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Article

Public Healthcare Expenditure and Labour Productivity Dynamics in Nigeria: Evidence from the ECM–ARDL Model (1986–2025)

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Abstract: This study investigates the impact of public healthcare spending, life expectancy, labour force participation rate, and real gross domestic product on labour productivity in Nigeria between 1986 and 2025. Based on Wagner's law of growing state activity, the study uses an Error Correction Model (ECM) and the Autoregressive Distributed Lag (ARDL) bounds testing approach to analyze annual data from the World Bank and the Central Bank of Nigeria Statistical Bulletin. While the limits test verifies a long-term cointegrating relationship between the variables (F-statistic = 72.31), unit root tests show a mixed order of integration, I(0) and I(1), supporting the ARDL technique. The findings demonstrate that labour productivity is negatively and statistically insignificantly impacted by public healthcare spending over both the short and long terms. Real gross domestic product has a substantial, positive, and considerable impact on labour productivity, whereas life expectancy and the labour force participation rate have large negative long-term effects. Every year, about 6.8% of short-run disequilibrium is rectified, according to the error correction term (−0.068). The study comes to the conclusion that increasing labour productivity in Nigeria is more dependent on fundamental labour-market reform and steady economic growth than on the amount of money spent on healthcare. It suggests shifting health spending to infrastructure and preventative care, coordinating labour force growth with job creation, and pursuing steady, growth-oriented macroeconomic policy.

Keywords: Healthcare Expenditure; Labour Productivity; Life Expectancy; Labour Force Participation; ARDL

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1. Introduction

Health is an essential component of human capital and a significant predictor of labor productivity [1]. A healthy workforce works longer, learns quicker, and generates higher-quality output, whereas bad health has a direct impact on national production via absenteeism, lower cognitive capacity, and early death [2]. Because health is a public good that cannot be wholly provided by private markets, government financing of healthcare is critical to how a country develops and supports this type of human capital [3].

However, Nigeria's public healthcare funding has consistently lagged behind set standards. In comparison to the 5.4 percent average for sub-Saharan Africa and the 15 percent aim established by the 2001 Abuja Declaration, government health spending has fluctuated between 3.5 and 5 percent of the national budget [4], [5]. As a result, private out-of-pocket spending has accounted for the majority of health spending, increasing from over 60% in 2000 to over 76% by 2021 [6]. Meanwhile, Nigeria's life expectancy (55.2 years in 2022) is still much lower than the global average of 72.6 years [5]. The trend of labor productivity has also been uneven, with notable drops between 2013 and 2018 ascribed to inadequate human capital development, poor governance, and fiscal indiscipline [7], [8].

Despite the well-established theoretical relationship between health spending and labour productivity, there is still a dearth of empirical data unique to Nigeria, and the transmission mechanism - from public health spending through life expectancy and labour force participation to real output - is rarely modelled in tandem. Few studies go beyond 2020, and the majority focus on education rather than health as the primary channel of human capital building [9], [10]. In order to close that gap, this study looks at how public healthcare spending, life expectancy, labour force participation rate, and real GDP all interact together to influence labour productivity in Nigeria between 1986 and 2025 within a single ARDL–ECM framework.

1.1 Objectives of the Study

Examining the relationship between public healthcare spending and labour productivity in Nigeria between 1986 and 2025 is the main objective of this study. The particular goals are to:

1. Determine how Nigerian labour productivity is affected by public healthcare spending;
2. Determine the degree to which life expectancy and labour productivity cointegrate in Nigeria;
3. Analyze the type and strength of the labour force participation rate's impact on labour productivity in Nigeria; and
4. Assess the causal relationship between real gross domestic product and labour productivity in Nigeria.

1.2 Research Hypotheses

H_{01}: Public healthcare expenditure has no significant impact on labour productivity in Nigeria.

H_{02}: Life expectancy has no significant cointegration with labour productivity in Nigeria.

H_{03}: Labour force participation rate has no significant impact on labour productivity in Nigeria.

H_{04}: Real gross domestic product has no significant relationship with labour productivity in Nigeria.

1.3 Conceptual Framework

Healthcare spending, which is considered globally as a gauge of a government's commitment to population health, refers to the resources - both capital and recurrent - directed toward hospitals, medications, staff, and public health initiatives [11]. Due to the lack of disaggregated labour productivity data for Nigeria, this study approximates labour productivity as GDP per capita divided by the labour force participation rate, which more accurately reflects output relative to the working population than GDP per capita alone. Labour productivity is a widely used indicator of an economy's efficiency and competitiveness [12]. While the labour force participation rate measures the portion of the working-age population that is economically active, life expectancy—the average number of years a newborn is expected to live—is both a result of healthcare investment and a proxy for the health stock of the workforce. This is a crucial channel through which health and demographic conditions translate into aggregate output [13].

1.4 Theoretical Review

This study is based on three theoretical strands. First, endogenous growth theory [14], [15], [16] maintains that long-term growth results from internal factors, such as investments in human capital, knowledge, and innovation, as opposed to exogenous technological change. This suggests that consistent investments in health, as a type of human capital, can produce long-term increases in productivity. Second, Grossman's [17] health production function provides the micro-foundation for treating healthcare spending, life expectancy, and labour supply as determinants of an aggregate production outcome by modelling health as a stock of capital that depreciates over time but can be replenished through healthcare consumption, favourable environmental conditions, and healthy behaviour. Third, Wagner's law of increasing state activity [18], [19], adopted as the foundation for this study, states that as an economy industrializes and national income rises, the demand for social and administrative services will drive an increase in public spending, including health spending. This study revisits this tension by directly modelling the health-expenditure channel to labour productivity. Empirical tests of Wagner's law have yielded inconsistent results across nations, with Nigeria-specific studies (e.g., [20]) generally finding no long-run relationship between government expenditure and output.

1.5 Healthcare Expenditure and Labour Productivity

Using Nigerian data from 1990 to 2022, Ugbaka and Ihuoma [21] applied the ARDL technique and discovered that while economic growth had a very little impact on productivity, health outcome indicators had a large short- and long-term impact. Applying a structural VAR to Nigerian data from 1986 to 2022, Ayaga, et al. [22] discovered a positive but statistically insignificant short-run relationship between health spending and labour productivity, drawing the conclusion that insufficient funding restricts the efficacy of health investment. Using an ARDL model (1990–2020), Odili, et al. [8] discovered that human capital development, along with capital intensity and salaries, had negative short-term effects on Nigerian labour productivity that only became significant and positive over time.Using a VAR model using Nigerian data from 1980 to 2018, Abdulwahab and Isiaka [23] discovered that while capital health expenditure had a negative impact during the same period, government recurrent health expenditure had a positive impact on labour productivity. Evbayiro-Osagie and Obasogie [24] examined Nigerian data from 1981 to 2017 using the Engle–Granger and Johansen cointegration tests. They discovered that public health spending had a large negative long-term impact on labour productivity and a positive but negligible short-term impact. Muhammad [25] established a substantial association between recurrent health expenditure and worker productivity using Chow breakpoint tests on Nigerian data from 1981 to 2016. This relationship was more pronounced in the post-millennium period than in the earlier structural-adjustment years.

1.6 Life Expectancy and Labour Productivity

Zaib-un-Nisa [26] discovered that life expectancy and education had a significant and beneficial impact on worker productivity using panel OLS, fixed-effects, and GMM estimators on South Asian data (1991–2019). Using a two-stage least squares instrumental-variable approach, Ng [27] discovered a positive correlation between life expectancy and labour productivity that operates through channels related to education, savings, and demographic transition. Mehmood, Siddique, and Ali [28] discovered that, in addition to schooling, life expectancy had a large and positive impact on labour productivity using panel data for South Asian Nations (1991–2019) and several estimators. After controlling for malaria prevalence and school enrolment, Iseghohi [29] used vector autoregression and Granger causality on Nigerian quarterly data (2000–2018) and discovered that life expectancy at birth had no discernible impact on output per worker. Using Pakistani data from 1980 to 2010, Saif, Malik, and Mahmood [30] employed the ARDL bounds technique and discovered that worker productivity increased by around 13.4% for every 1%

improvement in health condition. Dogrul [31] demonstrated that health status, as measured by life expectancy, has a substantial impact on labour force participation across age and gender groups using a two-stage estimation technique on Turkish cross-sectional data.

1.7 Labour Force Participation Rate and Labour Productivity

In a multi-variable regression using World Bank data from 2000 to 2020, Oyintoyo and Udeh [32] discovered that secondary school enrolment and oil revenue had a substantial impact on Nigeria's labour force participation rate, but unemployment and access to electricity did not. Using Johansen cointegration and a Vector Error Correction Model on Nigerian data from 1990 to 2017, Yakubu, Akanegbu, and Jelilov [33] discovered a long-term causal link between labour force participation, capital formation, and labour productivity. Using a dynamic panel GMM model for sub-Saharan Africa, Novignon, Novignon, and Arthur [34] discovered that life expectancy, a proxy for health status, had a significant impact on female labour force participation throughout the area. Using bivariate probit and instrumental-variable models using cross-sectional data from South Africa, Nwosu and Woolard [35] discovered a positive and substantial correlation between self-assessed health and labour force participation, which was stronger for men. According to Kalwij and Vermeulen's [36] analysis of eleven European nations, the impact of health indicators on the labour force participation of the elderly varied by nation and health measure.

1.8 Real Gross Domestic Product and Labour Productivity

Using cointegration techniques on Nigerian data from 1986 to 2021, Muhammad and Bichi [37] discovered that government spending on health and education, coupled with gross capital formation, had a considerable impact on GDP, even though the health-expenditure coefficient was negative. Using data from Nigeria, Olayiwola, et al. [38] investigated Wagner's hypothesis and discovered a long-term correlation between public health expenditures and economic growth, with a unidirectional causal link extending from total government spending to real GDP. Using an ECM on Nigerian data from 1985 to 2019, Imandojemu, et al. [39] discovered that real GDP per capita was positively impacted by government consumption, health spending share, and labour force participation. Using a generalized method of moments methodology, Udeorah, et al. [40] discovered that while education spending had a significant beneficial impact on Nigerian economic growth, healthcare spending was not statistically significant. Applying ARDL bounds testing to Nigerian data from 1985 to 2009, Karim [41] discovered that while health spending increased human capital and decreased infant mortality, it had no appreciable marginal impact on economic growth.

1.9 Gap in the Literature

While there is a substantial body of research linking public spending to economic growth and, separately, labour productivity, few studies model the entire transmission chain, from public healthcare spending to life expectancy and labour force participation to real output and labour productivity, within a single framework for Nigeria. Most known studies are also from before 2023 and are based on human capital or endogenous growth theories, with no mention of Wagner's law in this context. This study fills these gaps by extending the analysis to 2025 and jointly estimating the short-run and long-run dynamics of all four variables using the ARDL-ECM framework, adopting Ugbaka and Ihuoma's [21] model to a labour productivity framework rather than an industrial productivity framework.

2. Materials and Methods

2.1 Research Design and Theoretical Framework

The study uses an ex post facto research design, which is suitable for secondary time-series data-based studies. It is based on Wagner's law of growing state activity, which states that as an economy develops, becomes more industrialized, and its population

needs more public services, public spending, including health spending, increases [18], [42].

2.2 Model Specification

Adapting the model of Ugbaka and Ihuoma [21], who investigated health outcomes and industrial productivity, to a labour productivity framework, and adjusting for potential multicollinearity among their health-outcome proxies, the model is given as:

$$LPRD_t = f(HEXP_t, LEXP_t, LFPR_t, RGDP_t)$$

which is expressed in econometric and log-linear form as:

$$lnLPRD_t = \beta_0 + \beta_1 lnHEXP_t + \beta_2 LEXP_t + \beta_3 LFPR_t + \beta_4 lnRGDP_t + \varepsilon_t$$

LPRD stands for labour productivity, HEXP for public healthcare spending, LEXP for life expectancy, LFPR for labour force participation rate, RGDP for real gross domestic product, β_0 for the intercept, β_1–β_4 for coefficients, and ε for the stochastic error term. To lower the possibility of spurious regression, natural logarithms are applied to LPRD, HEXP, and RGDP. It is assumed that all coefficients will be positive.

2.3 Estimation Technique

The Autoregressive Distributed Lag (ARDL) bounds testing approach [43] is used because it accepts variables of different orders - I(0), I(1), or a combination of both - allows for simultaneous estimation of short-run and long-run relationships, and performs well in small samples. The general ARDL specification is changed to extract an error correction term (ECT), which measures how quickly the model recovers to long-run equilibrium after a short-run shock. Before doing ARDL estimate, the Augmented Dickey-Fuller (ADF) test is used to determine the order of integration of each variable, followed by the boundaries test to determine whether a long-run cointegrating connection exists. To demonstrate the model's robustness, post-estimation diagnostics are used, including the Breusch-Godfrey serial correlation LM test, the Breusch-Pagan-Godfrey heteroskedasticity test, the Ramsey RESET test, the Jarque-Bera normality test, and the CUSUM stability test.

2.4 Sources of Data

Annual time series data from 1986 to 2025 are derived from the World Bank Development Indicators (labour productivity, labour force participation rate, life expectancy) and the Central Bank of Nigeria Statistical Bulletin (public healthcare expenditure and real GDP).

3. Result

3.1 Descriptive Statistics

Table 1. Descriptive Statistics

Statistic	lnLPRD	lnHEXP	LEXP	LFPR	lnRGDP
Mean	7.369	4.644	49.118	59.158	9.470
Median	7.877	5.137	49.035	56.000	9.927
Std. Dev.	1.837	1.988	2.994	6.938	2.175
Skewness	-0.599	-0.564	0.223	2.039	-0.472
Kurtosis	2.079	2.042	1.672	5.791	1.953
Jarque-Bera (p)	0.164	0.177	0.212	0.000	0.207
Observations	38	38	38	38	38

***Source**: Author's computation using E-Views 13 output.*

Real GDP and labour productivity have relatively high means and have been trending upward during the course of the research. With its strong positive skewness and leptokurtosis, the labour force participation rate is the only variable that deviates from normalcy (Jarque-Bera p = 0.000); the other series are roughly normally distributed.

3.2 Correlation Matrix

Table 2: Correlation Matrix

Variable	lnLPRD	lnHEXP	LEXP	LFPR	lnRGDP
lnLPRD	1.000	0.993	0.902	0.457	0.998
lnHEXP	0.993	1.000	0.910	0.507	0.994
LEXP	0.902	0.910	1.000	0.638	0.924
LFPR	0.457	0.507	0.638	1.000	0.514
lnRGDP	0.998	0.994	0.924	0.514	1.000

***Source**: Author's computation using E-Views 13 output.*

Labour productivity is almost perfectly correlated with real GDP (0.998) and strongly correlated with health expenditure (0.993) and life expectancy (0.902), whereas labour force participation rate has only a moderate relationship with the other series, implying that its impact on productivity may differ from the other variables.

3.3 Unit Root Test

Table 3. Augmented Dickey-Fuller Unit Root Test

Variable	At Level	1st Difference	Order of Integration
lnLPRD	-2.957	—	I(0)
lnHEXP	-2.287	-2.329	I(1)
LEXP	-1.521	-7.198	I(1)
LFPR	-0.217	-3.641	I(1)
lnRGDP	-4.113	—	I(0)

***Note:** 5% critical value = -2.943. Source: Author's computation using E-Views 13 output.*

Labour productivity and real GDP are stationary at the level, I(0), whereas healthcare spending, life expectancy, and labour force participation rate are stationary at the first difference, I(1). This mixed order of integration supports the usage of the ARDL bounds testing method.

3.4 ARDL Bounds Cointegration Test

Table 4. ARDL Bounds Test Result (5% critical value)

F-statistic	k	I(0) Lower Bound	I(1) Upper Bound
72.309	4	2.947	4.088

***Source:** Author's computation using E-Views 13 output.*

The estimated F-statistic (72.31) exceeds the upper bound critical value at the 5% level, implying rejection of the null hypothesis of no cointegration. In Nigeria, there is a long-run relationship between public healthcare expenditure, life expectancy, labour force participation rate, real GDP, and labour productivity.

3.5 Short-Run Dynamics

Table 5. Short-Run ECM Results

Variable	Coefficient	t-Statistic	Prob.
ECT(-1)	-0.0676	-22.613	0.000

Variable	Coefficient	t-Statistic	Prob.
lnHEXP	-0.0015	-0.527	0.602
LEXP	0.0024	1.582	0.123
LFPR	-0.0148	-134.350	0.000
lnRGDP	0.9918	213.238	0.000

Source: *Author's computation using E-Views 13 output.*

Convergence toward long-run equilibrium at a moderate yearly pace of roughly 6.8 percent is confirmed by the error correction term, which is negative and significant (-0.068, p = 0.000). Real GDP is the primary driver, moving nearly one-to-one with labour productivity, while healthcare spending and life expectancy have no discernible impact on labour productivity in the medium term. The labour force participation rate has a slight but very significant negative impact.

3.6 Long-Run Relationship

Table 6. Long-Run ARDL Results

Variable	Coefficient	t-Statistic	Prob.
lnHEXP	-0.0227	-0.531	0.599
LEXP(-1)	-0.0412	-4.119	0.000
LFPR(-1)	-0.0139	-5.482	0.000
lnRGDP(-1)	0.9311	21.506	0.000
Constant	1.1325	3.183	0.003

Source: *Author's computation using E-Views 13 output.*

In the long run, public healthcare expenditure remains negative and statistically insignificant, demonstrating that, at current levels of investment and efficiency, health spending does not result in substantial productivity increases. Life expectancy and labour force participation rates are both negative and substantial, indicating that increases in longevity and labour supply have yet to be matched by adequate infrastructure, job creation, or productive workforce absorption. Real GDP still has a robust, positive, and highly significant influence, demonstrating the permanence of economic growth as a driver of labour productivity.

3.7 Post-Estimation Diagnostics

Table 7. Diagnostic Test Summary

Test	Statistic / p-value	Conclusion
Breusch-Godfrey LM (serial correlation)	F = 1.989, p = 0.118	No serial correlation
Durbin-Watson	1.680	No autocorrelation
Breusch-Pagan-Godfrey (heteroskedasticity)	F = 0.849, p = 0.569	Homoskedastic
Ramsey RESET	F = 0.305, p = 0.586	No specification error
Jarque-Bera (normality)	2.449, p = 0.294	Normally distributed
CUSUM	Within 5% bounds	Model is stable

Test	Statistic / p-value	Conclusion
Adjusted R^2	0.9995	High explanatory power

Source: *Author's computation using E-Views 13 output.*

The diagnostic results verify that the model is accurately described, normally distributed, structurally stable, free of serial correlation and heteroskedasticity, and that the explanatory variables collectively explain for 99.95 percent of the variance in labour productivity.

4. Discussion

The conclusion that public healthcare spending has no discernible impact on labour productivity over the short or long term is in line with the findings of Udeorah et al. [40] and Muhammad and Bichi [37]. It also fits with the larger pattern in the Nigerian literature that health spending has consistently been too low and too heavily weighted toward recurring administrative costs rather than infrastructure to produce quantifiable productivity returns [44]. Although it defies the theoretical predictions of Grossman [17] and Bloom and Canning [13], the negative long-term impact of life expectancy on productivity is consistent with research by Omonona, et al. [45] and Peykarjou [46]. This may indicate that a longer-lived population imposes dependency and resource-strain pressures rather than fully translating into productive years in the absence of corresponding improvements in healthcare quality, education, and employment absorption. Similar to Odili et al. [8], the substantial negative impact of labour force participation rate indicates that Nigeria's growing labour force is not being matched by corresponding job creation, leading to underemployment that lowers average productivity rather than increases it. The strong positive effect of real GDP, consistent with Olayiwola et al. [38] and Imandojemu et al. [39], demonstrates that broad-based economic growth is still the most reliable conduit for improving labour productivity in Nigeria.

4.1 Contribution to Knowledge and Suggestions for Further Study

By jointly modelling public healthcare spending, life expectancy, labour force participation rate, and real GDP for Nigeria within a single ARDL–ECM framework, extending the data horizon to 2025, and differentiating labour productivity from the industrial productivity measure used in closely related prior work, this study adds to the body of literature. Future research should pursue disaggregated and cross-country comparative analyses, incorporating governance quality, technological change, and demographic structure as additional explanatory variables, since the analysis is based on aggregate macroeconomic data and does not break down healthcare spending by recurrent and capital components or by sector.

5. Conclusion

Using the ARDL–ECM framework, this study looked at how public healthcare spending, life expectancy, labour force participation rate, and real GDP affected labour productivity in Nigeria between 1986 and 2025. The factors were shown to have a long-term cointegrating relationship. Real GDP had a large positive and substantial influence throughout, life expectancy and labour force participation rate had significant negative long-term effects, and public healthcare spending was shown to have statistically insignificant short- and long-term effects. A rather sluggish yearly adjustment (6.8%) toward long-run equilibrium is indicated by the error correction term. Overall, the findings imply that labour productivity improvements in Nigeria are still largely dependent on overall economic growth rather than just health or demographic variables,

and that the amount of health spending is less important than its efficiency and distribution. Based on the research findings, the following recommendations were made:

Since the advantages of health investment materialise gradually rather than immediately, the government should refocus healthcare spending on workforce development, primary health infrastructure, and preventative care rather than administrative recurring costs.

To ensure that longer lifespans result in more productive years rather than increased reliance pressure, policies to increase life expectancy, such as better nutrition, sanitation, and social protection, should be combined with investments in education and job absorption capacity.

To guarantee that a growing work force results in increased, not decreased, productivity, labour market policy should stimulate entrepreneurship and the development of jobs in the private sector and match occupational training and education with market need.

Given the significant and enduring impact of real GDP on labour productivity, the government should continue to implement growth-oriented macroeconomic policies, such as infrastructure investment, industrial support, and assistance for small and medium-sized businesses.

Given the large error correction term, policymakers should prioritise policy consistency and gradual, well-coordinated reform over abrupt reversals, giving the economy enough time to return to long-run equilibrium.

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