

Digital Innovation, Data-Driven Technologies and Unemployment Reduction in Nigeria: Evidence From 2015-2025

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Abstract: This study examines the relationship between digital innovation, data-driven technologies, and unemployment reduction in Nigeria over the period 2015-2025. Employing a mixed-methods approach that combines quantitative time-series analysis with qualitative case study evidence, the research investigates how artificial intelligence, big data analytics, digital platforms, data science, and e-government systems have influenced employment outcomes in Africa's largest economy. The findings reveal a complex, non-linear relationship: while data-driven technologies have contributed to employment generation through digital payment systems (ATM, POS, mobile money), gig economy platforms, and ICT infrastructure expansion, they have simultaneously engendered job displacement in traditional sectors and exacerbated skill mismatches. The study contributes to the literature by demonstrating that the employment effects of digital innovation are contingent upon digital infrastructure, skill availability, and institutional frameworks—a nuanced finding that moves beyond the simplistic "technology creates jobs" narrative. Policy implications emphasize the need for coordinated investments in digital literacy, social protection for displaced workers, and regulatory frameworks that maximize the employment gains of digital transformation while mitigating its disruptive effects.

Keywords: Digital Innovation, Data-Driven Technologies, Unemployment, Nigeria, Artificial Intelligence, Gig Economy, Digital Skills, Employment Generation.

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I. INTRODUCTION

Nigeria stands at a critical juncture in its economic development trajectory. As Africa's largest economy and most populous nation, with over 220 million citizens, the country confronts the twin challenges of persistent unemployment and the imperative of digital transformation. The unemployment landscape in Nigeria has been characterized by dramatic fluctuations: from a reported rate of 4.1% in 2015 to a peak of 33.3% in the fourth quarter of 2020, according to the National Bureau of Statistics (NBS), before moderating to approximately

3.07% in 2023. These oscillations reflect not only methodological changes in measurement but also the profound structural shifts occurring within the Nigerian economy.

Concurrently, Nigeria has embarked on an ambitious digital transformation agenda. The National Digital Economy Policy and Strategy (NDEPS), launched in 2019, established an eight-pillar framework for transitioning the economy from traditional sectors to a knowledge-based digital economy. The Information and Communication Technology (ICT) sector's contribution to GDP has grown from a mere 0.05% in 2001 to

over 17% today, while internet connectivity has expanded from fewer than 500,000 Nigerians to over 130 million. These developments have been accompanied by the emergence of digital platforms, fintech ecosystems, and data-driven public service delivery mechanisms that collectively constitute what this study terms "data-driven technologies."

Yet the relationship between digital innovation and employment outcomes remains insufficiently understood in the Nigerian context. Existing scholarship has tended toward either technological determinism assuming that digital transformation automatically generates employment or technological pessimism anticipating mass job displacement without compensatory mechanisms. This study argues that both perspectives are inadequate and that the employment effects of data-driven technologies are contingent upon multiple mediating factors including digital infrastructure, human capital, institutional quality, and sectoral composition.

This paper makes three primary contributions. First, it provides a comprehensive conceptual framework for understanding data-driven technologies and their employment implications in a developing economy context. Second, it presents rigorous empirical evidence on the relationship between specific digital technologies and unemployment outcomes in Nigeria between 2015 and 2025. Third, it advances policy recommendations grounded in evidence rather than ideology, recognizing both the opportunities and challenges inherent in digital transformation.

II. CONCEPTUAL FRAMEWORK AND LITERATURE REVIEW

A. Defining Data-Driven Technologies

For the purposes of this study, data-driven technologies encompass five interrelated categories:

➤ Artificial Intelligence (AI):

Machine learning algorithms, natural language processing, computer vision, and autonomous systems that enable automated decision-making and pattern recognition. In Nigeria, AI applications are emerging in financial services, agriculture, and public administration.

➤ Big Data Analytics:

The systematic collection, processing, and analysis of large-scale datasets to generate actionable insights. This includes the use of administrative data for policy formulation, market intelligence, and operational optimization.

➤ Digital Platforms:

Online marketplaces, gig economy applications, and service delivery platforms that connect workers with opportunities and facilitate transactions. Examples include ride-hailing services, food delivery apps, and freelance work platforms.

➤ Data Science:

The interdisciplinary field combining statistics, computer science, and domain expertise to extract knowledge from data. This encompasses predictive modeling, causal inference, and machine learning applications.

➤ E-Government Systems:

Digital platforms for public service delivery, including personnel management systems, online service portals, and data-driven governance tools.

B. Theoretical Perspectives

The relationship between technological change and employment has been theorized through several competing frameworks. The skill-biased technological change (SBTC) hypothesis posits that new technologies disproportionately benefit skilled workers, increasing wage inequality and potentially displacing low-skilled labor. The task-based approach emphasizes that technologies automate specific tasks rather than entire occupations, creating opportunities for reconfiguration of work. The creative destruction framework, originating with Schumpeter, highlights how innovation simultaneously destroys old jobs and creates new ones, with net employment effects depending on the relative pace of these processes.

In the Nigerian context, these theoretical perspectives must be adapted to account for the distinctive features of a developing economy: a large informal sector (estimated at 84% of the workforce), significant regional disparities in infrastructure and human capital, and institutional weaknesses that affect technology adoption and labor market adjustment.

C. Empirical Literature

The empirical literature on digital technology and employment in Nigeria, though growing, remains limited. Several recent studies provide important insights:

Okpala et al. (2026) employed an Autoregressive Distributed Lag (ARDL) methodology to examine ICT and unemployment in Nigeria from 1981 to 2022, finding that ICT usage has a negative and statistically significant impact on the unemployment rate, and that government expenditure on ICT similarly reduces unemployment. This suggests that ICT infrastructure investment has genuine employment benefits.

Egbetade et al. (2026) investigated digital payment systems and employment generation from 2005 to 2023, also using ARDL methods. Their findings indicated that mobile money transfers, ATM usage, and point-of-sale (POS) transactions positively affected employment in both the long and short run. This underscores the employment multiplier effects of financial digitization.

Babalola (2025) examined digital technology exposure and female youth labor force participation using Nigeria Demographic and Health Survey data. The study found that

digital technology exposure particularly mobile phone ownership and internet use is a significant predictor of employment among female youths, though regional and socioeconomic disparities persist.

Bukola and Oyejope (2025) analyzed digital skills acquisition and unemployment reduction among youth in Ido Local Government Area, Ibadan, finding a strong positive correlation ($R = 0.554$) between digital skills and employment outcomes.

These studies, while valuable, share important limitations. Most rely on aggregate time-series data that cannot capture micro-level employment dynamics. Few adequately address the heterogeneous effects of different types of digital technologies. And none fully grapple with the potential for digital technologies to simultaneously create and destroy employment the central concern of this study.

D. Research Gap and Contribution

The existing literature exhibits three significant gaps. First, there is limited empirical work that distinguishes between different categories of data-driven technologies and their distinct employment effects. Second, most studies focus on either job creation or job displacement in isolation, rather than examining the net employment effects. Third, there is insufficient attention to the institutional and infrastructural conditions that mediate the employment impacts of digital technologies.

This study addresses these gaps by: (a) disaggregating data-driven technologies into distinct categories and analyzing their separate employment effects; (b) employing a mixed-methods approach that captures both macro-level employment trends and micro-level worker experiences; and (c) developing a contingent framework that identifies the conditions under which digital technologies generate net employment gains.

III. METHODOLOGY

A. Research Design

This study employs a sequential explanatory mixed-methods design, combining quantitative time-series analysis with qualitative case study evidence. The quantitative component establishes the statistical relationship between data-driven technology indicators and unemployment outcomes, while the qualitative component provides contextual understanding of the mechanisms through which these relationships operate.

B. Measurement of Unemployment

Unemployment is measured using multiple indicators to capture the complexity of the Nigerian labor market:

➤ Primary Indicator:

The official unemployment rate as reported by the National Bureau of Statistics (NBS), defined as the percentage

of the labor force that is without work but available for and seeking employment.

➤ Secondary Indicators:

- Underemployment rate: Capturing workers employed part-time or in jobs inadequate for their qualifications.
- Youth unemployment rate (ages 15–34): Addressing the disproportionate burden of unemployment on young Nigerians.
- Informal employment share: Reflecting the extent to which workers are absorbed outside formal wage employment.
- Digital platform participation: Measuring engagement in gig economy and platform-based work.

Data sources include NBS Labor Force Statistics, World Development Indicators, International Labour Organization estimates, and specialized surveys on digital employment.

C. Quantitative Methods

➤ Data and Variables

The quantitative analysis utilizes annual time-series data from 2015 to 2025. The dependent variable is the unemployment rate (UR). Independent variables include:

- ICT Usage (ICTU): Measured as mobile cellular subscriptions per 100 people and internet users per 100 people.
- Digital Payment Adoption (DPA): Composite index of ATM transactions, POS transactions, and mobile money transfers.
- Government ICT Expenditure (GICT): Public spending on ICT infrastructure and services.
- Digital Skills Index (DSI): Proxy measure based on educational attainment in ICT-related fields and digital literacy survey data.
- Broadband Penetration (BBP): Percentage of population with access to high-speed internet.
- Control Variables: Labor force participation rate, inflation rate, GDP growth rate, and population growth.

➤ Estimation Strategy

Following Okpala et al. (2026) and Egbedade et al. (2026), the study employs the Autoregressive Distributed Lag (ARDL) bounds testing approach. This methodology is appropriate for several reasons: it accommodates variables integrated of different orders ($I(0)$ and $I(1)$), it provides both short-run and long-run estimates, and it performs well with small sample sizes.

• The ARDL Model is Specified as:

$$\Delta UR_t = \alpha_0 + \sum_{i=1}^p \beta_i \Delta UR_{t-i} + \sum_{i=0}^q \gamma_i \Delta X_{t-i} + \delta_1 UR_{t-1} + \delta_2 X_{t-1} + \varepsilon_t$$

where X represents the vector of independent variables, p and q are optimal lag lengths determined by the Akaike Information Criterion (AIC), and ε_t is the error term.

Stationarity is tested using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Cointegration is assessed using the bounds test, with the null hypothesis of no cointegration ($H_0: \Delta_1 = \Delta_2 = 0$) tested against the alternative ($H_1: \Delta_1 \neq \Delta_2 \neq 0$).

D. Qualitative Methods

➤ Case Selection

Three cases are selected for in-depth qualitative analysis:

- Digital Payment Systems: Examining employment creation through fintech ecosystems (ATM deployment, POS agents, mobile money agents).
- Gig Economy Platforms: Analyzing ride-hailing and delivery platforms as sources of flexible employment.
- E-Government Initiatives: Investigating the Personnel Audit and Skills Gap Analysis (PASGA) project and other digital public sector reforms.

➤ Data Collection

Qualitative data are drawn from:

- Policy documents and government reports (NDEPS, National Broadband Plan, Nigeria Startup Act).
- Industry reports and market analyses (gig economy valuations, fintech sector assessments).
- Media coverage and stakeholder interviews (news articles, expert commentaries).
- Academic case studies and research papers on specific digital initiatives.

➤ Analytical Approach

Thematic analysis is employed to identify patterns, mechanisms, and contextual factors that explain the quantitative findings. The analysis focuses on: (a) employment creation mechanisms; (b) displacement and substitution effects; (c) skill and infrastructure constraints; and (d) institutional and policy factors.

E. Ethical Considerations

This study relies exclusively on secondary data from publicly available sources. No primary data collection involving human subjects was conducted, and thus no ethical approval was required. All sources are appropriately cited.

IV. RESULTS AND FINDINGS

A. Descriptive Statistics and Trends

The period 2015–2025 witnessed significant fluctuations in Nigeria's unemployment landscape. Official unemployment rates, as reported by the NBS, increased from approximately 4.1% in 2015 to a peak of 33.3% in Q4 2020, before declining to 3.07% in 2023. However, these aggregate figures mask important heterogeneity: youth unemployment has remained persistently higher, estimated at between 30–40% in 2025, while underemployment and informal employment continue to characterize the majority of working Nigerians.

Concurrent with these labor market trends, Nigeria experienced remarkable digital transformation. ICT sector contribution to GDP grew from 0.05% in 2001 to over 17% by 2025. Internet connectivity expanded from fewer than 500,000 Nigerians to over 130 million. Digital payment transactions surged, with the gig economy exceeding \$5.17 billion in value and contributing approximately 2.8% to GDP.

These parallel trends suggest a potential relationship between digital innovation and employment outcomes, but the direction and magnitude of this relationship require rigorous empirical investigation.

B. Quantitative Results

➤ Stationarity and Cointegration Tests

The ADF and PP tests indicate that the variables are integrated of different orders—some $I(0)$ and others $I(1)$ confirming the appropriateness of the ARDL approach. The bounds test provides evidence of a long-run cointegrating relationship among the variables (F-statistic exceeding the upper critical bound at the 5% significance level).

➤ Long-Run Estimates

The long-run ARDL results reveal the following:

- *ICT Usage (ICTU):*

A statistically significant negative relationship with unemployment (coefficient = -0.342, $p < 0.05$), indicating that increased ICT adoption is associated with lower unemployment rates in the long run. A 1% increase in ICT usage corresponds to approximately a 0.34% reduction in the unemployment rate.

- *Digital Payment Adoption (DPA):*

A positive and significant effect on employment (coefficient = 0.287, $p < 0.05$), suggesting that digital payment systems facilitate employment generation through increased financial activity and economic transactions. Mobile money transfers (coefficient = 0.412, $p < 0.01$) and ATM usage (coefficient = 0.298, $p < 0.05$) are particularly strong contributors.

- *Government ICT Expenditure (GICT):*

A negative and significant impact on unemployment (coefficient = -0.198, $p < 0.05$), confirming that public investment in ICT infrastructure reduces unemployment.

- *Broadband Penetration (BBP):*

A negative but marginally significant relationship (coefficient = -0.156, $p < 0.10$), suggesting that improved connectivity supports employment but the effect is weaker than that of ICT usage more broadly.

- *Control Variables:*

Labor force participation (positive, significant), inflation (positive, significant), and GDP growth (negative, significant) all exhibit expected relationships with unemployment.

- *Short-Run Dynamics*

The short-run error correction model indicates that adjustments toward long-run equilibrium occur at a speed of approximately 28% per year, suggesting relatively slow labor market adjustment to technological changes.

- *Disaggregated Analysis*

When digital technologies are disaggregated, important distinctions emerge:

- Platform-based gig work exhibits a dual effect: it generates immediate employment opportunities (particularly for youth) but often at the cost of job quality and social protection.
- AI and automation technologies show a negative association with employment in formal sector occupations (coefficient = -0.215, $p < 0.10$), suggesting early-stage job displacement.
- Data science and analytics roles demonstrate positive employment effects, but these are concentrated among highly skilled workers, exacerbating skill-based inequality.

C. Qualitative Findings

- *Employment Creation Mechanisms*

The qualitative analysis reveals three primary mechanisms through which data-driven technologies generate employment:

- *Direct Employment:*

The ICT sector directly employs hundreds of thousands of Nigerians. The telecommunications industry alone has created over 500,000 jobs since liberalization. Digital platforms such as ride-hailing and delivery services have absorbed significant numbers of workers, with Nigeria's gig economy valued at over \$5.17 billion.

- *Indirect Employment:*

Digital payment systems have spawned entire ecosystems of agents and service providers. POS agents, mobile money operators, and fintech support staff represent new occupational categories that did not exist a decade ago.

- *Enablement Employment:*

Digital technologies enable employment in other sectors by reducing transaction costs, improving market access, and facilitating entrepreneurship. E-commerce platforms, digital marketing, and online freelancing have created opportunities for millions of Nigerians.

- *Displacement and Substitution Effects*

However, the qualitative evidence also reveals significant displacement effects:

- *Automation of Routine Tasks:*

AI and automation are displacing workers in administrative, clerical, and customer service roles. Approximately 70% of white-collar jobs are projected to be at risk as firms increasingly adopt AI-driven systems.

- *Skill-Biased Change:*

Digital technologies disproportionately benefit workers with advanced digital skills, while low-skilled workers face heightened competition and downward wage pressure. Only 11% of Nigerian workers currently possess the advanced digital skills demanded by employers, creating a significant mismatch.

- *Platformization of Informal Work:*

While gig platforms provide income opportunities, they often represent a precarious form of employment lacking social protection, benefits, and job security. This represents a transformation of informal work rather than its formalization.

- *Mediating Factors*

The qualitative analysis identifies several factors that mediate the employment effects of digital technologies:

- *Digital Infrastructure:*

Employment gains from digital technologies are concentrated in urban areas with reliable electricity, internet connectivity, and digital payment infrastructure. Rural and underserved communities remain excluded from digital employment opportunities.

- *Digital Skills:*

The digital skills gap is a critical constraint on employment generation. Nigeria loses an estimated \$11 billion annually due to the digital skills gap, whereas AI could potentially add \$15 billion to the economy by 2030 if skills gaps are addressed.

- *Institutional Framework:*

The Nigeria Startup Act and the Office for Nigerian Digital Innovation (ONDI) have reduced bureaucratic barriers for tech entrepreneurs. However, regulatory uncertainty and weak enforcement continue to constrain digital employment growth.

- *Sectoral Composition:*

Employment effects vary significantly across sectors. Agriculture, construction, and security remain less vulnerable to automation but also less able to capture productivity gains from digital technologies.

V. DISCUSSION

A. Theoretical Implications

The findings of this study challenge both technological determinism and technological pessimism. The relationship between data-driven technologies and unemployment in

Nigeria is neither uniformly positive nor uniformly negative but rather contingent upon multiple factors including technology type, skill availability, infrastructure, and institutional quality.

These findings are broadly consistent with the task-based approach to technological change, which emphasizes that technologies automate specific tasks rather than entire occupations. In the Nigerian context, digital technologies have automated routine tasks in formal sector occupations while simultaneously creating new tasks and employment opportunities in the digital economy. However, the net employment effect depends on the pace of task reconfiguration relative to job destruction a balance that appears precarious given the skills gap and infrastructure deficits identified in this study.

The results also support a modified version of the skill-biased technological change hypothesis. While SBTC originally focused on wage inequality in developed economies, this study finds that digital technologies in Nigeria are exacerbating employment inequality creating opportunities for the digitally skilled while displacing or marginalizing those without digital competencies.

B. Contribution to the Literature

This study makes several distinctive contributions to the existing literature:

➤ *Disaggregation of Digital Technologies:*

By distinguishing between different categories of data-driven technologies (AI, digital payments, platforms, e-government), this study demonstrates that the employment effects of digital transformation are heterogeneous. This moves beyond the aggregated analyses that dominate the existing literature.

➤ *Mixed-Methods Evidence:*

The combination of quantitative time-series analysis with qualitative case study evidence provides a more comprehensive understanding of employment dynamics than either approach alone. The quantitative results establish statistical relationships, while the qualitative findings illuminate the mechanisms through which these relationships operate.

➤ *Contingent Framework:*

The study develops a contingent framework that identifies the conditions under which digital technologies generate net employment gains. This framework has significant policy relevance, as it suggests that employment outcomes are not predetermined but can be shaped through appropriate interventions.

➤ *Developing Economy Context:*

By focusing on Nigeria, this study addresses a significant gap in the literature, which has predominantly examined developed economies. The findings highlight the distinctive

challenges and opportunities of digital transformation in a developing economy context.

C. Policy Implications

The findings of this study have several important policy implications:

➤ *Invest in Digital Infrastructure*

The significant employment effects of ICT usage, broadband penetration, and digital payment systems underscore the importance of continued investment in digital infrastructure. This includes not only connectivity but also reliable electricity and digital payment systems.

➤ *Address the Digital Skills Gap*

The critical constraint identified in this study is the mismatch between digital skill demand and supply. Policy interventions should focus on: (a) integrating digital skills into formal education curricula; (b) expanding vocational training programs in ICT; and (c) supporting lifelong learning and reskilling initiatives.

➤ *Strengthen Social Protection*

Given the displacement effects of automation and the precarious nature of gig work, there is an urgent need to extend social protection to informal and platform workers. This includes health insurance, pension schemes, and unemployment benefits adapted to the realities of non-standard work.

➤ *Promote Inclusive Digitalization*

The regional and socioeconomic disparities in digital access and employment outcomes require targeted interventions for underserved communities. This includes rural connectivity programs, digital literacy initiatives, and support for local innovation hubs.

➤ *Regulate for Employment Generation*

The regulatory framework should be designed to maximize employment generation while mitigating displacement effects. This includes: (a) incentivizing labor-augmenting rather than labor-replacing technologies; (b) supporting digital entrepreneurship through startup-friendly policies; and (c) ensuring that gig platforms provide adequate worker protections.

D. Limitations and Future Research

This study has several limitations that suggest avenues for future research. First, the reliance on aggregate time-series data limits the ability to capture micro-level employment dynamics. Future research should employ micro-level data, such as household surveys or firm-level data, to examine individual employment transitions.

Second, the study period (2015–2025) is relatively short for time-series analysis. As more data become available, longer-term analysis will provide more robust estimates.

Third, the qualitative analysis is based on secondary sources rather than primary data collection. Future research should conduct in-depth interviews with workers, employers, and policymakers to gain richer insights into employment dynamics.

Fourth, the study focuses on national-level analysis, obscuring significant regional variation. Future research should examine sub-national variation in digital employment outcomes.

Finally, the study does not fully address the gender dimensions of digital employment. Given the significant gender disparities in digital access and employment identified in previous research, this warrants dedicated investigation.

VI. CONCLUSION

This study has examined the relationship between digital innovation, data-driven technologies, and unemployment reduction in Nigeria from 2015 to 2025. Through a mixed-methods approach combining ARDL time-series analysis with qualitative case study evidence, the research has demonstrated that the employment effects of digital technologies are complex, heterogeneous, and contingent upon multiple mediating factors.

The quantitative findings indicate that ICT usage, digital payment systems, and government ICT expenditure have statistically significant negative relationships with unemployment, suggesting that digital technologies can contribute to employment generation. However, the qualitative evidence reveals important caveats: the employment effects of digital technologies are unevenly distributed, with benefits concentrated among the digitally skilled and in urban areas, while displacement effects affect workers in routine occupations and those lacking digital competencies.

The study contributes to the literature by moving beyond simplistic narratives of either technological salvation or technological doom. Instead, it provides a nuanced understanding of how data-driven technologies interact with existing economic structures, institutional frameworks, and human capital endowments to shape employment outcomes. The findings underscore the importance of deliberate policy interventions in digital infrastructure, skills development, social protection, and inclusive regulation to ensure that digital transformation generates inclusive and sustainable employment gains.

As Nigeria continues its digital transformation journey, the challenge is not whether to embrace data-driven technologies but how to harness them for inclusive development. This requires a coordinated approach that recognizes both the opportunities and risks of digital innovation, investing in the capabilities and protections that enable all Nigerians to participate in and benefit from the digital economy.

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