INTERNATIONAL JOURNAL OF RESEARCH AND INNOVATION IN SOCIAL SCIENCE (IJRISS)
ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

Socioeconomic Constraints, Fiscal Resource Allocation, and Secondary School Academic Performance in Nigeria: An Econometric Analysis and I (2) Cointegration Approach (2000–2025)

Olukotun, Monsuru Adedeji[1] , Gbesoevi, Semako Emmanuel[2] , Shoboyede, Olufemi Olaniyi[3]

[1]Directorate of Academic Planning, Nigeria

[2]Educational Management, Lagos State University, Nigeria

[3]Department of Economics, Topmost College of Education, Nigeria

DOI: https://doi.org/10.47772/IJRISS.2026.100700610

Received: 26 July 2026; Accepted: 31 July 2026; Published: 08 August 2026

ABSTRACT

This study examines the dynamic empirical relationship between fiscal resource allocations, secondary school academic performance (NECO SSCE benchmark), socioeconomic constraints, and out-of-school populations in Nigeria over a 26-year period (2000–2025). Employing annual time-series data, the preliminary descriptive statistics reveal significant variability across key indicators, with out-of-school children averaging 13.73 million (SD=3.30 million), fiscal education allocations averaging N586.13 billion (SD=759.98 billion), and academic pass rates (≥5 credits including English and Mathematics) averaging 44.32% (SD=21.91%). Pairwise correlation analysis indicates strong positive associations between education budget allocations and out-of-school children ($r=0.8469$, $p<0.01$), alongside moderate correlations with academic performance ($r=0.4489$, $p<0.05$), highlighting systemic structural bottlenecks. Standard Dickey-Fuller and Zivot-Andrews unit root tests with structural breaks confirm that key series exhibit second-order non-stationarity (I(2)) driven by regime shifts (notably in 2012, 2017, and 2022), rendering standard Autoregressive Distributed Lag (ARDL) bounds testing invalid.

To resolve this, the study implements the Juselius-Johansen I(2) Cointegration procedure [cite: 1]. The joint trace rank test identifies a single common I(2) stochastic trend with cointegrating rank $r=1$ and I(1) rank $s=1$. The normalized long-run polynomial cointegrating vector confirms that higher fiscal allocations ($\beta_2=+0.00396$) and improved academic performance ($\beta_3=+0.00972$) exert a statistically significant stabilizing effect on long-run educational retention [cite: 1]. Short-run dynamics modeled via a second-differenced Vector Error Correction Model (I(2)-VECM) demonstrate strong overall explanatory power across all equations ($R^2=84.42\%$ for out-of-school acceleration; $R^2=70.59\%$ for budgetary acceleration; $R^2=68.05\%$ for pass rate acceleration). The polynomial speed-of-adjustment coefficient ($\alpha_1=-0.2051$) establishes that 20.51% of short-run acceleration disequilibria is corrected annually toward long-run equilibrium. Lagged out-of-school growth displays significant negative self-correction ($\gamma=-2.2319$, $p<0.001$), while budgetary growth impacts out-of-school acceleration with a lag ($\gamma=+0.0151$, $p<0.10$), underscoring operational implementation lags [cite: 1]. Post-estimation diagnostic suite tests confirm that the estimated system is robust, non-spurious, and free from specification bias. Policy recommendations emphasize transitioning to a Medium-Term Expenditure Framework (MTEF), institutionalizing an automated Education Stabilization Fund, and linking spending expansions to quality benchmarks.

Keywords: I(2) Cointegration, Juselius-Johansen Framework, I(2)-VECM, NECO SSCE Performance, Out-of-School Children, Fiscal Allocation, Socioeconomic Determinants, Nigeria.

INTRODUCTION

Background and Macroeconomic Context

Academic performance serves as a critical indicator of a nation's human capital development and long-term economic growth trajectory (Segun & Campbell, 2013; Onuigbo, 2021). In Nigeria, the National Examination Council (NECO) Senior School Certificate Examination (SSCE) is a high-stakes assessment that dictates eligibility for transition into tertiary education institutions (Otuoku et al., 2026). The benchmark of securing 'five credits including Mathematics and English' is universally established as the standard metric for academic competency, educational progression, and socioeconomic mobility. However, achieving this benchmark is not merely a function of individual student intellect or effort; it is heavily structured by systemic socioeconomic factors, community illiteracy levels, demographic pressures, and state public funding (Adeyemo & Kelani, 2025).

Over the 26-year period spanning 2000 to 2025, Nigeria's educational sector has experienced severe volatility and structural shifts. While public education spending expanded in nominal terms from ₦83.90 billion in 2000 to ₦3.52 trillion in 2025, education allocations as a percentage of the national budget averaged only 8.46%, consistently falling below the UNESCO recommended benchmark of 15%–20% for developing nations. Simultaneously, rapid demographic growth expanded the secondary-age cohort (12–17 years) from 17.31 million in 2000 to 42.28 million in 2025. Absorptive capacity constraints in public secondary schools led to a dramatic expansion of out-of-school adolescents, peaking at 25.37 million in 2025. Understanding how these macroeconomic, demographic, and fiscal forces interact to shape academic outcomes requires rigorous empirical and econometric scrutiny.

Statement of the Problem

Despite repeated educational policy reforms and ongoing budgetary allocations, regional disparities in Nigerian secondary school outcomes remain stark (DRPC, 2026). A substantial proportion of candidates fail annually to achieve five credits in core subjects (Ononye & Obiakor, 2020). This widespread academic deficit is deeply tied to pervasive regional poverty and adult illiteracy rates, which curtail parental material support, home study environments, and learning resources (Aluko, 2020). Concurrently, a rapidly growing adolescent population combined with alarming numbers of out-of-school youth exerts severe pressure on school infrastructure and teaching capacity. When government secondary education spending fails to keep pace with these expanding demographic challenges, educational quality degrades.

From a methodological perspective, macroeconomic time-series data on public fiscal allocations, educational enrollment, and demographic populations frequently display second-order non-stationarity (I(2)) driven by structural policy shifts and regime breaks. Conventional econometric frameworks, such as standard Autoregressive Distributed Lag (ARDL) bounds testing, assume variables are at most I(1) and become invalid when I(2) processes are present, risking spurious regression results (Pesaran et al., 2001). This study addresses both the empirical problem of academic underperformance and the methodological challenge of I(2) non-stationarity by applying the Juselius-Johansen I(2) cointegration framework to evaluate secondary education dynamics in Nigeria.

Research Questions

- **Research Question 1:** What is the empirical relationship between regional poverty rates, community illiteracy, and the percentage of students achieving five credits including Mathematics and English in NECO exams?
- **Research Question 2:** To what extent do demographic pressures (adolescent population aged 12–17 and out-of-school youth density) impact secondary school academic outcomes and retention?
- **Research Question 3:** How does public fiscal allocation to secondary education influence long-run and short-run academic performance benchmarks?

- **Research Question 4:** What is the long-run structural cointegrating relationship and adjustment mechanism among fiscal education allocations, pass rates, and out-of-school youth when controlling for I(2) non-stationarity and structural breaks?

Research Objectives

- **Objective 1:** To evaluate the long-run and short-run impacts of regional poverty rates and community illiteracy on NECO examination success rates in Nigeria.
- **Objective 2:** To analyze how adolescent demographic expansion and out-of-school youth density affect national secondary educational outcomes.
- **Objective 3:** To measure the effectiveness and lag dynamics of federal government secondary education expenditure in improving national exam performance.
- **Objective 4:** To model the long-run polynomial cointegration and short-run acceleration dynamics among fiscal allocations, academic pass rates, and out-of-school populations using the Juselius-Johansen I(2) Vector Error Correction Model (I(2)-VECM) framework .

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Theoretical Framework

This study anchors its empirical framework on the Endogenous Growth Theory (Lucas, 1988; Romer, 1990) and the Human Capital Investment Model (Becker, 1964; Schultz, 1961), augmented by Social Production Function Theory and Coleman's Social Capital Theory.

Endogenous Growth and Human Capital Theory

Human Capital Theory posits that state budgetary allocations and expenditure on education represent direct productive investments that build cognitive capacity and human skill (Schultz, 1961; Becker, 1964). In macroeconomic modeling, national educational outcomes (Y_t) are modeled as a human capital production function driven by public fiscal inputs ($X_{1,t}$), structural socio-demographic retentions ($X_{2,t}$), and educational quality proxies ($X_{3,t}$) [cite: 1]:

Production Function: $Y_t = f(X_{1,t}, X_{2,t}, X_{3,t})$

Increased spending enhances teacher quality, science laboratory equipment, and learning facilities, which directly elevates academic outputs such as NECO pass rates (Oluwatobi & Ogunrinola, 2011; Chima & Yusuf, 2023). Endogenous growth theory further establishes that knowledge accumulation generates self-sustaining economic growth, making educational retention and exam success key macroeconomic priorities.

Coleman's Social Capital and Socioeconomic Status (SES) Theory

Coleman’s (1988) model asserts that academic achievement is determined not only by institutional school inputs but heavily by financial capital (household income) and social capital (parental educational background, home study support, and community norms) . In developing economies like Nigeria, pervasive household poverty restricts families' capacity to afford instructional materials, secondary school tuition, exam fees, and supplementary tutoring (Aluko, 2020; Adeyemo & Kelani, 2025). Concurrently, high adult illiteracy reduces parental capacity to supervise homework, provide intellectual guidance, and foster literate home environments required for success in core STEM and language subjects.

Econometric Theory of I(2) Cointegration

In macroeconomic time-series analysis, fiscal allocations and school enrolment populations frequently exhibit higher-order non-stationarity (I(2)) due to continuous cumulative growth and policy regime shifts. Standard Autoregressive Distributed Lag (ARDL) models assume that variables are at most I(1), rendering their bounds test statistics invalid when I(2) processes are present (Pesaran et al., 2001). To avoid spurious regression and

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

retain critical long-run level relationships, this study adopts the Juselius-Johansen I(2) Cointegration and Vector Error Correction Model (I(2)-VECM) framework (Johansen, 1995; Juselius, 2006).

EMPIRICAL LITERATURE REVIEW

Empirical studies evaluating secondary education performance in Nigeria present mixed findings regarding the efficacy of public expenditure. Segun and Campbell (2013) examined human capital indicators and secondary school performance, noting that while nominal allocations increased, real per-capita spending declined due to inflation and demographic expansion. Urhie (2014) and Chima and Yusuf (2023) demonstrated positive long-run impacts of public education spending on academic achievement, but highlighted significant operational implementation lags between budget approval and classroom utilization.

Regarding socioeconomic constraints, Aluko (2020) and Ononye and Obiakor (2020) documented strong negative correlations between regional poverty, community illiteracy, and standardized examination success rates. Adeyemo and Kelani (2025) emphasized that household poverty acts as an immediate barrier to examination entry, while adult illiteracy dilutes community accountability mechanisms that push public schools toward higher standards [cite: 2]. Furthermore, DRPC (2026) and Otuoku et al. (2026) highlighted that demographic pressures and expanding out-of-school populations create negative social externalities, crowding public school infrastructure and depressing pass rates. Methodologically, existing Nigerian literature has predominantly relied on standard OLS, VAR, or I(1) cointegration methods; this study bridges a major gap by applying the advanced Juselius-Johansen I(2) framework to account for structural breaks and second-order non-stationarity.

METHODOLOGY AND MODEL SPECIFICATION

Data and Variable Definitions

Annual time-series data covering the 26-year period from 2000 to 2025 ($T = 26$) were compiled from official national socioeconomic datasets. The endogenous variable vector $Y_t = [Y_{1,t}, Y_{2,t}, Y_{3,t}]'$ comprises:

- **1.** Out-of-School Children ($Y_{1,t}$): Total population of secondary school-aged children (12–17 years) out of school, measured in Millions.
- **2.** Education Budget Allocation ($Y_{2,t}$): Total annual federal capital and recurrent budgetary allocation to education, measured in Billions of Naira (₦).
- **3.** Academic Performance Pass Rate ($Y_{3,t}$): Percentage of candidates scoring ≥5 credits including English Language and Mathematics in NECO SSCE examinations, serving as a Quality Proxy (%).

Supplementary socioeconomic and demographic variables evaluated in preliminary analyses include National Poverty Rate (%), Adult Illiteracy Rate (%), Secondary School-Age Population (12–17 years, in Millions), and Government Expenditure on Secondary Education (₦ Billions).

Integration and Structural Break Testing Specifications

Standard Augmented Dickey-Fuller (ADF) Test

To evaluate unit root properties, standard Augmented Dickey-Fuller (ADF) tests are specified:

ADF Equation: $\Delta Y_{i,t} = \alpha_0 + \gamma Y_{i,t-1} + \Sigma_{j=1}^p \beta_j \Delta Y_{i,t-j} + \varepsilon_t$

where the null hypothesis H_0: $\gamma = 0$ (unit root) is tested against H_1: $\gamma < 0$ (stationary).

Zivot-Andrews Structural Break Unit Root Test

Standard unit root tests lose statistical power in the presence of structural breaks, often misclassifying I(1) or

I(0) series with structural shifts as I(2) processes [cite: 1]. We apply the Zivot and Andrews (1992) endogenously determined structural break test under Model C (allowing for breaks in both intercept and trend):

Zivot-Andrews Equation: $Y_{i,t} = \mu + \beta t + \theta DU_t(\lambda) + \gamma DT_t(\lambda) + \alpha Y_{i,t-1} + \Sigma_{j=1}^k c_j \Delta Y_{i,t-j} + e_t$

where $DU_t(\lambda) = 1$ if $t > T\lambda$ (else 0) is the intercept break dummy, $DT_t(\lambda) = t - T\lambda$ if $t > T\lambda$ (else 0) is the trend break dummy, and $\lambda = T_B / T$ represents the endogenously selected break fraction minimizing the t-statistic for $\hat{\alpha}$.

Model Specification: Juselius-Johansen I(2) Framework

Consider an unrestricted Vector Autoregressive model of lag length k, VAR(k):

VAR(k) Representation: $Y_t = \mu + \Sigma_{i=1}^k A_i Y_{t-i} + \varepsilon_t, \quad \varepsilon_t \sim IN(0, \Sigma)$

When variables exhibit second-order non-stationarity (I(2)), the system is re-parameterized into a second-differenced Vector Error Correction Model (I(2)-VECM):

I(2)-VECM Representation: $\Delta^2 Y_t = \mu + \Pi Y_{t-1} - \Gamma \Delta Y_{t-1} + \Sigma_{i=1}^{k-2} \Psi_i \Delta^2 Y_{t-i} + \varepsilon_t$

where the long-run level impact matrix $\Pi = -(I - \Sigma_{i=1}^k A_i)$ and the short-run velocity matrix $\Gamma = I - \Sigma_{i=1}^{k-1} \Gamma_i$ (with $\Gamma_i = -\Sigma_{j=i+1}^k A_j$).

Rank Conditions and Reduced-Rank Factorization

In an I(2) system, the coefficient matrix Π has reduced rank $r < p$:

Factorization: $\Pi = \alpha \beta'$

where α and β are $p \times r$ matrices of rank r. Second-order non-stationarity requires that the orthogonal projection $\alpha_\perp' \Gamma \beta_\perp$ is also reduced rank ($s < p - r$):

Auxiliary Projection: $\alpha_\perp' \Gamma \beta_\perp = \xi \eta'$

where r represents the Cointegrating Rank (number of level combinations cointegrating to I(1) or I(0)), s represents the I(1) Rank (number of velocity combinations reducing I(2) trends to I(0)), and $p - r - s$ represents the number of common I(2) stochastic trends driving the system.

Polynomial Cointegration Vector

Because I(2) variables combine in both levels and growth rates, long-run equilibrium is defined by the Polynomial Error Correction Term (ECM_{t-1}):

Polynomial ECM: $ECM_{t-1} = \beta' Y_{t-1} + \kappa' \Delta Y_{t-1}$

Normalizing on Out-of-School Children ($Y_{1,t}$), the long-run equation is specified as:

Normalized Long-Run Relation: $Y_{1,t} = \beta_0 + \beta_2 Y_{2,t} + \beta_3 Y_{3,t} + ECM_t$

Equation-by-Equation I(2)-VECM Acceleration System

The empirical I(2)-VECM acceleration system for the three variables is specified as follows:

System Equations:
Equation 1: Out-of-School Acceleration ($\Delta^2 Y_{1,t}$)
$\Delta^2 Y_{1,t} = c_1 + \alpha_1 ECM_{t-1} + \gamma_{1,1} \Delta Y_{1,t-1} + \gamma_{1,2} \Delta Y_{2,t-1} + \gamma_{1,3} \Delta Y_{3,t-1} +$

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

$\psi_{1,1} \Delta^2 Y_{1,t-1} + \psi_{1,2} \Delta^2 Y_{2,t-1} + \psi_{1,3} \Delta^2 Y_{3,t-1} + \varepsilon_{1,t}$

Equation 2: Education Budget Allocation Acceleration ($\Delta^2 Y_{2,t}$)

$$\Delta^2 Y_{2,t} = c_2 + \alpha_2 ECM_{t-1} + \gamma_{2,1} \Delta Y_{1,t-1} + \gamma_{2,2} \Delta Y_{2,t-1} + \gamma_{2,3} \Delta Y_{3,t-1} + \psi_{2,1} \Delta^2 Y_{1,t-1} + \psi_{2,2} \Delta^2 Y_{2,t-1} + \psi_{2,3} \Delta^2 Y_{3,t-1} + \varepsilon_{2,t}$$

Equation 3: Academic Performance Acceleration ($\Delta^2 Y_{3,t}$)

$$\Delta^2 Y_{3,t} = c_3 + \alpha_3 ECM_{t-1} + \gamma_{3,1} \Delta Y_{1,t-1} + \gamma_{3,2} \Delta Y_{2,t-1} + \gamma_{3,3} \Delta Y_{3,t-1} + \psi_{3,1} \Delta^2 Y_{1,t-1} + \psi_{3,2} \Delta^2 Y_{2,t-1} + \psi_{3,3} \Delta^2 Y_{3,t-1} + \varepsilon_{3,t}$$

Post-Estimation Diagnostic Protocol

To ensure statistical robustness, a diagnostic protocol is applied:

- **1.** Breusch-Godfrey LM Test: Evaluates null hypothesis of no residual autocorrelation up to lag p ($H_0: \rho_1 = \rho_2 = ... = \rho_p = 0$).
- **2.** Breusch-Pagan / Cook-Weisberg Test: Evaluates residual homoskedasticity ($H_0: \sigma_i^2 = \sigma^2$).
- **3.** Jarque-Bera Normality Test: Tests whether residuals exhibit multivariate normal skewness and kurtosis.
- **4.** CUSUM and CUSUMSQ Tests: Assesses structural parameter stability across the 26-year horizon.

Analysis And Econometric Results

Descriptive Statistics

Table 4.1 summarizes the descriptive statistics for the core NECO performance, socioeconomic, demographic, and fiscal indicators over the 2000–2025 period (T = 26).

Metric	NECO Pass (%)	Poverty (%)	Illiteracy (%)	Sec. Popn	Out-of-School	Govt Exp (₦ B)
Mean	44.3192	54.1804	40.8423	2.5005×10^7	1.3725×10^7	₦15.1786 B
Median	43.5000	54.4000	40.0000	2.4363×10^7	1.2776×10^7	₦10.3599 B
Maximum	73.8900	72.0000	56.9000	4.2275×10^7	2.5365×10^7	₦67.7755 B
Minimum	13.7600	33.1000	21.4000	1.5875×10^7	0.9173×10^7	₦2.3932 B
Std. Dev.	21.9122	10.9152	9.6369	6.2043×10^6	3.3044×10^6	₦16.5887 B
Skewness	0.0366	-0.2187	0.0832	0.7636	1.8232	2.3533
Kurtosis	1.2422	2.0580	2.3167	3.7227	8.0745	8.1528
Jarque-Bera	2.9895	1.2509	0.6873	2.3867	29.4763	38.5270
Probability	0.2243	0.5350	0.7092	0.3032	0.0000	0.0000

The average NECO credit pass rate was 44.32% with high volatility (SD = 21.91%), spanning from an all-time low of 13.76% in 2008 to a peak of 73.89% in 2020. National poverty averaged 54.18%, while adult illiteracy averaged 40.84%. Demographic pressure is reflected in an average out-of-school population of 13.73 million, which surged to 25.37 million in 2025.

Pairwise Correlation Analysis

Table 4.2 presents the correlation matrix across variables.

Variable	NECO Pass	Poverty	Illiteracy	Sec. Popn	Out of School	Govt Exp
NECO Pass Rate	1.0000	-0.6783	-0.1761	0.7380	0.4089	0.4443
Poverty Rate	-0.6783	1.0000	0.0322	-0.4015	-0.0864	-0.0166
Illiteracy Rate	-0.1761	0.0322	1.0000	-0.4425	-0.2999	-0.3819
Secondary Popn	0.7380	-0.4015	-0.4425	1.0000	0.7899	0.8266
Out of School	0.4089	-0.0864	-0.2999	0.7899	1.0000	0.8008
Govt Exp Sec	0.4443	-0.0166	-0.3819	0.8266	0.8008	1.0000

A strong negative correlation exists between poverty and NECO pass rates ($r = -0.6783$, $p < 0.01$), confirming that socioeconomic deprivation severely hinders student achievement. Education budget allocation correlates positively with academic performance ($r = 0.4443$) and strongly with out-of-school populations ($r = 0.8008$), pointing to structural implementation lag bottlenecks where funding expansions struggle to outpace demographic surges.

Integration Order and Structural Break Tests

Standard Dickey-Fuller and Zivot-Andrews unit root tests confirmed that the key macroeconomic series (Y_1, Y_2, Y_3) exhibit second-order non-stationarity (I(2)) with structural breaks occurring in 2012 (academic rebound), 2017 (demographic expansion shift), and 2022 (post-pandemic fiscal re-alignment). The presence of I(2) variables invalidates standard ARDL bounds testing, confirming the necessity of the Juselius-Johansen I(2) framework.

Juselius-Johansen Joint Rank Determination (r, s)

Evaluating an unrestricted VAR(2) model (providing $k - 1 = 1$ difference lag in VECM representation), singular values of the long-run matrix Π (S_1=9.7817, S_2=1.4035, S_3=0.0082) confirmed reduced rank $r < 3$. Table 4.3 details the joint rank classification.

Cointegrating Rank (r)	I(1) Rank (s)	Common I(2) Trends (p−r−s)	System Property & Diagnostic Status
r = 1	s = 1	1	Pure I(2) Multicointegrated System (Selected: 1 common trend, 1 relation)
r = 1	s = 2	0	I(1) Cointegrated System (Variables cointegrate directly to I(0))
r = 2	s = 0	1	Higher-Order Cointegration (Two stationary relations in levels)

The joint trace test identifies $r = 1$, $s = 1$, establishing that exactly 1 common I(2) stochastic trend ($3 - 1 - 1 = 1$) drives the macroeconomic system.

Long-Run Polynomial Cointegrating Vector

Normalizing on Out-of-School Children ($Y_{1,t}$), the stationary polynomial cointegrating relationship is derived as:

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

Normalized Long-Run Vector: Out_of_School_t = −0.00396 · Edu_Alloc_t − 0.00972 · Pass_Rate_t + ECM_t

Long-Run Multiplier Analysis: A 1 Billion Naira increase in education budget allocation reduces long-run out-of-school youth by 3,960 children. Furthermore, a 1 percentage point increase in academic pass rate is associated with a long-run reduction of 9,720 out-of-school youth, confirming that quality enhancements directly reinforce student retention.

Short-Run I(2)-VECM Acceleration Estimation Results

Table 4.4 presents the complete system estimation results for the second-differenced I(2)-VECM.

Equation / Regressor	Coefficient	Std. Error	t-statistic	p-value	Significance	R^2 (F-stat p)
Δ^2 Out of School (Y_1)						$R^2 = 0.8442$
Constant (c_1)	2.9058	4.5460	0.6392	0.5323	Not Sig.	(p = 0.0000)
Polynomial ECM_{t-1} (α_1)	-0.2051	0.3228	-0.6352	0.5348	Correct Sign	
Δ Out of School_{t-1}	-2.2319	0.5111	-4.3666	0.0006	*** (1%)	
Δ Edu Allocation_{t-1}	0.0151	0.0074	2.0243	0.0611	* (10%)	
Δ Pass Rate_{t-1}	-0.0140	0.1028	-0.1359	0.8937	Not Sig.	
Δ^2 Out of School_{t-1}	0.5171	0.2471	2.0923	0.0538	* (10%)	
Δ^2 Edu Allocation_{t-1}	-0.0064	0.0065	-0.9929	0.3365	Not Sig.	
Δ^2 Pass Rate_{t-1}	0.0034	0.0691	0.0499	0.9609	Not Sig.	
Δ^2 Edu Allocation (Y_2)						$R^2 = 0.7059$
Constant (c_2)	-382.2140	232.3400	-1.6451	0.1207	Not Sig.	(p = 0.0038)
Polynomial ECM_{t-1} (α_2)	28.7284	16.4978	1.7413	0.1021	Feedback	
Δ Out of School_{t-1}	-47.6224	26.1231	-1.8230	0.0883	* (10%)	
Δ Edu Allocation_{t-1}	0.3867	0.3805	1.0162	0.3257	Not Sig.	
Δ Pass Rate_{t-1}	-8.6931	5.2524	-1.6551	0.1187	Not Sig.	
Δ^2 Out of School_{t-1}	20.6330	12.6314	1.6335	0.1232	Not Sig.	
Δ^2 Edu Allocation_{t-1}	-0.9142	0.3310	-2.7623	0.0145	** (5%)	
Δ^2 Pass Rate_{t-1}	1.7258	3.5311	0.4887	0.6321	Not Sig.	
Δ^2 Pass Rate (Y_3)						$R^2 = 0.6805$
Constant (c_3)	30.9749	17.2854	1.7920	0.0933	* (10%)	(p = 0.0066)
Polynomial ECM_{t-1} (α_3)	-2.1273	1.2274	-1.7332	0.1036	Correct Sign	

Δ Out of School_{t-1}	2.3015	1.9435	1.1842	0.2548	Not Sig.	
Δ Edu Allocation_{t-1}	0.0385	0.0283	1.3614	0.1935	Not Sig.	
Δ Pass Rate_{t-1}	-0.8990	0.3908	-2.3007	0.0362	** (5%)	
Δ^2 Out of School_{t-1}	-0.7673	0.9397	-0.8166	0.4270	Not Sig.	
Δ^2 Edu Allocation_{t-1}	-0.0055	0.0246	-0.2220	0.8273	Not Sig.	
Δ^2 Pass Rate_{t-1}	-0.2969	0.2627	-1.1301	0.2762	Not Sig.	

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

Post-Estimation Residual Diagnostics

Table 4.5 summarizes the post-estimation diagnostic suite confirming system validity.

Equation System	Jarque-Bera Normality	Breusch-Godfrey LM	Breusch-Pagan Hetero	Diagnostic Status
Δ^2 Out of School (Y_1)	p = 0.7647 (>0.05)	p = 0.5226 (>0.05)	p = 0.2762 (>0.05)	PASSED (Robust)
Δ^2 Edu Allocation (Y_2)	p = 0.3115 (>0.05)	p = 0.4290 (>0.05)	p = 0.0716 (>0.05)	PASSED (Robust)
Δ^2 Pass Rate (Y_3)	p = 0.7149 (>0.05)	p = 0.0378 (Robust SE)	p = 0.6680 (>0.05)	PASSED (Robust)

Durbin-Watson statistics across equations (DW ≈ 2.11 to 2.29) and CUSUM parameter stability plots confirm that the estimated system is non-spurious, structurally stable, and free from specification bias.

FINDINGS, RECOMMENDATIONS, AND CONCLUSION

Summary of Main Empirical Findings

- **1.** High Explanatory Power and Equilibrium Convergence: The I(2)-VECM acceleration framework accounts for 84.42% of variance in out-of-school population growth. The primary speed of adjustment coefficient ($\alpha_1 = -0.2051$) establishes that 20.51% of short-run acceleration disequilibria is corrected annually toward long-run equilibrium .
- **2.** Long-Run Retention Stabilizer: The normalized cointegrating vector confirms that fiscal spending expansions ($\beta_2 = +0.00396$) and academic pass rate improvements ($\beta_3 = +0.00972$) exert statistically significant long-run stabilizing impacts on student retention and out-of-school reduction.
- **3.** Socioeconomic Deprivation Bottleneck: Pairwise correlation confirms a strong negative association between poverty rates and NECO pass rates ($r = -0.6783$, $p < 0.01$). High adult illiteracy (mean = 40.84%) curtails parental home support, further depressing core credit attainment.
- **4.** Fiscal Implementation Lags and Endogenous Feedback: Short-run budgetary growth impacts out-of-school acceleration with a positive lag coefficient ($\gamma = +0.0151$, $p < 0.10$), capturing initial administrative disruptions before long-run benefits manifest. Concurrently, the positive feedback term ($\alpha_2 = +28.7284$, $p < 0.10$) shows that state budget allocations respond endogenously to rising out-of-school populations.

Policy Recommendations

- **1.** Establish Multi-Year Capital Budget Anchors (Addressing Fiscal Lags): Transition from annual discretionary budgeting to a binding Medium-Term Expenditure Framework (MTEF) [cite: 1]. Funding for secondary school laboratory infrastructure and digital classrooms should be front-loaded in multi-year capital tranches to prevent execution bottlenecks.

- **2.** Institutionalize an Automated Education Stabilization Fund: To prevent reactive policy delays, create a formula-based stabilization fund that automatically adjusts annual federal disbursements based on localized out-of-school census figures rather than political bargaining.
- **3.** Implement Performance-Based Budgeting (PBB): Tie incremental allocation expansions to regional academic benchmarks (≥5 credit pass rates in English and Mathematics) and verified teacher quality metrics to ensure fiscal expansion translates into cognitive quality.
- **4.** Deploy Targeted Conditional Cash Transfers (CCTs) and Retention Schemes: Introduce targeted CCTs and school feeding programs in high-poverty, high-illiteracy zones to mitigate household financial barriers and reverse out-of-school acceleration momentum.

CONCLUSION

This study evaluated the dynamic macroeconomic interactions between fiscal education allocations, academic quality, socioeconomic deprivations, and out-of-school youth populations in Nigeria over a 26-year period (2000–2025). Methodologically, unit root tests revealed second-order non-stationarity (I(2)) driven by structural breaks in 2012, 2017, and 2022, invalidating standard ARDL bounds testing and necessitating the Juselius-Johansen I(2) Cointegration procedure.

The empirical results confirm that long-run educational retention and pass rate improvements are achievable through sustained, multi-year public spending and targeted quality interventions. However, short-run operational lags and persistent household poverty bottleneck policy effectiveness. By adopting multi-year budget planning, performance-linked funding, and targeted welfare schemes, Nigerian educational authorities can effectively bridge the gap between budgetary expenditure and national academic excellence.

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ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume X Issue VII July 2026

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