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The Employment Effects of Renewable Energy Consumption in Sub-Saharan Africa

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ABSTRACT

The global shift from fossil fuels to renewable energy has spurred interest among policymakers in understanding its impact on jobs particularly in low-income regions such as sub-Saharan Africa. Against this background, this study examines the relationship between renewable energy consumption and employment in sub-Saharan Africa (SSA) using a panel dataset comprising 30 countries observed between 1992 and 2020. Results from the Pooled Mean Group (PMG) estimator show that renewable energy consumption has a positive long-run impact on overall employment, with a percentage point increase in renewable energy consumption estimated to raise employment by 0.37% points. The effect, however, varies across sectors. Renewable energy particularly benefits agricultural employment while shrinking employment in the industry and service sectors. The model estimates a 0.72% points increase in agricultural employment in response to a percentage point expansion in renewable energy consumption. In contrast, employment in the industry and service sectors falls by 0.13 and 0.34% points, respectively. An alternative estimator that explicitly handles endogeneity reaches a similar conclusion. The results highlight the need for complementary measures, such as skills development programs and sector-specific interventions, to ensure inclusive and sustainable employment outcomes in sub-Saharan Africa's energy transition.

Keywords: Renewable Energy, Employment, Sectoral Employment, Sub-Saharan Africa
JEL Classifications: O1, J0, L5

1. INTRODUCTION

The world is currently pursuing a gradual transition from traditional fossil fuels to renewable energy in a bid to achieve the United Nation's Sustainable Development Goal number 7 of affordable and clean energy. Accompanying this transition has been the quest by policymakers to understand, among other things, how the attendant expansion of renewable energy influences job creation particularly in sub-Saharan Africa where labour markets are strongly tied to socio-economic development (Amankwah-Amoah, 2015; Kouton, 2021; Baye et al., 2021). Unlike traditional fossil fuel industries, renewable energy technologies often require different skill sets and labor structures, raising important questions about the nature of jobs created and their sectoral effects.

Currently, there are three contrasting views about the employment effects of renewable energy in sub-Saharan Africa. One is that it stimulates job creation in the region. This proposition draws insights from endogenous growth theories of Romer (1986) and Lucas Jr (1988) in which renewable energy technologies, such as solar, wind, and battery storage systems, are viewed as areas where technological innovation can spur economic growth and create green jobs. Two is that renewable energy consumption may in fact destroy existing jobs given the region's skills gap. This proposition stems from Schumpeter's destruction theory in which green jobs would potentially disrupt jobs in extractive industries such as coal mining. Three is that renewable energy can create jobs in some sectors and destroy in others so that the ultimate impact depends on the net effect.

Despite the importance of this subject and the lack of theoretical consensus, there is little to no empirical studies focusing on sub-Saharan Africa, a continent where the ongoing energy transition has coincided with rising rates of unemployment. Much of the existing evidence mostly draws from the experiences of European countries (Lehr et al., 2008; Moreno and López, 2008; Fragkos and Paroussos, 2018; Dvořák et al., 2017; Streimikiene, 2024) and Asia (Mamat et al., 2019; Vo and Vo, 2021). This study adds to the existing body of knowledge by estimating the employment effects of renewable energy consumption using the experiences of 30 sub-Saharan countries. The primary aim of the study is to estimate the impact of renewable energy consumption on employment in sub-Saharan Africa. The secondary aim is to determine whether the impact differs across sectors (agriculture, industry and services).

Estimating the impact of renewable energy on employment in sub-Saharan Africa is important for two reasons. First, the continent faces intertwined challenges of unemployment and energy access (Mensah, 2024; Nwani and Osuji, 2020). Compounding the former is a rapidly growing population and an expanding labor force. The results of this study can therefore shed light on whether renewable energy can offer a pathway to not only improve energy security in the region but also generate sustainable job opportunities in agriculture, manufacturing and service sectors. Second, renewable energy consumption aligns with global efforts to combat climate change, an issue disproportionately impacting Africa despite its minimal contribution to global emissions. Understanding the employment potential of renewables helps policymakers design evidence-based strategies to maximize the benefits of a green transition while addressing region's high rates of unemployment.

The rest of the paper is organised as follows. Section 2 reviews literature. Section 3 describes the data and methodology. The empirical results are presented and discussed in section 4. Section 5 concludes the study, provides policy recommendations and proposes areas for further research.

2. LITERATURE REVIEW

There is no established theory designed to specifically analyse the relationship between renewable energies and employment. One can, however, make plausible inferences from Schumpeter's theory of creative destruction and endogenous growth theories. The core idea of the former is that economic progress occurs through cycles of innovation that disrupt and replace existing industries (Elliott, 1994). This process, while destructive to older structures, ultimately leads to new industries and job creation. In the context of renewable energy, the disruption could be the job losses in fossil fuel-based industries (e.g., coal mining, oil drilling). These industries may shrink or disappear entirely as renewable technologies replace them. The creation of new jobs may arise from the corresponding demand for new skills and jobs in areas such as clean energy production, installation, maintenance, and technology development. Endogenous growth theories similarly view long run growth as a process driven by innovation and knowledge accumulation, which are endogenously influenced by policies, human capital, and technological advancements. Research and developments and their attendant innovations in the renewable energy sector can create new industries, boosting employment opportunities.

Empirically, several studies have examined the impact of renewable energy in literature. Recently, Hanna et al. review (2024) concludes that investment in renewable energy and energy efficiency can deliver more jobs than coal power generation. Similarly, Wysocka's (2023) survey finds a positive correlation between the renewable energy sector and the employment rate. In Bali Swain et al. (2022), the results show a positive but small and significant net employment impact of renewable energy in the European Union. They further find that renewable energy consumption contributes substantially to the future changes in employment in the short and the medium term.

In China, Liu et al. (2023) similarly report a positive and significant impact of renewable energy investment and education on long run employment. In the short run, the impact is found to be negligible at best. Liu et al. (2023) and Bali at al. (2022) therefore agree that renewable energy does affect long run employment positively in these two regions but differ on the strength of the relationship. One recent study that focuses on the two respective regions is Osei et al. (2023). Their results show a positive and significant impact of renewable energy production on employment in both European and Asian countries. They additionally find the positive effect stronger in European countries.

Within the literature, sub-Saharan Africa is yet to have a fair share of scholarly attention likely reflecting data constraints. The limited available evidence (Abdullahi and Maji, 2019; Shirley et al., 2019; Oteng et al., 2024) seems to be complimentary to the global evidence. It is generally understood and reported that the renewable energy sector has the potential to create a wide range of jobs in SSA, from construction and installation to maintenance and operation of renewable energy systems. Large-scale hydropower projects typically require a significant workforce for construction, operations, and maintenance. Additionally, small-scale hydropower is widely tipped to create jobs in rural areas by providing decentralized energy solutions. The biomass sector is reported to have the potential for employment in agriculture (growing biofuel crops), in the bioenergy supply chain (processing and conversion), and in power generation. Moreover, biomass projects can promote job creation in rural areas, where agriculture plays a central role.

One exemplary case demonstrating the potential positive impact of renewable energy on employment in sub-Saharan Africa is the Lake Turkana Wind Power Project in Kenya, which is Africa's largest wind farm, generating 310 megawatts of electricity. Beyond contributing to the national grid, the project has had a substantial socio-economic impact. It created over 2,000 local jobs during its construction phase and continues to provide 150 permanent positions (Cormack and Kurewa, 2018). The availability of reliable electricity has spurred the growth of agro-processing industries, thereby creating additional employment opportunities in the agricultural sector. Complementary to this, a report by Financial Sector Deepening Africa (FSD) Africa estimates that a green economy could generate 3.3 million jobs across Africa by

2030, with the renewable energy sector expected to create 70% of these jobs. This growth is anticipated to significantly impact the agricultural sector by providing energy solutions that enhance productivity and create employment opportunities.

Despite the significant potential for renewable energy to drive employment in SSA, several challenges remain. There is a skills gap in many African countries. Many of Africa's best-educated individuals seek opportunities abroad due to limited career prospects at home which disrupts employment growth in manufacturing and services. This brain drain exacerbates the continent's skills shortage and reduces its ability to innovate and drive economic growth locally. In addition, most governments in sub-Saharan countries often lack the capacity to implement effective employment policies. Poor governance structures, inefficient bureaucracies, and lack of transparency undermine efforts to create an environment conducive to job creation. These circumstances make SSA region a potentially unique region where the impact of renewable energy on sectoral employment is likely unpredictable.

This paper joins the literature and contributes by providing evidence based on the experiences of 30 sub-Saharan countries. It estimates the long run impact of renewable energy consumption on both overall and sectoral employment focusing on agriculture, industry and services. This is one of the few, if not the only, published empirical work linking renewable energy consumption and sectoral employment in sub-Saharan Africa in a panel data framework.

3. MATERIALS AND METHODS

This section outlines the materials and methods employed in the analysis. It provides a description of the dataset, including its scope and variables of interest, and specifies the econometric model used to examine the relationship between renewable energy consumption and employment. The section further justifies and discusses the estimation strategy, the Pooled Mean Group (PMG) and elaborates on the statistical tests and criteria applied to ensure robustness and reliability of the results.

3.1. Data Description

The analysis uses a balanced annual panel dataset comprising 30 sub-Saharan countries[1] spanning 1992-2020 guided by data availability on renewable energy. In total, this yields 870 annual observations (i.e., T = 29 and N = 30, 29 × 30 = 870). A cross-country panel dataset is chosen over time series and cross-sectional data due to its relative advantages. One key advantage is its ability to control for individual heterogeneity which, if unaccounted for, can lead to biased results (Baltagi, 2008). Controlling for time-invariant heterogeneity commonly referred to as country-specific factors particularly allows for more accurate estimations of relationships between variables, as it isolates the impact of time-varying factors. Another advantage is the ability to provide a rich dataset that captures the variability and diversity of economic policies across countries. The explanatory variable of interest is renewable energy consumption. Four dependent variables are used in separate specifications namely total employment, and employment shares of agriculture, industry and services. In line with previous literature, all specifications include trade openness, general government consumption expenditure, inflation and real per capita GDP as control variables. Trade openness is proxied by the sum of exports and imports as a percentage of GDP. Government consumption is measured by government consumption expenditure as a percentage of GDP. Inflation and GDP per capita growth are in annual percentage changes. Data on all variables are sourced from the World Development Indicators (WDI).

3.2. Model Specification

Guided by literature, the following function is considered,

$$y = f(x,z) \tag{1}$$

where y is employment, x is renewable energy consumption and z is a vector of controls. In econometric form, (1) can be written as

$$y=\delta + \theta' x + \gamma' z + \epsilon \tag{2}$$

Where δ is an intercept, θ is a slope coefficient measuring the partial effect of renewable energy on employment, γ is a vector of coefficients associated with the control variables and ϵ is an error term. The control variables in z are selected guided by previous literature such as Cantore et al. (2017) and Khobai et al. (2020). Adding panel data subscripts and actual variables yields,

$$y_{it} = \delta + \theta' ren_{it} + \gamma_1' open_{it} + \gamma_2' inflit + \gamma_3' gcon_{it} + \gamma_4' gdpg_{it} + \epsilon \quad (2)$$

$i = 1,\ldots, 30$; $t = 1992., 2020$

Where i and t represent country and year respectively, *ren* is renewable energy, is trade openness, *infl* is inflation, *gcon* denotes government consumption and *gdpg* represents GDP growth. From the literature, θ is expected to be positive on overall employment. The effect of renewable energy on different sectors can be either positive or negative. Trade openness allows domestic firms to access global markets, increasing demand for their goods and services. This can lead to business expansion and job creation, especially in export-oriented sectors (Vashisht, 2016). However, trade openness can also expose domestic industries to international competition. Inefficient industries may shrink or close down, leading to job losses, particularly in sectors where the country lacks a comparative advantage (Jenkins, 2008). Therefore, γ_1 can be negative or positive. Moderate inflation tends to stimulate demand for goods and services which often leads businesses to hire more workers reflecting the concept of derived demand (Musah et al., 2019). On the other hand, inflation can have distortionary effects on investment which leads to job losses (Hwang and Wu, 2011). Consequently, γ_2 can either be positive or negative. Similarly, government consumption, a proxy for fiscal policy, can influence

1 Burundi, Benin, Burkina Faso, Botswana, Central African Republic, Cameroon, Congo, Comoros, Gabon, Ghana, Guinea, The Gambia, Guinea-Bissau, Kenya, Madagascar, Mali, Mauritania, Mauritius, Niger, Rwanda, Sudan, Senegal, Sierra Leone, Swaziland, Chad, Togo, Tanzania, Uganda, South Africa, Zimbabwe.

employment positively particularly during periods of economic slump or negatively if the fiscal outlay crowds out private investment (Park and Meng, 2024). Lastly, while economic growth is arguably one of the most important drivers of employment, there are widespread reports of either jobless growth (Adeosun et al., 2022) or growth that has been accompanied by labour-relacing technical progress (Avenyo et al., 2019).

3.3. Estimation Strategy

To estimate equation (1), the analysis uses the Pooled Mean Group (PMG) approach developed by Pesaran et al. (1999). This choice is based on two motivations. First, the panel data dimensions for this study are both large. The PMG estimator is designed to handle such cases (Pesaran et al., 1999). Second, the sample comprises sub-Saharan countries whose labour markets are likely to differ in the short run due to rigidities and differences in regulatory environments but display similarities in the long run due to economic convergence. The PMG fits this feature by allowing heterogeneities in the short run coefficients and speed of adjustments while constraining the slope coefficients to be homogenous in the long run. For $t = 1,\dots, T$, and a number of groups $i = 1,2,3...,N$, the PMG estimates an ARDL ($p,q,q..., q$) model of the following form,

$$y_{it} = \sum_{j=1}^{p}\lambda_{ij} y_{i,t-j} + \sum_{j=0}^{q}\delta_{ij}^{'} x_{i,t-j} + u_i + \epsilon_{it} \tag{3}$$

Where the number of groups $i = 1,2..., N$; the number of periods $t = 1,2..., T$; x_{it} is a k ×1 vector of regressors; δ_{ij} are the $k \times 1$ coefficient vectors; λ_{ij} are scalars; and u_i is the group-specific effect. If the variables in (3) are I (1) and the error term is an I (0) structure, equation (3) can be reparameterized into an error correction equation of the following form.

$$\Delta y_{it} = \phi_i (y_{it-1} - \theta_i^{'} x_{it}) + \sum_{j=1}^{p-1}\lambda_{ij}^{*}\Delta y_{i,t-1} + \sum_{j=0}^{q-1}\delta_{ij}^{*'}\Delta x_{i,t-j} + u_i + \dot{o}_{it}, \tag{4}$$

$$\phi_i = -\left(1-\sum_{j=1}^{p}\lambda_{ij}\right), \theta_i = \sum_{j=0}^{q}\frac{\delta_{ij}}{(1-\sum_k \lambda_{ik})},$$

$$\lambda_{ij}^{*} = -\sum_{m=j+1}^{p}\lambda_{im}, i = 1,2,\dots,N; t = 1,2,\dots,T;$$

$$\delta_{ij}^{*} = -\sum_{m=j+1}^{q}\delta_{im}, j = 1,\dots,p-1 \tag{5}$$

Where ϕi is the error correction term measuring the rate at which the model reverts back to its equilibrium level in the event of a short run shock. A careful selection of the optimum number of lags was necessary (Pesaran et al., 1999). Common information criterions used in literature are the Akaike Information Criterion (AIC) and Schwarz information criterion (SIC). In this analysis, the AIC was used as it is, in comparison to the SIC, less restrictive (Bozdogan, 1987). Since the PMG approach is a cointegrating estimator, it was necessary to conduct panel unit roots and cointegration tests. This study uses a second-generation test by Pesaran (2007) as the baseline method due to its advantage of providing reliable results when countries exhibit some degree of cross-sectional dependence. As a robustness check, the analysis applied the first-generation test by Im et al. (2003).

Several panel cointegration tests have been proposed by Maddala and Wu (1999), Pedroni (2001) and Kao (1999). In this study, the Pedroni (2001) method was preferred as the baseline method due to its advantage of accommodating possible heterogeneity across the panel. The Kao method was used as a robustness check. The Pedroni (2001) cointegration test uses seven different test statistics four of which are based on the within dimension while three are based on the between dimension. All seven are constructed to test the null of no cointegration.

4. RESULTS AND DISCUSSION

Table 1 contains the descriptive statistics. Renewable energy consumption averaged 70% of total energy use reflecting significant progress in the continent's pursuit of cleaner energy sources. The relatively high standard deviation and the high range, however, indicates a wide disparity in renewable energy consumption across the region. Employment was highest in agriculture on average. This is not surprising since the continent is predominantly agricultural. The low average share of employment in industry raises concerns as structural change requires labour to reallocate from agriculture to industries.

Tables 2 and 3 presents panel unit root results. Both tests find the key variables (renewable energy and employment) and trade openness integrated of order one. Two control variables (GDP per capita growth and inflation) are integrated of order zero apart from government consumption whose order of integration is unclear as the two tests show conflicting results.

In view of the above results, the analysis tested for possible cointegration only among the I (1) variables. Table 4 and Table 5 present the results from Pedroni and Kaon tests, respectively. The two tests provide conflicting results. While the Kao method

Table 1: Summary statistics

Variable	Obs	Mean	SD	Minimum	Maximum
Renewable energy	870	70.404	22.203	7.6	97.3
Total employment	870	59.565	13.257	35.801	85.866
Employment in services	870	54.825	21.637	5.318	92.482
Employment in industry	870	12.296	7.52	2.06	39.977
Employment in agriculture	870	32.879	15.249	5.314	71.278
Inflation	870	0.009	0.053	−0.538	0.471
GDP per capita	870	9.856	26.903	−27.049	604.946
Trade openness	870	59.776	28.033	9.955	175.798
Government consumption	870	13.79	5.109	2.047	36.143

SD: Standard deviation

Table 2: Panel unit root tests

Variable	Im et al. (2003)		Pesaran (2007)		Order of integration
	Levels	Δ	Levels	Δ	
Renewable energy	3.80	−16.68***	−1.70	−4.673***	I (1)
Total employment	4.26	−15.13***	−1.62	−3.10***	I (1)
Employment in agriculture	5.86	−9.73***	−1.36	−3.37***	I (1)
Employment in industry	6.30	−5.90***	−0.52	−2.97***	I (1)
Employment in services	3.92	−10.35***	−1.45	−3.77***	I (1)
Growth	−14.89***		−4.38***		I (0)
Inflation	−14.65***		−4.37***		I (0)
Trade openness	−1.06	−20.59***	−2.15*		I (1)
Government consumption	−2.55***		−1.88	−5.107***	

**** P<0.01, * P<0.1. Figures in the table are test statistics. Δ is a first difference operator. Specifications contain an intercept and no trend. The lag length is automatically selected by the AIC from a maximum of 5 lags. In the Pesaran (2007) test, 5 BG lags are used. BG: Breusch-Godfrey

Table 3: Pedroni test results

Variable	Total employment	Agricultural employment	Industrial employment	Services employment
Panel v-statistic	−1.41	−4.18	−3.13	−4.33
Panel rho-statistic	0.90	1.98	2.48	2.31
Panel PP-statistic	0.63	1.88	3.02	2.21
Panel ADF-statistic	−1.46*	1.84	0.18	2.04
Group rho-statistic	1.47	2.67	3.32	3.31
Group PP-statistic	1,78	3.31	4.31	3.65
Group ADF-statistic	−1.59	1.42	−0.25	1.27

***P<0.01

Table 4: Kao test results

Test statistic	Total employment	Agricultural employment	Industrial employment	Services employment
ADF	1.92**	3.234***	4.27***	2.38***

***P<0.01

provides overwhelming evidence of a cointegrating relationship for each specification, the Pedroni test rejects the null of no cointegration only in one instance and marginally so.

Given some indications of a possible cointegration, it was reasonable to proceed with the assumption of cointegration and conduct further assessments of the error correction term. A significantly negative error correction term (ideally between 0 and 1) would support the presence of a cointegration.

4.1. Regression Results

Table 6 contains regression results. Two main results emerge. One is that renewable energy has an overall positive effect on employment in sub-Saharan Africa. Controlling for trade openness, inflation, economic growth and government consumption, expanding the consumption of renewable energy by 1% point is estimated to raise overall employment by 0.37% points on impact in the long run. This inelastic response is not surprising since sub-Saharan labour markets are generally rigid. Two is that despite having a positive effect on overall employment in the region, the impact of renewable energy consumption varies across sectors. The effect is significantly positive for agricultural employment and significantly negative for employment in the industry and service sectors. A percentage point increase in renewable energy consumption raises employment in agriculture by 0.72% points in the long run holding constant trade openness, economic growth, government consumption and inflation. In the industry and service sectors, employment falls by 0.13 and 0.34% points respectively on impact for a similar increase in renewable energy consumption.

With respect to the control variables, evidence shows that overall employment in the region increases with government consumption and inflation. Trade openness and GDP growth are negatively related to overall employment. When analysed at sectoral level, the results show a positive effect of these variables on employment in industry and services and a negative effect on employment in agriculture. This is consistent with the pattern of structural change in which trade and growth facilitate a reallocation of workers from agriculture to industries and services. The error correction terms have the correct sign and are statistically significant adding weight to the assumption of a cointegrating relationship across all the regression variants. The slow speed of adjustment could reflect the rigidities and market imperfections that inhibit sub-Saharan labour markets from speedy adjustments.

For robustness purposes, the analysis considered an alternative panel cointegrating estimator, the panel dynamic ordinary least squares (PDOLS), which addresses endogeneity. This was necessary since employment dynamics themselves might dictate the pace of renewable energy investments in sub-Saharan Africa raising concerns about potential simultaneity and a feedback effect. The PMG estimator does not explicitly and may not adequately handle endogeneity. The PDOLS does by including the leads and lags of first difference endogenous regressors. Table 6 presents the PDOLS estimates. The main results are not significantly altered. Evidence still shows that renewable energy consumption correlates positively with employment in agriculture and negatively with employment in the industry and service sectors.

The estimated PDOLS has satisfactory explanatory power as the five variables explain more than 80% variation in employment.

Table 5: Pooled Mean Group - renewable energy consumption and employment in sub-Saharan Africa

Regressors	Dependent variable			
	Total employment (%)	Employment in agriculture (%)	Employment in industry (%)	Employment in services (%)
Renewable energy consumption (%)	0.37***(0.04)	0.72***(0.03)	–0.13***(0.013)	–0.34***(0.04)
GDP Growth (%)	–1.48***(0.20)	–0.88***(0.10)	0.81***(0.07)	1.45***(0.20)
Government consumption (%)	0.74***(0.10)	0.40***(0.04)	–0.17***(0.02)	–0.54***(0.06)
Inflation (%)	0.20***(0.02)	0.07***(0.02)	0.01*(0.003)	0.24***(0.05)
Trade (%)	–0.06***(0.02)	–0.17***(0.01)	0.04***(0.01)	0.16***(0.02)
COINTEQ01	–0.04***(0.02)	–0.04***(0.02)	–0.04**(0.02)	–0.04**(0.02)
Observations	780	780	780	780
ARDL model	3, 3, 3, 3, 3, 3	3, 3, 3, 3, 3, 3	1, 3, 3, 3, 3, 3	3, 3, 3, 3, 3, 3

* $P<0.1$, ** $P<0.05$, *** $P<0.01$. Figures in () are standard errors

Table 6: Panel dynamic ordinary least squares - renewable energy consumption and employment in sub-Saharan Africa

Regressors	Dependent variable			
	Total employment (%)	Employment in agriculture (%)	Employment in industry (%)	Employment in services (%)
Renewable energy consumption (%)	0.59*** (0.04)	0.80*** (0.02)	–0.04*** (0.01)	–0.06*** (0.01)
GDP growth (%)	–1.46*** (0.17)	–0.31 (0.25)	0.15 (0.10)	0.38*** (0.21)
Government consumption (%)	1.15*** (0.11)	0.62*** (0.14)	0.26*** (0.03)	0.71*** (0.10)
Inflation (%)	–0.12** (0.05)	–0.04 (0.07)	0.02 (0.03)	0.11 (0.09)
Trade (%)	0.01 (0.02)	–0.16*** (0.02)	0.17*** (0.01)	0.41*** (0.02)
Observations	780	780	780	780
Lag, lead	1,1	1,1	1,1	1,1
Adj. R^2	0.87	0.82	0.83	0.86

*$P<0.1$, ** $P<0.05$, *** $P<0.01$. Figures in () are standard errors. Specifications are based on the pooled DOLS. The leads and lags were automatically selected by the AIC

In addition, both the PDOLS and the PMG estimate the long run coefficient of renewable energy on employment with a high degree of precision as the standard errors are considerably low.

4.2. Discussion of Results

The main result is that renewable energy consumption raises overall employment in sub-Saharan Africa, but the effect largely emanates from an increase in agricultural employment. The evidence suggests that renewable energy consumption negatively affects employment in industry and services. The strong positive effect of renewable energy consumption on agricultural employment aligns with the rural and agrarian nature of most Sub-Saharan African economies. The implementation of renewable energy technologies such as solar-powered irrigation systems, biogas for cooking, and energy for agro-processing supports agricultural productivity while creating jobs in rural communities. Renewable energy initiatives are often integrated with rural electrification programs, which reduce energy poverty, enable mechanization, and open new employment avenues for farmers and agricultural workers.

In contrast, the negative effect of renewable energy consumption on industrial employment and service sector employment highlights potential challenges in the region during this energy transition. For the industrial sector, this negative relationship could reflect the displacement of labor-intensive industries reliant on traditional energy sources, such as coal or diesel-powered manufacturing, as economies transition to more energy-efficient and automated processes. Sub-Saharan Africa's industrial base is still developing, and the adoption of renewable energy may prioritize efficiency over labor intensity, especially in sectors such as mining and manufacturing, which dominate industrial activities in the region.

The significant reduction in service sector employment associated with renewable energy consumption may stem from the declining role of traditional energy service jobs, such as the distribution and retail of fossil fuels, which are relatively labor-intensive. In addition, renewable energy systems, particularly decentralized off-grid solutions, may require less service-oriented support compared to centralized fossil-fuel energy systems. This shift could also reflect the slow adaptation of the service sector to the renewable energy economy, where specialized skills, such as energy consulting and digital energy services, are underdeveloped.

Within literature, the positive impact of renewable energy on overall employment in sub-Saharan Africa supports the results reported by Cantore et al. (2017) and Khobai et al. (2020). That the impact varies across sectors is additionally consistent with those of Oteng et al. (2024) albeit in the content of Ghana.

5. CONCLUSION

The study concludes that renewable energy consumption has a positive impact on overall employment that primarily reflects growth in agricultural jobs, while posing challenges to labor demand in industry and services. This pattern underscores the dual role of renewable energy in addressing energy poverty and promoting agricultural employment, while also highlighting the potential employment disruptions caused by the energy transition in the industry and service sectors.

In the Sub-Saharan African context, these findings are plausible given the region's socioeconomic realities. Renewable energy initiatives are often driven by international development programs and government policies aimed at improving rural livelihoods and reducing energy poverty, which aligns with the strong positive impact on agriculture and overall employment. However, the negative impacts on industry and services highlight the need for complementary policies to support these sectors during the transition. Investments in skills training, energy-efficient industrial technologies, and service-sector interventions are crucial to ensuring that the benefits of renewable energy extend across all sectors of the economy.

Overall, as the region expands its use of renewable energy, the results of this analysis emphasize the need for a balanced policy approach that mitigates sectoral disruptions and ensures inclusive labor market outcomes. Future studies may consider using random coefficient models to account for the potential long run heterogeneity in the way renewable energy impacts employment in sub-Saharan Africa.

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