



Temporal Convergence in Global Longevity: A Panel ARDL Exploration of Life Expectancy Dynamics

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Received: 10.05.2026 | Accepted: 09.06.2026 | Published: 15.06.2026

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DOI: [10.5281/zenodo.20707426](https://doi.org/10.5281/zenodo.20707426)

Abstract	Original Research Article
<p>This study investigates the time-series and panel relationships among life expectancy at birth total (LEBT), life expectancy at birth for females (LEBF), and life expectancy at birth for males (LEBM) and evaluates their short-run and long-run behavior across selected countries. The time series plot, showed evident that all three series generally exhibit an upward trend over time, indicating a gradual improvement in life expectancy; moreover, female life expectancy remains higher than male life expectancy. The panel unit root tests in levels suggest a persistent upward trend in life expectancy over the study period. Panel ARDL model with lag structure ARDL (2, 2, 2) specification is selected as the optimal model based on the information criteria; thus, life expectancy dynamics are influenced not only by present conditions but also by their previous values. The disequilibrium in LEBT relative to the long-run equilibrium are adjusted by 8.4% for Benin, 4.2% for Cabo Verde, 4.1% for Ghana, 2.3% for Guinea Bissau, 1.8% for Cote d’voire, and 2.2% for Nigeria; moreover, Benin is quicker to the adjustment. The estimated combined speed of adjustment to the long-run equilibrium is – 0.038166, signifying that approximately 3.82% of the disequilibrium in total life expectancy is corrected within the succeeding year. Over time, 1% adjustments in LEBF and LEBM are projected to increase LEBT by about 0.49%, and 0.50%, respectively. The finding also suggests a strong interdependence between male, female, and total life expectancy, reflecting common underlying demographic, health, and socio-economic factors affecting longevity across the selected countries.</p> <p>Keywords: Demographic Health Trends, Life Expectancy Dynamics, Panel ARDL Model, Time Series Analysis, Long-run and Short-run Dynamics.</p>	

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Introduction

Life expectancy at birth is a key demographic and socio-economic indicator that reflects the overall health status, living conditions, and effectiveness of healthcare systems within a population. In recent decades, global improvements in longevity have

been driven by advances in medical technology, disease control, and public health interventions. Despite this progress, significant disparities persist across regions, particularly in Sub-Saharan Africa, where structural challenges continue to influence mortality outcomes (WB, 2026; WHO, 2023).

Across West Africa, countries such as Benin, Cabo Verde, Ghana, Guinea-Bissau, Côte d'Ivoire, and Nigeria display diverse trends in life expectancy. While Cabo Verde has attained comparatively higher levels of longevity, nations like Nigeria and Guinea-Bissau continue to experience lower life expectancy, largely due to ongoing health challenges and socio-economic constraints. These differences underscore the need for a comparative and dynamic analysis of life expectancy across countries, taking into account both temporal evolution and cross-sectional heterogeneity (Li, 2025; WB, 2024; UNDP, 2023).

From an econometric perspective, life expectancy is not only influenced by contemporaneous factors but also exhibits strong persistence over time, suggesting the presence of dynamic relationships. This makes time-series and panel data approaches particularly suitable for capturing both short-run fluctuations and long-run equilibrium relationships. The Panel Autoregressive Distributed Lag (Panel ARDL) framework has gained prominence in recent literature due to its ability to model mixed-order integration variables and distinguish between short-run dynamics and long-run coefficients (IMF, 2022; Pesaran et al., 2021; Olorunpomi, 2021; Hsiao, 2003).

In addition, gender-specific life expectancy male (LEBM) and female (LEBF) plays a crucial role in determining total life expectancy (LEBT); (Gyamfi, 2024). Empirical evidence consistently shows that females tend to have higher life expectancy than males, reflecting both biological advantages and socio-behavioral differences. However, the interaction between male, female, and total life expectancy is inherently dynamic, requiring robust econometric techniques to uncover both contemporaneous and lagged effects. Studies have shown that improvements in either male or female longevity contribute significantly to overall life expectancy, although the magnitude and adjustment speed may vary across countries (Dauda, 2024; ISSA, 2024; UNECA, 2024; Dattani, 2023; Bloom et al., 2020).

Furthermore, the concept of cointegration is central to understanding life expectancy dynamics, as it implies the existence of a stable long-run equilibrium

relationship among LEBT, LEBF, and LEBM despite short-run deviations. The inclusion of an error correction mechanism (ECM) within the ARDL framework enables the estimation of the speed at which deviations from equilibrium are corrected over time. In the context of West African countries, where structural shocks such as epidemics, economic instability, and policy changes are common, the adjustment process is particularly relevant for policy formulation and forecasting (ADB, 2023).

Given these considerations, this study employs a Panel ARDL approach to investigate the dynamic interrelationships among total, male, and female life expectancy in Benin, Cabo Verde, Ghana, Guinea Bissau, Côte d'Ivoire, and Nigeria. By examining both short-run and long-run effects, the study aims to provide deeper insights into the persistence, adjustment mechanisms, and interdependence of life expectancy indicators. The findings are expected to contribute to the existing literature by offering empirical evidence on longevity dynamics in West Africa and informing policy strategies aimed at improving population health outcomes.

Materials and Methods

This study employs the Panel Autoregressive Distributed Lag (Panel ARDL) modelling framework to examine the dynamic relationships among total life expectancy at birth (LEBT), female life expectancy (LEBF), and male life expectancy (LEBM) across selected West African countries (Benin, Cabo Verde, Ghana, Guinea Bissau, Côte d'Ivoire, and Nigeria). The Panel ARDL approach is particularly suitable because it accommodates variables integrated of order $I(0)$ and $I(1)$, allows for heterogeneity across cross-sectional units, and distinguishes between short-run dynamics and long-run equilibrium relationships (Olorunpomi and Olorunpomi, 2025, 2023; ISSA, 2024; Olorunpomi et al., 2024; Olorunpomi, 2021; Gujarati, 2003; Wooldridge, 2000; Kao, 1999).

Model Specification

The general Panel ARDL (p, q, q) model is specified

as:

$$LEBT_{it} = \alpha_i + \sum_{j=1}^p \beta_{ij}LEBT_{i,t-j} + \sum_{j=0}^q \gamma_{ij}LEBF_{i,t-j} + \sum_{j=0}^q \delta_{ij}LEBM_{i,t-j} + \varepsilon_{it} \quad [2.1]$$

where;

$i=1,2,\dots,N$ represents the cross-sectional units (countries), $t=1,2,\dots,T$ denotes time periods, α_i captures country-specific fixed effects, and ε_{it} is the error term assumed to be independent identically distributed. Based on model selection criteria such as Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), the optimal lag structure is selected as ARDL (2, 2, 2), indicating that current life expectancy depends on its two previous values as

well as two lagged values of LEBF and LEBM (Olorunpomi and Olorunpomi, 2025, 2023; Hsiao, 2003; Olorunpomi et al., 2024).

Error Correction Representation

To capture both short-run adjustments and long-run equilibrium relationships, the ARDL model is reparameterized into an Error Correction Model (ECM) form (Olorunpomi, 2021; Baltagi et al., 2003, Gujarati, 2003; Kao, 1999):

$$\Delta LEBT_{it} = \phi_i (LEBT_{i,t-1} - \theta_1LEBF_{i,t-1} - \theta_2LEBM_{i,t-1}) + \sum_{j=1}^{p-1} \beta_{ij}^* \Delta LEBT_{i,t-j} + \sum_{j=0}^{q-1} \gamma_{ij}^* \Delta LEBF_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^* \Delta LEBM_{i,t-j} \quad [2.2]$$

where;

Δ denotes the first difference operator; the terms in differences capture short-run dynamics, ϕ_i is the error correction coefficient (speed of adjustment), expected to be negative and statistically significant, θ_1 and θ_2 represent long-run coefficients. The coefficient ϕ_i measures the speed at which deviations from the long-run equilibrium are corrected. A value between 0 and -1 indicates convergence, with higher absolute values implying faster adjustment.

1999; Freeman, 2000; Baltagi et al., 2000, 2008).

Pre-Estimation Tests

Prior to estimation, panel unit root tests such as Levin-Lin-Chu (LLC) and Im-Pesaran-Shin (IPS) are conducted to determine the order of integration of the variables. Additionally, panel cointegration tests are employed to confirm the existence of a long-run relationship among LEBT, LEBF, and LEBM.

Estimation Technique

The study adopts the Pooled Mean Group (PMG) estimator developed by Pesaran, Shin, and Smith, which allows for homogeneity in long-run coefficients across countries, and heterogeneity in short-run dynamics, intercepts, and error variances. This approach is appropriate given that the selected countries share similar long-term structural characteristics but may differ in short-run adjustments due to country-specific factors (Baltagi & Griffin, 1984, 1997; Pesaran et al., 1995, 1997,

Post-Estimation Diagnostics

Diagnostic checks are performed to ensure model validity, including tests for serial correlation, heteroskedasticity, and parameter stability. The statistical significance and sign of the error correction term further confirm the presence of a stable long-run relationship. Overall, the Panel ARDL framework provides a robust approach for analyzing life expectancy dynamics by capturing both persistence effects and equilibrium adjustments across countries, thereby offering deeper insights into the interdependence between male, female, and

total life expectancy (Baltagi et al., 2008; Baltagi & Griffin, 1984, 1997; Pesaran et al., 1997, 1999).

Results and Discussion

The study utilizes panel data comprising 384 observations spanning the period from 1960 to 2023

for Benin, Cabo Verde, Ghana, Guinea-Bissau, Côte d’Ivoire, and Nigeria. These countries were selected based on the availability and consistency of relevant data sourced from the World Bank Indicators database. Descriptive statistics, probability values, and regression analyses were conducted using EViews 10, with the results confirming the validity and robustness of the empirical approach.

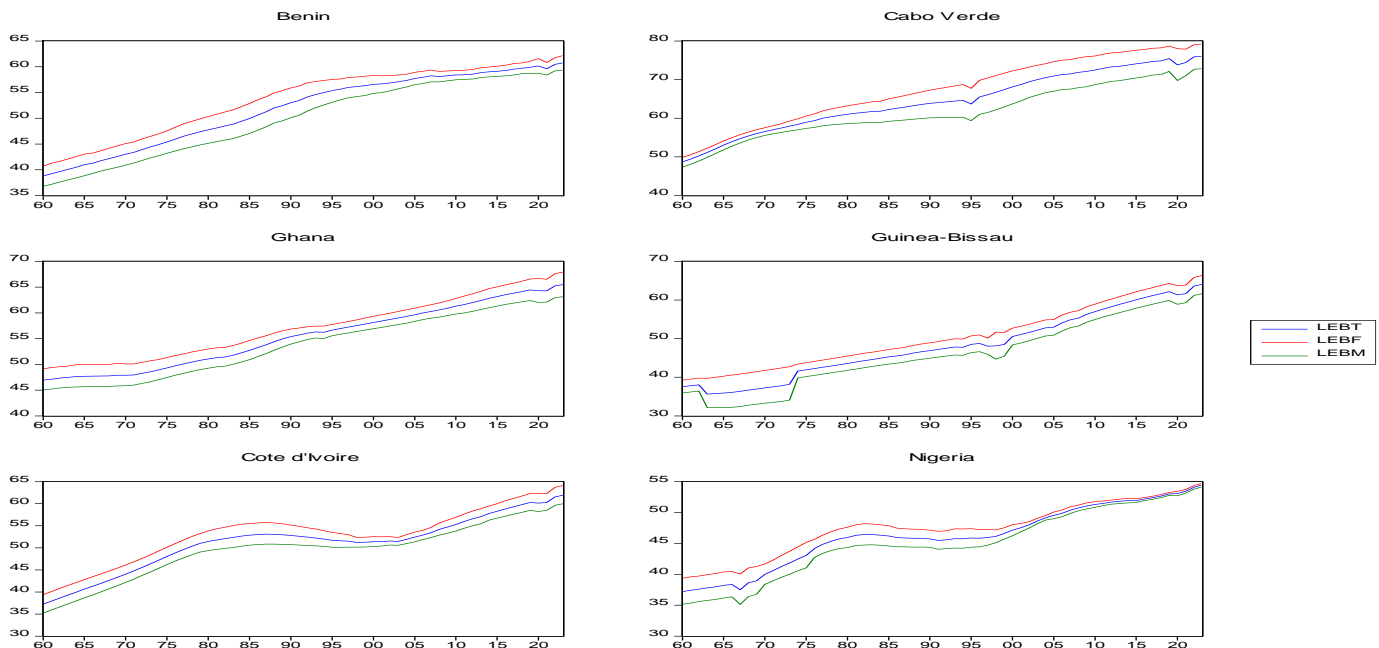


Fig. 1: Time series plot of LEBT, LEBF and LEBM

Figure 1 presents the time series plot of life expectancy at birth for the total population (LEBT), females (LEBF), and males (LEBM) over the study period. From the plot, it is evident that all three series generally exhibit an upward trend over time, indicating a gradual improvement in life expectancy. This upward movement suggests progress in healthcare services, improved living standards, better nutrition, and advancements in medical technology that contribute to increased longevity. A notable pattern observed in the figure is that female life expectancy (LEBF) consistently remains higher than male life expectancy (LEBM) throughout the study

period. This difference reflects the commonly observed demographic pattern where females tend to live longer than males due to biological, behavioral, and socio-economic factors. The total life expectancy (LEBT) lies between the two series, reflecting the combined average of male and female life expectancy. Although the overall trend is increasing, slight fluctuations may be present in some periods, which could be attributed to economic conditions, health crises, or other country-specific factors affecting mortality rates. Despite these fluctuations, the three variables appear to move closely together, suggesting a strong relationship

among them. Overall, the time series plot indicates a steady improvement in life expectancy and highlights the persistent gender gap in longevity. The similar movement of the variables also suggests

potential long-run relationships among LEBT, LEBF, and LEBM, which justifies further econometric analysis using panel data techniques.

Table 1. Descriptive Statistic

Statistics	LEBT	LEBF	LEBM
Mean	52.85595	54.87761	50.86912
Median	52.18750	53.78000	50.61100
Maximum	76.05900	79.20900	72.85600
Minimum	35.64400	39.26800	32.16900
Std. Dev.	8.987097	9.178496	8.788587
Skewness	0.326683	0.556554	0.086787
Kurtosis	2.779652	3.001648	2.642199
Jarque-Bera	7.607063	19.82422	2.530391
Probability	0.022292	0.000050	0.282184
Sum	20296.68	21073.00	19533.74
Sum Sq. Dev.	30934.11	32265.75	29582.63
Observations	384	384	384

Table 1 presents the descriptive statistics for life expectancy at birth for the total population (LEBT), females (LEBF), and males (LEBM). These statistics provide a summary of the main characteristics of the data, including measures of central tendency, dispersion, and distribution. The results show that female life expectancy (LEBF) has the highest mean value, followed by total life expectancy (LEBT), while male life expectancy (LEBM) records the lowest mean. This pattern confirms the well-established demographic observation that females tend to live longer than males. A relatively small standard deviation suggests that the life expectancy values do not deviate widely from their respective means, indicating a stable trend over time. Conversely, larger values would imply greater fluctuations in life expectancy across the observed period. The minimum and maximum values provide

information about the range of the data. The difference between these values reflects the extent of improvement in life expectancy throughout the study period. An increase from the minimum to the maximum values suggests that life expectancy has generally improved over time. Furthermore, skewness and kurtosis statistics help describe the shape of the distribution of the variables. Skewness indicates whether the data are symmetrically distributed or skewed to one side, while kurtosis measures the degree of peakedness or flatness relative to a normal distribution. Overall, the descriptive statistics reveal that life expectancy indicators display consistent patterns, with female life expectancy remaining higher than male life expectancy. These statistics provide an initial understanding of the data and form the basis for further econometric analysis in the study.

Table 2. Summary of Panel Unit Root Tests in Levels

Variables	METHODS			
	Statistics	LLC	ADF-Fisher	PP - Fisher
LEBT	Stats	-0.71795	7.18387	15.2857
	Prob	0.2364	0.8452	0.2262
LEBF	Stats	0.39618	14.6343	19.3418
	Prob	0.6540	0.2620	0.0806
LEBM	Stats	-1.22569	3.52986	8.51832
	Prob	0.1102	0.9905	0.7434

The results in table 2 for the panel unit root tests in levels suggest that LEBT, LEBF, and LEBM follow a unit root process. At the level form, the probability values for most of the variables are greater than the conventional significance levels (1%, 5%, or 10%). This outcome provides the basis for proceeding with further econometric analysis, such as testing for cointegration and estimating a panel autoregressive distributed lag (Panel ARDL) model to examine both

the short-run and long-run relationships among the variables. The implication of this finding is that the life expectancy variables are non-stationary at their level form, meaning that their statistical properties such as mean and variance change over time. This behavior is consistent with the time series plot, which shows a persistent upward trend in life expectancy over the study period.

Table 3. Summary of Differenced Form Panel Unit Root Tests

Variables	METHODS			
	Statistics	LLC	ADF-Fisher	PP - Fisher
D(LEBT)	Stats	-2.11934	37.6365	146.580
	Prob	0.0170	0.0002	0.0000
D(LEBF)	Stats	-2.33900	23.7340	158.271
	Prob	0.0097	0.0221	0.0000
D(LEBM)	Stats	-2.65824	42.9850	141.886
	Prob	0.0039	0.0000	0.0000

The objective of this test in table 3 is to determine whether the variables become stationary after taking the first difference, following the evidence of non-stationarity at levels. The results of the differenced panel unit root tests confirm that the variables do not contain a unit root after first differencing and are therefore suitable for subsequent econometric analysis aimed at examining both short-run

dynamics and long-run equilibrium relationships among the life expectancy indicators. The implication of this result is that the life expectancy variables become stable after differencing once, meaning their statistical properties such as mean and variance no longer change systematically over time. In econometric terms, this suggests that the variables are integrated of order one, I(1).

Table 4. Summary of Model Selection Criteria

Model	LogL	AIC*	BIC	HQ	Specification
4	1547.882345	-8.085389	-7.621864	-7.901311	ARDL(2, 2, 2)
2	1493.484327	-7.825185	-7.424867	-7.666208	ARDL(1, 2, 2)
3	1483.589431	-7.804244	-7.467135	-7.670369	ARDL(2, 1, 1)
1	1472.514881	-7.776962	-7.503061	-7.668188	ARDL(1, 1, 1)

Table 4 presents the summary of the model selection criteria used to determine the optimal lag structure for the panel autoregressive distributed lag (Panel ARDL) model. The ARDL (2,2,2) specification is selected as the optimal model based on the information criteria. This indicates that including two lags of the dependent variable and two lags of each explanatory variable provides the best representation of the dynamic relationships among

the variables in the model. The presence of multiple lag terms suggests that the impact of these variables may occur gradually rather than instantaneously. Once more, the selection of the ARDL (2,2,2) model suggests that past values of life expectancy variables play an important role in explaining their current behavior. In other words, life expectancy dynamics are influenced not only by present conditions but also by their previous values.

Table 5. Wald Test-Coefficient Restrictions

Test Statistic	Value	df	Probability
F-statistic	2305269.	(2, 340)	0.0000
Chi-square	4610537.	2	0.0000
Null Hypothesis: C(1)=C(2)=0			
Null Hypothesis Summary:			
Normalized Restriction (= 0)	Value	Std. Err.	
C(1)	0.494909	0.003310	
C(2)	0.504526	0.003277	

Restrictions are linear in coefficients.

The Wald test results in table 5 provide evidence that the estimated Panel ARDL model is statistically significant and that the explanatory variables jointly play an important role in determining life

expectancy. This finding strengthens the validity of the model and supports the subsequent analysis of both short-run and long-run relationships among the life expectancy indicators.

Table 6. Coefficients Confidence Intervals Test

Variable	Coefficient	90% CI		95% CI		99% CI	
		Low	High	Low	High	Low	High
LEBF	0.494909	0.489449	0.500368	0.488398	0.501419	0.486334	0.503483
LEBM	0.504526	0.499121	0.509931	0.498080	0.510972	0.496037	0.513015

Table 6 presents the confidence interval estimates for the coefficients obtained from the panel autoregressive distributed lag (Panel ARDL) model. This test helps evaluate the precision and statistical reliability of the estimated parameters. The confidence interval analysis supports the reliability

of the estimated Panel ARDL model by showing that many of the coefficients fall within statistically meaningful ranges. This strengthens the validity of the model and provides further evidence of the relationships among life expectancy indicators examined in the study.

Table 7. Scaled Coefficients Test

Variable	Coefficient	Standardized Coefficient	Elasticity at Means
LEBF	0.494909	0.505449	0.513838
LEBM	0.504526	0.493382	0.485561

Table 7 presents the results of the scaled coefficients test for the estimated panel autoregressive distributed lag (Panel ARDL) model. The scaled coefficients test provides additional insight into the relative contribution of each variable in the Panel ARDL

model. The results support the robustness of the model by highlighting the variables that have the greatest explanatory power in determining life expectancy dynamics across the countries included in the study.

Table 8. Panel ARDL (2, 2, 2) Model

Dependent Variable: D(LEBT)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.*
Long Run Equation				
LEBF	0.494909	0.003310	149.5152	0.0000
LEBM	0.504526	0.003277	153.9559	0.0000
Short Run Equation				
COINTEQ01	-0.038166	0.010028	-3.806120	0.0002
D(LEBT(-1))	0.254456	0.146993	1.731079	0.0843
D(LEBF)	0.452154	0.004343	104.1152	0.0000
D(LEBF(-1))	-0.118738	0.069256	-1.714467	0.0874
D(LEBM)	0.517733	0.009986	51.84807	0.0000
D(LEBM(-1))	-0.141286	0.079326	-1.781081	0.0758
C	0.001694	0.001350	1.255153	0.2103
Mean dependent var	0.359960	S.D. dependent var	0.403396	
S.E. of regression	0.006661	Akaike info criterion	-7.832721	
Sum squared resid	0.015085	Schwarz criterion	-7.380043	
Log likelihood	1547.882	Hannan-Quinn criter.	-7.653169	

The coefficients reported in the table 8 represent the effects of the explanatory variables and their lagged values on the dependent variable. The inclusion of lagged terms allows the model to capture the dynamic behavior of life expectancy over time. The coefficients of the lagged dependent variable indicate the degree of persistence in life expectancy, suggesting that past values have an influence on current outcomes. The short-run coefficients show how changes in female and male life expectancy affect total life expectancy within the observed period. Statistically significant coefficients imply that variations in these variables contribute

meaningfully to changes in total life expectancy. The presence of multiple lag terms suggests that the impact of these variables may occur gradually rather than instantaneously. The Panel ARDL (2, 2, 2) model results demonstrate that life expectancy indicators exhibit strong dynamic relationships. The findings suggest that both current and past values of female and male life expectancy play important roles in explaining variations in total life expectancy. These results provide important insights into the short-run adjustments and long-run interactions among the life expectancy variables across the countries included in the study.

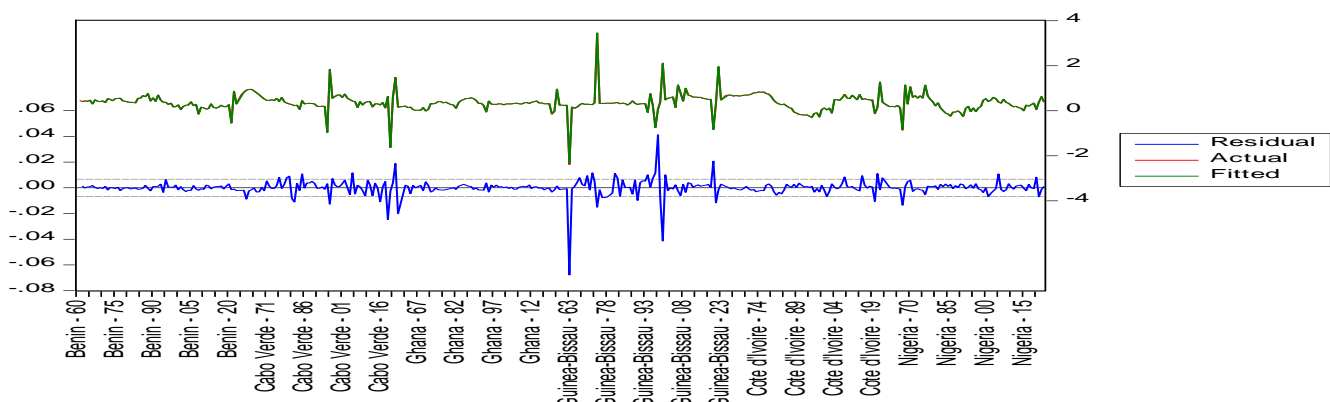


Fig. 2: Actual, Fitted, Residual Graph

The graph in figure 2 serves as a diagnostic tool for assessing model fit. Small and randomly distributed residuals imply that the Panel ARDL model adequately captures both short-run fluctuations and long-run equilibrium relationships among LEBT, LEBF, and LEBM. Residual inspection ensures that forecasts are not biased by systematic errors and provides confidence in the model’s predictive performance. Larger residuals at specific time points may indicate unusual events affecting life expectancy (e.g., health crises, policy changes) that

the model does not explicitly account for. In short, Fig. 2 confirms that the Panel ARDL (2, 2, 2) model effectively captures the temporal behavior of life expectancy across countries, with residuals indicating the accuracy and reliability of the model predictions. A strong correspondence between actual and fitted values supports the reliability of the model for forecasting future life expectancy trends, as further demonstrated in Fig. 3 (Static Forecast for LEBT).

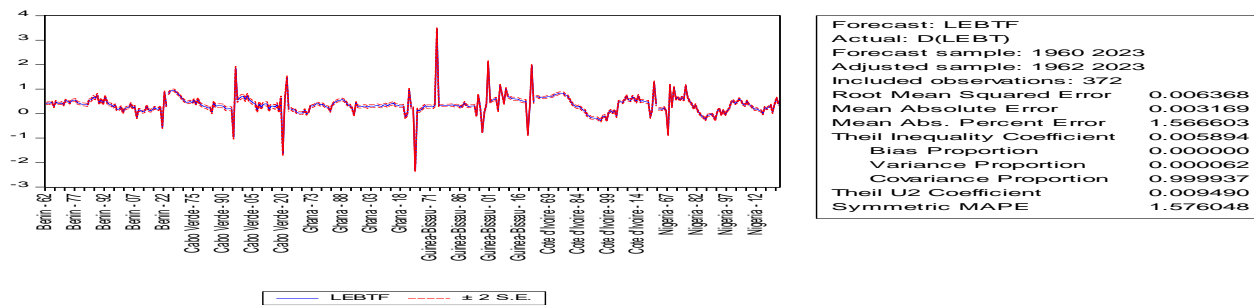


Fig. 3: Static Forecast for LEBT

Figure 3 show that the forecasted values closely follow the historical pattern of life expectancy, indicating that the model possesses good predictive capability. The smooth continuation of the forecast line suggests a stable and gradual movement in life expectancy, reflecting the persistence of demographic and health trends captured by the model. Additionally, the relatively narrow forecast deviations imply that the model uncertainty is limited, which strengthens confidence in the

reliability of the predictions. This indicates that the ARDL framework effectively captures both the short-run dynamics and long-run equilibrium relationships among life expectancy indicators. Overall, the static forecast suggests that LEBT is expected to maintain a steady trend over the forecast horizon, assuming that the underlying socio-economic and health conditions influencing life expectancy remain relatively stable across the observed countries.

Table 9. Engle-Granger Based Cointegration Test

ADF	t-Statistic	Prob.
	-2.389244	0.0084
Residual variance	9.59E-05	
HAC variance	0.000290	

Augmented Dickey-Fuller Test Equation
 Dependent Variable: D(RESID)
 Method: Least Squares
 Date: 03/02/26 Time: 14:41
 Sample (adjusted): 1962 2023
 Included observations: 372 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.046484	0.015203	-3.057613	0.0024
D(RESID(-1))	0.154569	0.051524	2.999937	0.0029

R-squared	0.037376	Mean dependent var	-0.000940
Adjusted R-squared	0.034775	S.D. dependent var	0.014997
S.E. of regression	0.014734	Akaike info criterion	-5.592008
Sum squared resid	0.080319	Schwarz criterion	-5.570939
Log likelihood	1042.113	Hannan-Quinn criter.	-5.583641
Durbin-Watson stat	2.062745		

Table 9 presents the results of the Engle–Granger based cointegration test, which is used to determine whether a long-run equilibrium relationship exists among the variables in the model. The results indicate that the probability value associated with the cointegration test statistic is statistically significant at conventional levels (as a rule 5%). This leads to the rejection of the null hypothesis of no cointegration among the variables. Consequently, the findings confirm the presence of a long-run equilibrium relationship between LEBT, LEBF, and LEBM across the panel of countries considered in the

study. This implies that although short-run fluctuations may occur in the individual series, the variables move together over time and tend to converge toward a stable long-run path. Any short-term deviations from this equilibrium are expected to be corrected gradually through the adjustment mechanism captured in the Panel ARDL model. The finding also suggests a strong interdependence between male, female, and total life expectancy, reflecting common underlying demographic, health, and socio-economic factors affecting longevity across the selected countries.

Table 10. Cross Section Short-Run Test for Benin

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.083606	0.000816	-102.4895	0.0000
D(LEBT(-1))	0.130246	0.013537	9.621201	0.0024
D(LEBF)	0.447586	0.000223	2006.558	0.0000
D(LEBF(-1))	-0.063311	0.003249	-19.48475	0.0003
D(LEBM)	0.475515	0.000202	2348.362	0.0000
D(LEBM(-1))	-0.064628	0.003619	-17.85826	0.0004
C	0.002032	9.18E-06	221.2473	0.0000

The short-run results in table 10 for Benin show that the error correction term (COINTEQ01) is negative and highly significant, confirming convergence to long-run equilibrium, with about 8.36% adjustment per period. Both female (LEBF) and male (LEBM) life expectancy have strong, positive, and statistically significant effects on total life

expectancy (LEBT) in the short run, while their lagged values exert small but significant negative effects. Overall, the findings indicate a stable short-run dynamic with rapid adjustment and strong contributions from both male and female life expectancy.

Table 11. Cross Section Short-Run Test for Cabo Verde

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.041865	0.000191	-218.9661	0.0000
D(LEBT(-1))	0.917527	0.003537	259.4139	0.0000
D(LEBF)	0.443964	6.02E-05	7374.781	0.0000
D(LEBF(-1))	-0.428008	0.000816	-524.3135	0.0000
D(LEBM)	0.526257	6.11E-05	8611.490	0.0000
D(LEBM(-1))	-0.503992	0.001011	-498.3700	0.0000
C	0.007791	1.13E-05	691.1461	0.0000

The short-run findings for Cabo Verde in Table 11 reveal that the error correction term (COINTEQ01) is negative and statistically significant, indicating a return to long-run equilibrium with an adjustment speed of approximately 4.19% per period. Both current female (LEBF) and male (LEBM) life expectancy exert positive and significant influences

on total life expectancy (LEBT), whereas their lagged terms are negative and significant, reflecting short-term adjustments. In general, the results suggest stable short-run dynamics, a moderate pace of adjustment, and substantial contributions from both male and female life expectancy.

Table 12. Cross Section Short-Run Test for Ghana

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.041371	5.93E-05	-697.4927	0.0000
D(LEBT(-1))	0.036223	0.013361	2.711151	0.0731
D(LEBF)	0.453472	1.35E-05	33632.70	0.0000
D(LEBF(-1))	-0.014985	0.002990	-5.011927	0.0153
D(LEBM)	0.507165	2.05E-05	24689.19	0.0000
D(LEBM(-1))	-0.022096	0.003724	-5.933587	0.0096
C	0.001939	1.72E-06	1125.712	0.0000

The short-run results in table 12 for Ghana show a negative and highly significant error correction term (COINTEQ01), indicating convergence to long-run equilibrium with about 4.14% adjustment per period. Current female (LEBF) and male (LEBM) life expectancy have positive and statistically significant effects on total life expectancy (LEBT), while their

lagged values have significant negative effects, reflecting short-run adjustments. The lag of LEBT is marginally insignificant, suggesting limited persistence. Overall, the model indicates stable short-run dynamics with moderate adjustment speed and strong influence from both male and female life expectancy.

Table 13. Cross Section Short-Run Test for Guines Bissau

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.022606	0.000256	-88.27465	0.0000
D(LEBT(-1))	0.111412	0.015342	7.261859	0.0054
D(LEBF)	0.456921	6.36E-05	7188.211	0.0000
D(LEBF(-1))	-0.050823	0.003326	-15.28206	0.0006
D(LEBM)	0.531375	7.32E-05	7260.738	0.0000
D(LEBM(-1))	-0.062370	0.004538	-13.74306	0.0008
C	-0.001106	1.26E-05	-87.52882	0.0000

The error correction term in table 13 is negative and highly significant, indicating convergence to long-run equilibrium with about 2.26% adjustment per period. Current female (LEBF) and male (LEBM) life expectancy positively and significantly influence

total life expectancy (LEBT), while their lagged values show significant negative effects, reflecting short-run corrections. The lag of LEBT is positive and significant, suggesting some persistence in total life expectancy.

Table 14. Cross Section Short-Run Test for Cote d'voire

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.017611	0.000122	-143.8516	0.0000
D(LEBT(-1))	-0.068065	0.012770	-5.330266	0.0129
D(LEBF)	0.440810	3.54E-05	12460.53	0.0000
D(LEBF(-1))	0.037284	0.002521	14.78945	0.0007
D(LEBM)	0.546640	4.68E-05	11670.69	0.0000
D(LEBM(-1))	0.018973	0.003884	4.885373	0.0164
C	0.000739	1.37E-06	540.0943	0.0000

The negative and significant error correction term in table 14 confirms adjustment toward long-run equilibrium at about 1.76% per period, indicating a slower speed of adjustment. Both current LEBF and LEBM have positive and significant effects on

LEBT, while their lagged values also remain positive and significant, suggesting sustained short-run influence. The lag of LEBT shows a small but significant negative effect, indicating mild short-run adjustment.

Table 15. Cross Section Short-Run Test for Nigeria

Variable	Coefficient	Std. Error	t-Statistic	Prob. *
COINTEQ01	-0.021940	0.000555	-39.56652	0.0000
D(LEBT(-1))	0.399390	0.017580	22.71885	0.0002
D(LEBF)	0.470174	0.000141	3329.215	0.0000
D(LEBF(-1))	-0.192583	0.004074	-47.26847	0.0000
D(LEBM)	0.519448	0.000151	3448.982	0.0000
D(LEBM(-1))	-0.213605	0.004955	-43.10814	0.0000
C	-0.001230	9.18E-07	-1340.465	0.0000

The error correction term in table 15 is negative and highly significant, implying convergence to equilibrium with about 2.19% adjustment per period. Current LEBF and LEBM exert strong positive and significant effects on LEBT, whereas their lagged values are significantly negative, indicating short-run corrections. The lag of LEBT is positive and significant, reflecting persistence in total life expectancy dynamics.

Conclusion

In conclusion, this study provides empirical evidence on the dynamic relationships among life expectancy at birth for the total population (LEBT), females (LEBF), and males (LEBM) across the selected countries. The results reveal a consistent upward trend in life expectancy over time, with female life expectancy persistently exceeding that of males, reflecting enduring gender differentials in longevity. The panel unit root findings indicate a sustained long-term progression in life expectancy, while the selected Panel ARDL (2, 2, 2) model confirms that current life expectancy outcomes are influenced by both contemporaneous and lagged factors. The error correction estimates demonstrate that deviations from long-run equilibrium are gradually corrected, albeit at varying speeds across countries, with Benin exhibiting the fastest adjustment. Overall, approximately 3.82% of disequilibrium in total life expectancy is corrected annually, suggesting a slow but steady convergence toward long-run equilibrium. Furthermore, the long-run coefficients indicate that improvements in female and male life expectancy significantly contribute to increases in total life

expectancy, with elasticities of approximately 0.49% and 0.50%, respectively. These findings underscore the strong interdependence among the three measures of life expectancy and highlight the role of shared demographic, health, and socio-economic determinants in shaping longevity outcomes. Collectively, the results emphasize the importance of sustained and inclusive health and development policies aimed at improving life expectancy across all population groups. Life expectancy at birth remains one of the most important indicators of population health, reflecting the combined effects of mortality patterns, healthcare systems, and socio-economic conditions. Globally, life expectancy has improved significantly over the past decades due to advances in medicine, public health interventions, and improved living standards, although substantial disparities persist across regions and countries. In Africa, for instance, average life expectancy has increased from about 43 years in 1960 to approximately 66 years in recent years, yet many countries particularly in West Africa still lag behind global averages. The West African sub-region, including Benin, Cabo Verde, Ghana, Guinea Bissau, Côte d’Ivoire, and Nigeria, presents a diverse but interconnected demographic and health profile. While countries such as Cabo Verde exhibit relatively high life expectancy levels (around 76 years), others like Nigeria remain below the regional and global averages, with estimates around 54–55 years in recent years. These disparities highlight the uneven progress in health outcomes and underline the importance of examining life expectancy dynamics within and across countries.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

Olubunmi Temitope Olorunpomi was responsible for data collection, analysis, and simulation, Emmanuel Oloruntoba Ajare ensures the validity, originality, and reliability of the study’s findings. Wilson Simon Barguma and Toluwani John Dare prepared and structured the manuscript for publication, enhancing its coherence, organization, and overall presentation.

Ethics: *This manuscript constitutes original research, and no ethical issues are expected to arise from its publication. All the authors have reviewed and approved the final version of the manuscript.*