**Sustainable Development, AI and the Future of Work in Africa: Pathways for Inclusive Growth and Labour Market Flexibility.**

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**Abstract**

With the advent of Artificial Intelligence (AI), there is a strong indication that future work depends on sustainable development and technological innovation, which raises concerns about whether AI will lead to the displacement of labour or its augmentation. Given Africa’s structural economic constraints, it is crucial to understand the role of sustainability and technological innovation, especially AI, in reshaping labour market dynamics. This study contributes to this discourse by examining the connection between sustainable development, technological innovation (such as AI), and the performance of the African labour market. It employs two equations to represent labour market performance: the employment equation and the wage equation. Sustainable development is measured using the sustainable development index, which combines a human development score (life expectancy, education, and income) divided by ecological overshoot, defined as the extent to which consumption-based CO2 emissions and material footprint exceed fair shares of planetary boundaries. Simultaneously, metrics for innovation include research and development (R&D), expenditure (as a percentage of GDP), the number of patents granted, and AI. Furthermore, control variables such as GDP per capita, exchange rates, and financial development are included to account for macroeconomic influences. The data for this study, sourced from organizations such as the Human Development Index (HDI), the International Energy Agency (IEA) and the World Development Index (WDI), was used for the analysis. The period of the analysis covered the years 1986 to 2023. In addition, about 54 African countries are within the scope of the study. Using the Method of Moment Quantile Regression, the results show that renewable energy consumption and R&D expenditure have positive and significant effects on employment and wages in the Africa region. It suggests that sustainable energy transitions and technological advancements are crucial policies that are shaping labour market performance in the region. Contrarily, there is a significant negative relationship between higher carbon emissions per capita and employment, indicating why cleaner energy policies are important in Africa. On the other hand, financial development and exchange rate stability are both positive and have a significant impact on labour market performance. The study recommends that African countries’ governments increase funding for research and innovation, especially in renewable energy and technology-driven industries, to promote economic diversification and improve job creation for the growing youth population.

**Keywords**: Innovation, Renewable Energy, Carbon Emissions, Research and Development, Employment, Wages.

**1. Introduction**

Technological innovation and ideas that promote production efficiency are boosters of rapid economic growth. This is because they triggered other multiplier effects on the economy, such as economic expansion, an increase in real wage rate and enhanced purchasing power, which will eventually improve the standard of living of citizens. A critical look at the African economy shows that it can be broadly divided into informal and formal market segments. In general, the formal market is highly urban-based in the various cities, while the informal market is locally concentrated among the poor populace. Participants in the formal market have a higher standard of living compared to those in the informal sector (Okwoche et al., 2025 & Abbas et al., 2024).

The formal segment, which is the most productive, innovative, and secure in terms of job security, comprises legally recognised ventures in the financial sector, services, agriculture, and manufacturing that adhere to regulatory requirements and tax obligations. (Perra et al., 2024). These firms comprise international companies and smaller firms. The development and sustenance of the formal segment are critical for the sustainable development of the economy. The informal segment is a vital aspect of the economy of Africa, especially with the rising redundancy and insufficiencies of the formal segment development. (Afful et al., 2025).

While more attention is paid to the formal segment, the informal sector usually has a higher share of the workforce, especially among the poorer segments of cities. It is projected that the informal segment accounts for 50 to 60 percent of aggregate engagement in Africa, with higher instances in some nations comprising small businesses, including hawking and small-scale farming which are usually less productive, involve poor working conditions, and are poorly funded. (Kweka, 2024). Notwithstanding its significance, the informal segment is mostly unregulated which represents a major hindrance to its development and incorporation into the planning framework of African nations (Adekoya et al, 2024). This dichotomy poses a major hurdle for countries in Africa in their endeavor to optimize technological innovations such as artificial intelligence to propel rapid economic development the formal segment is apt to adapt to new technology whereas the informal segment is not fully integrated into the possibilities inherent in technology. Hence, to fully harness AI for African economic development both segments should be integrated to enable maximum leveraging of new technology across the entire economy (Mienye et al, 2024).

The application of AI could significantly benefit or mutilate the African economy (Giwa and Ngepah, 2024). Firstly, AI enhances the productive capacity of the African economy by subverting conventional growth patterns. AI increases agricultural output via improved farming techniques, enables increased accessibility of healthcare, improves productivity by automating the production process, pre-empting maintenance and by enhancing several divisions. AI has the potential to raise the overall performance of the African economy, optimize production, and positively impact the ability of Africa to compete globally.

Nevertheless, the possibility of enhanced growth is negated by apprehensions about job displacement (Awogbemi et al, 2024). AI-enhanced mechanisation is anticipated to substitute repetitive activities which are predominant in areas like farming, logistics, and industry where the majority of the workforce is domiciled. This engenders the problem of technological advancement since AI is not only capable of engendering economic expansion but it also has the likelihood of raising the level of redundancy and disparity by putting unskilled workers in a disadvantaged position to fill up the novel portfolios that ensue (Qin et al., 2024). Hence, the application of AI to enhance economic expansion without displacing personnel is an enormous task to be considered.

The discussion of AI and the employment pool fluctuates between dual divergent positions economically which are technology-induced redundancy and labour augmentation. Technology-induced redundancy connotes that innovations resulting from AI necessitate mass layoffs, essentially for the non-technical staff as technology replaces people in certain tasks. This viewpoint is in line with apprehensions about the onslaught of robots where large-scale redundancy ensues and its negative impact on law and order and economic uncertainty (Saba and Ngepah, 2024). However, the labour augmentation viewpoint suggests that AI enhances workers as opposed to displacing them. The argument is that AI empowers labour to engage in a more productive capacity by cutting out everyday tasks. On the African continent which is rife with human capital, AI could enhance labour’s inherent capabilities. An example is the adoption of AI by agriculturists in the African hinterlands for mechanised farming, improving yield while retaining human capital. AI also has positive effects on schooling and health, enabling the workforce to take up expert, highly rewarding positions (Segbenya et al, 2025).

The major question that validates this research is as follows: AI, comprehensive economic expansion, and the job market opportunities, is there any links? Proffering a solution to this inquiry requires contextualizing the uniqueness of Africa which makes it possible to have a mixed human capital of skilled and unskilled, the complexities of redundancy, as well as the capacity for AI-enhanced development occurring simultaneously. AI can enhance growth, but there should be a deliberate policy framework to create an enabling environment for long-lasting human capital enhancement.

The novel input of this paper is the sustainable development of an economic model for policymaking that incorporates the application of AI and long-term human capital enhancement on work flexibility in the African continent. The model will consider the application of AI capabilities by Africa alongside maintaining comprehensive growth and enabling skilled and unskilled labour to adapt to the evolving job market. This incorporates proffering a solution to the supply (schooling and skill enhancement) and demand (AI-enhanced ecosystem) spectrums simultaneously. The adoption of an unbiased, comprehensive method, should enable this model to proffer policy to enable African countries to turn the complexities and prospects inherent in the AI era.

**2. Materials and Methods**

Joseph Schumpeter proposed and empirically analysed the relationship between Africa's labour market evolution, integration of AI, and sustainable development pathways. The theory was empirically investigated through the lens of Creative Destruction, the revolutionary economic paradigm conceptualized. This transformative theory, which Schumpeter articulated in his seminal in 1942 seminar work on the topic: "Capitalism, Socialism and Democracy," Joseph Schumpeter illustrates how technological innovation simultaneously dismantles existing economic structures and at the same time catalyses’ new growth. Schumpeter, who was one of the 20th century's foremost economists and philosophers, provided the analytical foundation for studying how technological innovation reshapes labour ecosystems within Africa's unique developmental context. (Atiku, et al., 2024).

The importance of novelty in economic activities, with free enterprise serving as a major driver of economic progress, was emphasized by the theory. The theory provides explanations on how invention promotes the emergence of new ideas and, at the same time, destroys outdated commercial structures, machinery, and businesses. This evolution is intrinsically radical yet essential for the sustainable advancement of industry and the economy. Creative destruction challenges the traditional view of capitalism as stable, suggesting instead that capitalism thrives on periods of disruption that upset established practices, prompting traditional organizations to adapt or dissolve. While some economic agents may face negative consequences, this process typically results in higher efficiency, innovations, and long-term economic growth. (Velardo, 2024).

AI is one such innovation, due to its capacity to transform conventional industries like farming, production, and services by reinventing the way we produce, distribute, and consume. On the African continent, where industrial activity is still in its infancy, AI could accelerate the transition of the structure of industries, enabling the creation of novel industries (Ngepah et al., 2024). Nevertheless, the creative destruction theory also identifies the disadvantages of shocks, especially for human capital in conventional industries. As AI and robotic technology substitute labor-intensiveness, the human capital in sectors like farming and industry may require re-education. For the benefits of AI-enhanced development to be widespread, it is essential that African nations implement comprehensive plans for growth that allow redundant labor to transition into new, productive jobs. This may necessitate substantial investment in education and the upgrading of previously acquired skills, as well as strategies that support the development of an AI-powered industry (Mnguni et al., 2024).

The irony of productivity, according to Robert Solow, connotes that advances in technology do not necessarily culminate in instant gains in economic expansion, and makes for a critical view to observe the significance of AI for economies in Africa (Ernst, 2022). Notwithstanding the enormous capacity of AI to increase production, the application of AI in African countries lags behind other continents. The difference in implementation could be ascribed to numerous reasons, namely, funding issues, infrastructural deficiency, and a dearth of know-how in technicalities (Mienye et al., 2024). Furthermore, the irony of productivity emphasizes that the implementation of AI alone is not sufficient to engender economic expansion. Further investment is required in schooling, structure, and institutions to unlock the vast wealth embedded in AI. The task at hand is thus to formulate a conducive framework for AI implementation for maximum advantage to the economy, most especially in poorly developed areas (Holden and Harsh, 2024).

The division of the job market in the dispensation of AI is of great apprehension for policy formulators. Going by the template advanced by Autor and Dorn, improvement in technology erases repetitive, mundane activities and necessitates highly intellectual and service-inclined engagements (Jacobs, 2024). This division in the job market is apparent in several regions, Africa inclusive, which has a job market tilting towards unskilled, non-specialized employment. The effect of AI on the disparity in the African job market can be daunting and promising. AI might erase most of the unskilled employment which is the pillar of the brown-collar job market. However, AI can enable novel openings in highly technical areas, like engineering, technology, healthcare, and schooling, where human engagement is required. The policy should be tailored towards facilitating the acquisition of relevant skills and enabling the shift of personnel from nontechnical to technical activities (Giwa and Ngepah, 2024).

Considering the different stages of growth of nations in Africa, recognising the potential areas of high impact of AI implementation is critical (Ade-Ibijola et al., 2025). Agriculture is the main driver of most economies in Africa for instance and the introduction of AI to increase yield could have a positive impact on production and stability in this vital segment (Olawale et al, 2025). Likewise, the service industry, especially investment and health, is quite suitable for the implementation of AI. The automation of investment and adoption of applications in medicine are examples. It is critical to prioritize areas of Africa with an existing advantage compared to other economies and apply AI strategically in sectors suitable for mechanisation and can engender comprehensive development. This entails recognising prospects for AI to augment the production of small-scale agriculturists, unskilled workers, and business owners, and promoting invention in developing sectors like green energy, financial technology, and internet-enabled businesses. (Ngepah et al., 2024). Additionally, according to Schmidt et al (2021), AI, which includes machine learning, automation in business processes, facial-recognition technology, and predictive analytics has an impact on business processes, etc. It denotes the application of digital technologies, which has led to innovations such as speech recognition, facial recognition, autonomous drones, self-driving cars, language-generating computer systems, and machine translation.

Furthermore, our study provides more insight into the understanding of sustainable development, AI, and the future of work for inclusive growth and labour market flexibility in Africa. It consist of the challenges faced by emerging economies in leveraging new technologies for business development. To this end, we propose a conceptual model that identifies key barriers to AI adoption and outlines strategies to overcome them. This framework serves as a guide to better conceptualize and understand the diverse obstacles that developing nations encounter when fostering an environment conducive to AI-driven innovation, sustainability, and growth in the labour market. Additionally, our research addresses a gap in the existing and expanding AI literature, specifically the lack of insight into how firms operating in institutionally weak environments can utilize AI to boost their work flexibility and market competitiveness. We offer perspectives on how the benefits of AI can be further realized and strategically maximized in such contexts.

**3. Methodology**

This study adopts a robust empirical framework to explore the relationship between sustainable development, artificial intelligence (AI), and labour market performance in Africa, with a particular focus on employment and wage rate dynamics. The study utilises panel data covering 54 African countries from 1986 to 2023. The analysis is grounded in the theory of Creative Destruction, emphasizing the duality of innovation in spurring economic renewal and displacing outdated labour frameworks.

**3.1. Model Specification**

The base line for labour market performance is assessed using two core equations:

1. Employment Equation: This equation models how employment levels are determined by AI adoption, economic growth, labour market flexibility, and other structural factors. The implicit form is expressed as follows:

EMPit = $f( AI, GDP, LMF, HMD, SDG)$……………………………………..(1)

Where

* EMPit= Employment level in country at time it
* AI = Level of AI adoption
* GDP = GDP growth rate
* LMFit = Labour market flexibility index (e.g., ease of hiring/firing, contract diversity)
* HCDit = Human capital development (education, skills training)
* SDGit = Progress on relevant Sustainable Development Goals
* μi = Country-specific fixed effects
* εit = Error term

While expressing equation 1 in the structural form, it becomes:

EMPit = αo + α1 ⋅ AIit + α2 ⋅ GDPit + α3 ⋅ LMFit + α4 ⋅ HCDit + α5 ⋅ SDGit + μi + εit …………(2)

**Where:** it = time zones

1. In the wage equation below, wage is assumed to be determined by workers' productivity, integration of AI, the interplay of labour demand and supply, and institutional factors such as laws and social protections. The implicit form of the relationship is expressed as:

WAGEit = $f\left(AI, PROD, EDU, UNEMP, INST\right)……………………………………………………\left(3\right)$

Where

* WAGEit = wage level in a country at time it
* PROD = Labour productivity
* EDU= Educational attainment or skill level
* UNEMP = Unemployment rate (proxy for labour market pressure)
* INST = Institutional quality (e.g., wage laws, social protections)
* μi = Country-specific fixed effects
* εit = Error term

While expressing equation 2 in the structural form it becomes:

WAGEit = βo + β1 ⋅ AIit + β2 ⋅ PRODit + β3 ⋅ EDUit + β4 . UNEMP + β5 . INSTit + μi + εit …………(4)

The dependent variables to be analysed in equations (2) and (4) above are the employment rate and wage rate in each country. Employment level in a country at time is assumed to be determined by the following independent variables, such as the level of AI adoption, GDP growth rate, Labour market flexibility index (e.g., ease of hiring/firing, contract diversity), Human capital development (education, skills training) and Progress on relevant Sustainable Development Goals. On the other hand, wage level in a country at a time is assumed to be determined by these independent variables: Labour productivity, educational attainment or skill level, Unemployment rate (proxy for labour market pressure) and Institutional quality (e.g., wage laws, social protections)

**3.2. Estimation Technique**

Due to the nature of the data for this study, which is panel data. The most appropriate method to use for analysis is the panel data analytical method. There can either be random or fixed effects in the countries covered by the study. Because of country-specific factors, the fixed effect method is more appropriate compared to the random effect method. In addition, Method of Moments Quantile Regression (MMQR) was carried out to assess its ability to handle complexities and variation when working with data from different countries.

**3.3. Data Sources**

Data for the study is available online from the World Bank's World Development Indicators (WDI), the United Nations Human Development Index (HDI), the International Energy Agency (IEA), as well as the World Intellectual Property Organisation (WIPO). Where necessary, the data was transformed, and the models were checked for serial correlation and heterogeneity

**4. Results and Discussion**

The insights gained from the MMQR estimation analysis deepen understanding of the interplay between Africa’s sustainable development, AI implementation, and the productivity of the labor market.

**4.1. Employment Equation**

Both Renewable Energy Consumption and Employment in R&D have a positive and highly marked impact on employment across all quantiles. This suggests that sustainability and innovation further propels the creation of more inclusive employment. Carbon Emissions Per Capita has a negative impact on employment, strengthening the association between pollution-intensive growth and employment opportunities.

The AI Index has a mixed impact: beneficial for upper quantiles (indicating that AI increases employment in developed labor markets with better infrastructure) and harmful for lower quantiles, indicating replacement effects where automation cuts off entry-level positions for unskilled workers. Scholarly literature suggests that Exchange Rate Volatility and Financial Development have a marked impact on employment, emphasizing the importance of macroeconomic stability for labour market participation.

**4.2. Wage Equation**

R&D Expenditure and AI Adoption are positively associated with wages, especially at the upper quantiles, indicating skill premiums and productivity improvements. The Sustainable Development Index (SDI) also correlates positively with wage levels which suggests that more comprehensive human development increases compensation results. Carbon Emissions again hurt wages, which is associated with unsustainable and inefficient technocapitalist industrial capitalism.

**5. Conclusion and Recommendations**

This research has offered striking empirical insights into the interrelationship between macroeconomic governance, technological development, and sustainable development in Africa’s labor markets. The study illustrates that innovation, proxied by R&D spending, patent activity, and AI adoption, in combination with development efforts, materially affects job and wage levels. Still, the impacts are not uniform across quantiles, revealing deep structural inequalities in the continent's labor markets. While AI has great promise in driving productivity and job creation, its deployment remains highly concentrated in certain demographics. In regions with advanced infrastructure and an innovation workforce, AI increases wages and employment opportunities. In contrast, AI accelerates jobless growth in areas with little to no innovation preconditions. Hence, a more targeted approach for the integration of AI, including the development of human capital as well as adaptive policy frameworks, is needed.

Based on the findings of this study, the following recommendations are made for African Countries to take advantage of to boost the performance of inclusive growth and labour work flexibility. First, the government should invest in Human Capital Development. This is by expanding and implementing education and vocational programs that prepare all levels of workers for the digital economy should be prioritized by governments. There should be a greater emphasis and investment on reskilling and up skilling programs. Secondly, they should invest on scale R&D and Innovation Funding. This is by involving public–private collaborations, which should be broadened to increase R&D spending in areas such as renewables, energy, and other digital technologies, encourage greater engagement in innovation through the patenting process and the establishment of innovation ecosystems. Thirdly, AI adoption should be inclusive. It should be focused on high-impact areas, including agri-food systems, education, and primary healthcare, where there is greater potential for enhancement rather than replacement. There should be consideration of differential impacts of AI policies (regional variation) will be needed in the mechanisms designed to assist vulnerable groups in the workforce. Also, reinforcement of financial and monetary systems should be allow for a stable exchange rate and capital circulation, which are requirements for innovation-driven employment. Lastly, environmental sustainability should be integrated into economic approaches through support for clean energy and strict emission controls. Implement labour-intensive green infrastructure initiatives to create jobs and promote environmental balance. The government should also strengthen institutional capacity by empowering regulatory agencies to promote labour market flexibility and innovative governance.

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