating FDI contributes to growth in MENA countries. However, the limited impact may stem from the efficiency in utilizing FDI and its benefits are more pronounced when direct towards MENA sectors such as manufacturing or technology where renewable energy sources are integrated to enhance sustainability. Furthermore, the real interest rates showed a positive but weak connection, indicating that although higher interest rates can draw in foreign investment and promote economic expansion in the Middle East and North Africa (MENA) region, their total influence is still rather small. Interest rates affect saving volume and behavior, investment volume and productivity, and can all have a significant impact on the pace and pattern of economic growth (Khurshid, 2015). This is particularly true in nations with sufficiently established financial markets or when private investment accounts for a sizeable portion of total investment. Interest rates can significantly affect how households save and invest, especially in nations where the public sector makes up the majority of the investment sector or in less developed financial systems. According to Njie and Badjie (2021), real exchange and interest rates have an impact on GDP and economic growth. This has to do with the speed of adjustment or the negative coefficient on the mistake correction term.

Moreover, the analysis indicated that inflation presents a moderately positive relationship with GDP per capita, implying that its impact on economic growth. In this the study by (Batayneh, et al., 2021)inflation has a statistically significant negative effect on financial sector development both in the shirt and long term in Jordan. The negative impact on in the sector can hinder overall economic impact and growth on the GDP. The weak correlation of the study suggests that, effective monetary and fiscal policies which stabilize the economy, can

mitigate the negative effects of inflation. For the purpose of lowering inflation and limiting risks to financial stability, fiscal policy can make the mission of monetary policy easier to accomplish (IMF, 2022). According to Chugunov et al. (2021), fiscal policy has a significant impact on inflation whereas monetary policy, partocualry through real interest rates helps in stabilizing and reduce the adverse effects.

The important finding of the study of variable renewable energy showed a negative correlation with GDP per capita indicating that an increase in the use of renewable energy sources can initially slow down economic growth. According to Dees, and Vidican Auktor, (2018) big initial investments in renewable energy electricity generation boosted economic growth. Although the casual relationship is unclear, it indicates that investments in renewable energy do not inhibit economic growth in MENA countries. Socioeconomic challenges and international efforts to impede the shift to a more sustainable energy system and lessen the effects of climate change are forcing the economies of the MENA to look for alternative energy sources. The nations of the As stated by BARGAOUI (2021), these nations' worries about the environment ought to be given more weight. These nations are extremely powerful and adept at implementing energy-saving technologies. It was suggested that the introduction of new energy-efficient technology sustain positive externalities. The number of emissions from renewable energy was not significantly reduced. It is possible that this is because to MENA's low adoption rate (BARGAOUI, 2021)

On the other hand, the significant capital investments is required to developing renewable energy infrastructure, which may not provide immediate economic returns, transitioning from fossil fuels to renewable energy can also introduce inefficiencies and disruptions. Despite these initial challenges, the long-term benefits of including environmental sustainability and cost reductions are likely to positively impact the economic growth over time in MENA regions. Salah, Abuhelwa, and Bashir, (2021) stated that investment in renewable energy is essential for addressing energy shortages, reducing energy costs, and generating new economic opportunities which contributes to sustainable development of MENA nations. Research by (Awijen, et al., 2022)showed that improved innovation performance raises the governance quality's impact on renewable energy adoption. The implementation of renewable energy is being propelled by several reasons, such as financial development, political stability, innovation, and high-quality governance. According to the report, implementing sustainable policies that enhance innovation and governance is necessary to boost the production of renewable energy.

The MENA economic development has lead to the process of rural-urban drift meaning that economic activities are moving towards the urban centers. Furthermore, (Al-Marri, et al. , 2018) also pointed out that contrary to other oil-rich countries Qatar is becoming sustainable by minimizing use and maximizing sustainable energy. Qatar’s energy consumption is determined by employing different methodologies to analyze the customer behavior and their perspective towards energy efficiency as well as renewable energy. Although awareness and knowledge regarding the environment are essential, the Qatari subsidies of energy employ economic infancy to slow down the cutting of colossal consumption. Concerning the region of Ghana, Koomson & Danquah, (2021) have discussed the issue of energy shortage and financial inclusion. It proved that one of the valuable effects of the financial services is the decrease of the energy shortage that households face, with the exceptional importance of renewable energy. Likewise, Addai et al. (2021) focused on the banking service and lighting energy consumption to rural Ghana. The Ghana households in the rural communities can even pay for renewable energy sources such as batteries, candles, or power using mobile money. Conversely, Aarakit et al., 2022

conducted research work to establish the relationship between Solar Photovoltaic (PV) installations and financial liberalization within the Ugandan region. According to the result of a cross-sectional survey of the study, the determination of Malaysian households towards the solar PV systems improved by 3. 6%, which is an increase in every unit of financial inclusion," the minister said. Mobile money was also established to have a higher impact on Ugandan communities' adoption of solar photovoltaics.

The MENA region should promote the use of clean technologies as part of their manufacturing processes which include the use of renewable energy. This could, in turn, help in accelerating economic growth since potential renewable energy sources are in the area. This indicates that through promotion of renewable energy sources, countries do not transform into climate change victims and enclose their energy structures in carbon-intensive development processes (Kahia et al. 2019). There is the possibility of some MENA nations to diversify their sources of energy and hence minimizing on the use of fossil fuel by embracing the use of renewable sources of energy such as wind and solar energy. The governments should encourage such activities that minimize pollution of the environment. The governments of the MENA area should increase the export through adoption of clean technologies on international trade. In addition, the Policymakers in the MENA area must pay attention to the green and inclusive environmental policies employing the methodologies of the ecological economy and the environmental economics to decrease the total stock and the disaggregate impacts of the outputs in the deterioration of the environment (Omri, and Saidi, 2022). This can be achieved through promotion of use of renewable energy resources since they are known to have the ability of lowering CO2 emission. Other benefits that renewable energy sources are deemed to offer over the nonrenewable energy sources include cheaper fossil fuel prices, enhanced air quality, lesser emissions and high employment rate.

The most significant conclusions of Charfeddine, and Kahia, (2019) summed up in four points. Using renewable energy negatively impacts CO2 emissions, which suggests that encouraging the renewable energy sector could improve the environmental circumstances in the MENA region. However, the research demonstrated that there was no discernible detrimental effect of financial development on environmental degradation. Second, we found that the use of renewable energy had statistically significant, marginally favourable effects on economic growth at the 10% level (Charfeddine, and Kahia, 2019). However, the results indicate that financial development has an unanticipated detrimental effect on economic growth. Third, the findings indicate that the labour force in the MENA region is the primary impetus behind economic expansion. Furthermore, we discovered that the amount of capital affects environmental quality but has no noticeable effect on economic growth. The study also indicated that the growth of the financial business has a significant negative impact on the usage of renewable energy, implying that the financial sector is not making the expected contribution to the renewable energy sector (Charfeddine, and Kahia, 2019).

5. Conclusions

The study indicated that renewable energy adoption is critical in the MENA region. Employment across industries in MENA countries improves living standards and the economy. Renewable energy has reduced carbon dioxide emissions, raised awareness about climate change, and strengthened communities. The report discovered that MENA countries employ solar and wind power in an economic and sustainable manner. Climate-impacted places prefer renewable energy to fossil fuels. The study also found that renewable energy policies and

investments could boost GDP. Green energy reduces energy poverty and financial imbalance, particularly in Africa. Renewable energy reduces energy costs while increasing family income and mobile money inclusion. Financial inclusion, renewable energy, and carbon neutrality may benefit the environment and the economy.

GDP per capita, real interest rates, inflation, renewable energy usage, and FDI vary across MENA. Even though renewable energy is dependent on national regulations and resource availability, inflation affects project pricing and economic stability. FDI has little impact on GDP per capita, although real interest rates and inflation do. The negative association between GDP per capita, renewable energy adoption, early capital expenditures, and transitional challenges was explained. The heteroscedasticity study found that MENA economic conditions influence regression model dependability. Economic policy and strategic planning should consider how FDI, real interest rates, and renewable energy affect GDP per capita growth, as demonstrated by the GLS regression analysis. The findings indicate that renewable energy investments may alleviate energy shortages, lower energy prices, and provide new economic opportunities, all of which improve regional sustainability. Regression analysis demonstrates that FDI, real interest rates, and renewable energy use all increase GDP per capita. The model suggests that other factors may mediate GDP per capita and inflation. These findings highlight the importance of economic considerations and MENA-specific sustainable development. GDP per capita had minimal link with FDI, hence greater governance and regulation are needed to maximize it. Effective and clear laws may encourage foreign direct investment in renewable energy. By reducing bureaucracy and corruption, the Middle East and North Africa might attract more foreign investment and growth. Due to the negative association between GDP per capita and renewable energy usage, high upfront expenses may stymie economic development when converting to renewable energy. To address this, MENA states should seek international financial assistance and partnership on renewable energy projects.

It is recommended that governments offer renewable energy initiatives with tax advantages, subsidies, and simpler financing. These measures may reduce the initial capital expenditure hurdles for renewable energy projects, attracting both local and international investors. Funding regional infrastructure and renewable energy could benefit the local economy while reducing energy imports. The MENA countries should prioritize macroeconomic stability because inflation affects renewable energy project pricing and economic stability. Strong, inflation-controlled monetary policy encourages investment. To encourage FDI and economic development, local central banks should maintain stable interest rates and regulate inflation. Long-term investments such as renewable energy benefit from low risk premiums due to stable macroeconomic conditions. The data also imply that real interest rates have a large impact on GDP per capita. As a result, monetary policy should aim to balance interest rates in order to promote economic growth without constraining lending. Higher interest rates may entice overseas investors, whilst lower rates may encourage green energy finance and investment. Policymakers must strike a balance between low borrowing rates that encourage investment and low borrowing costs that limit inflation. Financial inclusion must also improve. Mobile banking and microfinance for individuals and small businesses may encourage green energy investment. Financial institutions may offer renewable energy loans and bonds. This strategy has the potential to reduce the cost of using renewable energy.

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