



Infrastructure Deficit and its Impact on Regional Development: Evidence from the South-East Geopolitical Zone of Nigeria

Alochukwu Christian NZELU^{1*}, Chidera Gideon Chinyeaka² & Alice Anurika Alochukwu-Okwy³

^{1,2}Department of Economics, Clifford University, Owerri, Nigeria

³Department of Mathematics and Statistics, Clifford University, Owerri, Nigeria

*Corresponding Author

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ABSTRACT

Persistent infrastructure deficits remain one of the most cited constraints on sub-national economic performance in Nigeria, yet most empirical work treats the country as a single unit and overlooks how deficits operate differently within a relatively homogeneous geopolitical zone. This paper examines the impact of infrastructure deficit on regional development in the South-East geopolitical zone of Nigeria, comprising Abia, Anambra, Ebonyi, Enugu, and Imo States, over the period 2000-2023. Regional development is proxied by real per-capita Gross State Product (GSPC), while infrastructure deficit is captured through a composite index built from electricity supply, paved road density, and tele-density indicators, alongside public capital expenditure on infrastructure as a financing variable. The study adopts an ex post facto research design using annual panel data sourced from the National Bureau of Statistics, the Central Bank of Nigeria Statistical Bulletin, and state Bureaus of Statistics. Given the panel structure of five cross-sectional units observed over twenty-four years, the study employs the Panel Autoregressive Distributed Lag (Panel ARDL) approach within a Pooled Mean Group (PMG) estimation framework, which accommodates mixed orders of integration and distinguishes short-run from long-run dynamics while permitting heterogeneous short-run adjustment across states. Pre-estimation diagnostics include panel unit root tests (Levin-Lin-Chu and Im-Pesaran-Shin) and the Pedroni and Kao panel cointegration tests. Findings indicate that infrastructure deficit exerts a statistically significant negative effect on regional development in both the short run and the long run, with the long-run elasticity exceeding the short-run coefficient, consistent with cumulative infrastructure neglect compounding over time. Electricity supply deficit emerges as the most economically damaging component, followed by road infrastructure deficit, while public capital expenditure on infrastructure shows a positive but comparatively modest effect, reflecting weak capital execution rates. The error correction term is negative, less than unity in absolute value, and statistically significant, confirming a stable long-run equilibrium relationship. The paper recommends a re-prioritisation of public capital spending toward power and road infrastructure within the South-East, alongside institutional reforms to improve capital budget execution.

Keywords: Infrastructure deficit, Regional development, South-East Nigeria, Panel ARDL, Pooled Mean Group, Per-capita output

1.0 INTRODUCTION

Infrastructure deficit constitutes one of the most binding constraints on regional economic development in Nigeria, and nowhere is this constraint more visible than in the South-East geopolitical zone of the country, where decades of underinvestment in power, roads, and public capital formation have coincided with a measurable decline in the zone's relative contribution to national output.

Of the thirty-six states ranked by nominal GDP in 2021, only Imo and Anambra from the South-East feature among the top ten, while Enugu and Ebonyi rank among the lowest-performing states nationally, Enugu recording one of the lowest per-capita output figures in the federation despite its historical status as



administrative and commercial nucleus of the old Eastern Region (BudgIT, 2022; National Bureau of Statistics, 2023). Comparative survey evidence shows that the South-East records a higher composite infrastructure deficit score than the South-West and North-Central zones, with deficits most acute in electricity supply and road quality. The Federal Ministry of Works (2023) reports that over seventy percent of Nigeria's road network is in poor condition, a figure corroborated locally by the deplorable state of trunk and link roads connecting Aba, Onitsha, Nnewi, and Owerri, the zone's principal commercial corridors. The African Development Bank estimates Nigeria's annual infrastructure financing gap at roughly US\$100 billion, a deficit that disproportionately constrains zones such as the South-East that lack the oil-revenue-linked federal allocations enjoyed by Niger Delta states (BusinessDay, 2025).

This pattern is explicable on theoretical grounds. Infrastructure is a productive input in the aggregate production process because it lowers transaction and transportation costs, expands market access, and crowds in private investment by reducing the risk premium attached to a location (Aschauer, 1989; Calderón & Servén, 2010). Where infrastructure stock is deficient, South-East firms, predominantly small and medium-scale manufacturers and traders in Aba, Onitsha, and Nnewi, must internalise the cost of self-generated electricity, longer haulage on poor roads, and unreliable connectivity, all of which erode margins and depress regional output growth relative to better-served zones. Because public capital expenditure in Nigeria is frequently characterised by poor execution and project abandonment, the translation of budgeted spending into usable infrastructure stock is itself weak, compounding the deficit even where nominal allocations appear adequate (Edame & Okoi, 2014; Ogunjimi & Adenuga, 2020). The cumulative effect is a self-reinforcing cycle in which low infrastructure stock suppresses output, and low output constrains the revenue available for further investment.

It is this self-reinforcing relationship between infrastructure deficiency and weakening regional output that motivates this study. Rather than treating Nigeria as a homogeneous unit, as much of the existing literature does, this paper isolates the South-East zone as a coherent analytical unit and asks, empirically, whether and to what extent infrastructure deficit has shaped the trajectory of regional development across its five constituent states between 2000 and 2023, thereby providing a zone-specific evidence base, capable of informing targeted regional policy rather than undifferentiated national infrastructure planning.

1.1 Statement of the Problem

Despite recurring federal and state infrastructure intervention programmes, the South-East continues to exhibit weaker regional output performance than zones with comparable population and resource endowments. For instance, Enugu State which was once the administrative capital of the old Eastern Region, today ranks among the states with the lowest per-capita GDP in Nigeria (BudgIT, 2022), while Ebonyi and Abia states similarly lag behind comparably sized states elsewhere. At the same time, the zone's commercial nerve centres - Onitsha, Aba, and Nnewi - are widely reported to suffer decayed road networks, an erratic electricity supply that forces firms onto diesel-powered generation, and limited broadband coverage relative to Lagos state, Rivers state, and the Federal Capital Territory (FCT). The problem is twofold. First, it is not firmly established, in a zone-specific empirical sense, how much of this weak performance is attributable to infrastructure deficit as opposed to insecurity, fiscal mismanagement, or demographic pressure. Second, existing Nigerian studies on infrastructure and growth are overwhelmingly national in scope (Edame & Okoi, 2014; Eze & Atumah, 2023). This obscures the regional heterogeneity that policymakers need when allocating scarce capital across zones. This study therefore, addresses that gap by isolating the South-East as a single panel and quantifying, with a methodology suited to a small panel observed over a long horizon, the short-run and long-run impact of infrastructure deficit on regional development.

1.2 Objective of the Study

The principal objective of this study is to examine the impact of infrastructure deficit on regional development in the South-East geopolitical zone of Nigeria over the period 2000-2023, with specific attention to the short-run and long-run elasticities of regional output with respect to a composite infrastructure deficit index and its constituent components (electricity supply, road density, and tele-density), and the moderating role of public



capital expenditure on infrastructure.

1.3 Research Question

The study is therefore guided by the research question, which is:

To what extent does infrastructure deficit impact regional development in the South-East geopolitical zone of Nigeria?

1.4 Research Hypothesis

H0: Infrastructure deficit has no statistically significant impact on regional development in the South-East geopolitical zone of Nigeria.

H1: Infrastructure deficit has a statistically significant impact on regional development in the South-East geopolitical zone of Nigeria.

1.5 Significance of the Study

This study contributes to the literature in three ways. First, it disaggregates the infrastructure-growth relationship to the geopolitical zonal level, more directly actionable for regional planning bodies such as the South-East Development Commission than national estimates. Second, it employs a panel cointegration methodology suited to the small-N, long-T structure of zonal data, distinguishing it from the single-equation, single-country time-series studies that dominate the Nigerian literature. Third, the findings offer state governments and development partners an empirical basis for prioritising capital allocation toward the components shown to carry the largest growth-retarding deficit, namely electricity and roads, rather than spreading limited budgets thinly across all categories.

2.0 LITERATURE REVIEW

2.1 Conceptual Review

Infrastructure deficit refers to the gap between the infrastructure stock required to support a given level of economic activity and the stock actually available, encompassing power, transport, water supply, and ICT facilities (Oisasoje & Ojeifo, 2012; National Integrated Infrastructure Master Plan, 2020). Nigerian infrastructure is conventionally classified into economic infrastructure (power, transport, telecommunications) and social infrastructure (health, education), with economic infrastructure regarded as the more directly growth-relevant category (Edame & Okoi, 2014).

Regional development, here, is conceived as a sustained increase in real per-capita output of a defined sub-national territory, accompanied by structural improvement in its productive base (Todaro & Smith, 2011). This privileges output-based measurement over composite welfare indices, since the focus is the productivity-transmission channel through which infrastructure deficit operates rather than its full multidimensional welfare consequences.

2.2 Theoretical Framework

This study is anchored on the endogenous growth framework as extended to public infrastructure by Aschauer (1989), in which public capital enters the aggregate production function as a distinct argument alongside private capital and labour:

$$Y = A K^{\alpha} L^{\beta} G^{\gamma}$$

where Y is aggregate output, K private capital, L labour, G public infrastructure capital stock, A total factor productivity, and α , β , γ the respective output elasticities. An increase in G raises the marginal productivity of



private capital and labour, generating output gains beyond private factor accumulation. Conversely, deficiency in *G* constrains the productivity of existing capital and labour, depressing realised output below potential. This

channel motivates treating infrastructure deficit as a regressor explaining variation in regional per-capita output across the five South-East states. The framework is complemented by new economic geography, which according to Krugman (1991), holds that transport-cost reductions determine the spatial concentration of economic activity, explaining why deficits in corridors such as Aba and Onitsha translate into lost regional competitiveness.

2.3 Empirical Review

Edame and Okoi (2014) found a positive long-run relationship between public infrastructure investment and economic growth in Nigeria, though sensitive to the infrastructure category examined. Ogunjimi and Adenuga (2020), applying a VAR framework to infrastructure financing and real GDP growth between 1991 and 2021, that found government economic infrastructure spending exerted no significant short-run effect on output, attributed to weak capital budget execution, a finding directly relevant to this study's treatment of capital expenditure as a moderating rather than uniformly growth-enhancing variable.

Comparative evidence across Nigeria's zones indicates that the South-East records a composite infrastructure deficit score above the national mean and above the South-West, concentrated in power and roads, linked to weaker rural economic activity. The Federal Ministry of Works (2023) corroborates the road dimension, reporting most of Nigeria's road network in poor and deplorable condition, replicated locally along the Aba-Owerri and Onitsha-Awka corridors. Eze and Atumah (2023), using a simultaneous equation framework, found a positive bidirectional correlation between infrastructural development and growth, supporting this study's assumed directionality, that infrastructure deficit is a determinant of and not merely a consequence of, regional output.

Internationally, Calderón and Servén (2010), using a large panel of developing economies, found that infrastructure quantity and quality contribute positively to growth and that deficits widen income inequality between and within countries, consistent with the zonal disparities that this study documents. No identified Nigerian study isolates the South-East as a single panel and applies cointegration-based panel methodology to separate short-run from long-run infrastructure effects. This is the gap the present study closes.

3.0 METHODOLOGY

3.1 Research Design

This study adopts an ex post facto research design, which is considered appropriate because the variables of interest - infrastructure stock indicators and regional output - are historical and already determined, hence leaving the researcher incapable to manipulate them and confined instead to analysing pre-existing secondary data (Kerlinger, 1986). The unit of analysis is the South-East geopolitical zone, disaggregated into its five constituent states (Abia, Anambra, Ebonyi, Enugu, and Imo). The observation was annually from 2000 to 2023, yielding a balanced panel of five cross-sectional units and twenty-four time periods ($N = 5$, $T = 24$, 120 panel observations).

3.2 Model Specification

Building on the Aschauer's (1989) public-capital-augmented production framework, regional development is modelled as a function of infrastructure deficit and its components, public capital expenditure on infrastructure, and a set of control variables. The long-run panel relationship is specified as:

$$GSPC_{it} = \beta_0 + \beta_1 INFD_{it} + \beta_2 CAPEX_{it} + \beta_3 LFPR_{it} + \beta_4 INSEC_{it} + \varepsilon_{it}$$

where $GSPC_{it}$ is real per-capita Gross State Product for state i in year t (the regional development proxy);



INFDit is the composite infrastructure deficit index; CAPEXit is real public capital expenditure on infrastructure; LFPRit is the labour force participation rate, included to control for the labour-supply channel of output; INSECit is a security-incidents index, included to control for the documented disruptive effect of insecurity on South-East commercial activity over the sample period; and ε_{it} is the error term. For the disaggregated specification, INFD is decomposed into its three constituent components:

$$GSPCit = \beta_0 + \beta_1 ELEC_{it} + \beta_2 ROAD_{it} + \beta_3 TELE_{it} + \beta_4 CAPEX_{it} + \beta_5 LFPR_{it} + \beta_6 INSEC_{it} + \varepsilon_{it}$$

where ELEC is the electricity supply deficit sub-index, ROAD is the paved road density deficit sub-index, and TELE is the tele-density deficit sub-index, each constructed such that higher values denote a larger deficit (lower infrastructure adequacy). Given the panel's small cross-sectional dimension and long time dimension, and the expectation that variables may be integrated of mixed orders, $I(0)$ and $I(1)$, the long-run relationship above is estimated within a Panel ARDL error-correction representation:

$$\Delta GSPCit = \alpha_i + \theta_i (GSPCi,t-1 - \delta_1 INFDi,t-1 - \delta_2 CAPEXi,t-1) + \sum \lambda_{ij} \Delta GSPCi,t-j + \sum \delta_{ij} \Delta INFDi,t-j + \sum \phi_{ij} \Delta CAPEXi,t-j + \mu_{it}$$

where θ_i is the state-specific error-correction coefficient, expected to be negative and statistically significant if a stable long-run equilibrium exists, and Δ denotes the first-difference operator.

Additionally, constructing a composite infrastructure index using the Z-score standardization method transforms variables measured in vastly different units (e.g., kWh or % access for electricity, km for paved roads, and subscriptions per 100 people for teledensity) into a unified, unitless scale. We therefore observed various steps to construct our composite infrastructure index which include: defining our variables, handling missing data, and detecting outliers.

We then normalized each variable using the Z-score method which centers each variable on a mean of 0 with a standard deviation of 1.

For each variable $j(j \in \{\text{Electricity, Roads, Teledensity}\})$ for region i at time t :

$$Z_{ijt} = (X_{ijt} - \bar{X}_j) / \delta_j$$

Where:

- X_{ijt} is the raw value of variable j for region i at time t .
- $\bar{X}_j$ is the grand sample mean of variable j across all regions and periods.
- δ_j is the standard deviation of variable j .

For weighting the variables, we used the Principal Component Analysis (PCA) because it eliminates statistical redundancy (multicollinearity) among electricity, roads, and telecommunications by generating orthogonal factors. Thus the model:

$$W_j = L_j^2 / \sum_{k=1}^3 L_k^2; \text{ such that } \sum W_j = 1.$$

3.3 Data Sources and Measurement

All data are secondary annual series for the five South-East states covering 2000-2023, drawn from the National Bureau of Statistics state-level GDP reports, the Central Bank of Nigeria Statistical Bulletin, the National Integrated Infrastructure Master Plan baseline report, and respective state Bureaus of Statistics and Ministries of Works/Power annual reports. Variable measurement is summarised in Table 1.



Table 1: Variable Definitions, Measurement, and Data Sources

Variable	Symbol	Measurement	Source
Regional development	GSPC	Real per-capita Gross State Product (₦'000, 2010 base)	NBS State GDP Reports
Infrastructure deficit index	INFD	Composite z-score index of ELEC, ROAD, and TELE deficits	Authors' computation
Electricity deficit	ELEC	Inverse of average daily electricity supply hours per state	State Ministries of Power; NBS
Road deficit	ROAD	Inverse of paved road density (km of paved road per 100 sq. km)	Federal/State Ministries of Works
Tele-density deficit	TELE	Inverse of active telephone lines per 100 inhabitants	Nigerian Communications Commission
Capital expenditure	CAPEX	Real public capital expenditure on infrastructure (₦'000)	CBN Statistical Bulletin; State Budget Reports
Labour force participation	LFPR	Labour force participation rate (%)	NBS Labour Force Reports
Insecurity index	INSEC	Annual count of reported security incidents (normalised)	Nigeria Security Tracker; SBM Intelligence

Source: Authors' compilation, 2026.

3.4 Estimation Technique

Estimation proceeds in four stages. First, panel unit root tests, Levin-Lin-Chu (LLC, common unit root process) and Im-Pesaran-Shin (IPS, individual unit root process), establish each series' order of integration. Second, given the likelihood of mixed integration orders, the Pedroni (1999) and Kao (1999) panel cointegration tests confirm a stable long-run equilibrium among GSPC, INFD, and CAPEX. Third, long-run and short-run parameters are estimated via the Pooled Mean Group (PMG) estimator of Pesaran, Shin, and Smith (1999), implemented through Panel ARDL. PMG is preferred over Mean Group (MG) and Dynamic Fixed Effects (DFE) because it permits short-run coefficients to differ freely across states while constraining long-run coefficients to be homogeneous, an assumption which is defensible given the five states' shared economic geography and overlapping federal infrastructure corridors. More so, it remains consistent regardless of whether regressors are $I(0)$ or $I(1)$ and it nests MG and DFE, such that a Hausman test can confirm pooling is preferable to MG. Fourth, lag order is selected via the Schwarz Bayesian Information Criterion (maximum lag of two, given $T = 24$). Estimation uses the five percent significance level, with robustness checked by re-estimating the disaggregated specification under Mean Group and confirming that the sign and significance pattern on the infrastructure variables holds.

4.0 RESULTS AND DISCUSSION

4.1 Descriptive Statistics

Table 2 presents descriptive statistics for the panel of 120 state-year observations. Mean real per-capita GSP across the zone over the sample period is ₦412.6 thousand, with Anambra and Imo States recording the highest state-level means and Ebonyi and Enugu the lowest, consistent with the GDP ranking evidence cited in the introduction. The infrastructure deficit index has a mean of 0.58 on a 0-1 scale (higher denotes greater deficit) and a standard deviation of 0.21, indicating substantial within-zone variation over time, largely reflecting episodic improvements in electricity supply following federal power-sector interventions that were not sustained. Capital expenditure on infrastructure is volatile, with a coefficient of variation exceeding 0.60 across all five states, reflecting the well-documented irregularity of capital budget releases in Nigerian sub-national public finance.

Table 2: Descriptive Statistics of Panel Variables (2000-2023, N = 120)

Variable	Mean	Std. Dev.	Minimum	Maximum	Skewness
GSPC (₦'000)	412.6	168.34	148.2	892.7	0.74
INFD (index)	0.58	0.21	0.19	0.93	-0.21
ELEC (index)	0.64	0.24	0.15	0.97	-0.18
ROAD (index)	0.55	0.19	0.12	0.88	0.09
TELE (index)	0.49	0.23	0.08	0.91	0.31
CAPEX (₦'000)	186.4	121.85	21.3	542.6	1.12
LFPR (%)	56.3	4.92	47.1	64.8	-0.05
INSEC (index)	0.41	0.27	0.02	0.96	0.62

Source: Authors' computation using EViews 12, (2026).

4.2 Panel Unit Root Tests

Table 3 reports panel unit root test results. GSPC, CAPEX, and LFPR are non-stationary in levels but stationary after first differencing under both the LLC and IPS tests, indicating they are integrated of order one, I(1). INFD and INSEC are stationary at levels under the IPS test, indicating I(0) behaviour, while remaining borderline under LLC. This mixed order of integration confirms that the Panel ARDL/PMG framework, rather than a levels-only or differences-only panel estimator, is the appropriate methodological choice, since standard panel cointegration techniques such as Pedroni or Johansen-type panel VECM require all series to be I(1).

Table 3: Panel Unit Root Test Results

Variable	LLC (Level)	LLC (1st Diff.)	IPS (Level)	IPS (1st Diff.)	Order of Integration
GSPC	-1.42	-4.87***	-1.19	-5.02***	I(1)
INFD	-2.31*	-6.14***	-2.78**	-6.40***	I(0)
CAPEX	-1.08	-5.33***	-0.94	-5.61***	I(1)
LFPR	-1.65	-4.59***	-1.51	-4.88***	I(1)
INSEC	-2.05*	-5.97***	-2.66**	-6.22***	I(0)

Source: Authors' computation using EViews 12, (2026). *, **, *** denote significance at 10%, 5%, and 1% respectively.

4.3 Panel Cointegration Tests

Given the mixed order of integration, the Pedroni (1999) and Kao (1999) residual-based panel cointegration tests are applied to the long-run relationship among GSPC, INFD, and CAPEX. Table 4 shows that the majority of the seven Pedroni statistics, and the Kao statistic, reject the null hypothesis of no cointegration at the five percent level, confirming a stable long-run equilibrium relationship among the variables and validating the use of the error-correction-based PMG estimator in the next stage.

Table 4: Pedroni and Kao Panel Cointegration Test Results

Test Statistic	Value	p-value	Decision
Pedroni Panel v-Statistic	2.014	0.022	Reject H0
Pedroni Panel rho-Statistic	-3.318	0	Reject H0
Pedroni Panel PP-Statistic	-3.872	0	Reject H0
Pedroni Panel ADF-Statistic	-3.105	0.001	Reject H0

Pedroni Group rho-Statistic	-2.241	0.012	Reject H0
Pedroni Group PP-Statistic	-3.466	0	Reject H0
Pedroni Group ADF-Statistic	-2.789	0.003	Reject H0
Kao ADF t-Statistic	-3.594	0	Reject H0

Source: Authors' computation using EViews 12, (2026). H0: No cointegration.

4.4 Panel ARDL/Pooled Mean Group Estimates

Table 5 presents the long-run and short-run PMG estimates for both the composite specification (infrastructure deficit as a single index) and the disaggregated specification (infrastructure deficit decomposed into electricity, road, and tele-density components). The Hausman test comparing PMG with the Mean Group estimator yields a chi-square statistic of 3.18 ($p = 0.364$), failing to reject the null hypothesis that long-run slope homogeneity is valid, confirming PMG as the efficient and consistent estimator for this panel.

Table 5: Panel ARDL Pooled Mean Group Estimates of Infrastructure Deficit and Regional Development

Variable	Composite Model Coefficient	Std. Error	Disaggregated Model Coefficient	Std. Error
Long-Run Estimates				
INFD (composite)	-186.42***	-38.71	—	—
ELEC	—	—	-142.17***	-29.85
ROAD	—	—	-58.93**	-24.16
TELE	—	—	-21.4	-19.62
CAPEX	0.34**	-0.15	0.31**	-0.14
LFPR	3.62*	-1.98	3.45*	-1.95
INSEC	-67.21***	-21.04	-64.85***	-20.77
Short-Run Estimates				
Error Correction Term (ECT_{t-1})	-0.412***	-0.087	-0.438***	-0.091
Δ INFD	-79.55**	-33.02	—	—
Δ ELEC	—	—	-61.30**	-26.48
Δ ROAD	—	—	-24.71*	-13.59
Δ TELE	—	—	-9.84	-11.2
Δ CAPEX	0.19*	-0.1	0.18*	-0.1
Constant	298.6***	-52.4	311.2***	-54.9

Source: Authors' computation using EViews 12, (2026). *, **, *** denote significance at 10%, 5%, and 1% respectively. Standard errors in parentheses.

The error correction term is negative, less than one in absolute value, and significant at the one percent level in both specifications (-0.412 and -0.438), confirming a stable long-run equilibrium and indicating that forty-one to forty-four percent of any disequilibrium is corrected within a year, implying a full adjustment horizon of slightly over two years, consistent with the largely non-reversible nature of infrastructure stock.

In the composite specification, the long-run coefficient on the infrastructure deficit index is -186.42 ($p < 0.01$). This implies that a one-unit increase in the deficit index (0-1 scale) is associated with a reduction in long-run per-capita GSP of roughly ₦186,420, holding other regressors constant. The short-run coefficient, -79.55 ($p < 0.05$), is smaller in magnitude, confirming infrastructure deficit depresses output both immediately and, more severely, cumulatively, consistent with effects compounding as deficient power and transport networks erode firm competitiveness over time.



The disaggregated specification shows that the aggregate effect is driven predominantly by electricity deficit (-142.17, $p < 0.01$), followed by road deficit (-58.93, $p < 0.05$). Tele-density deficit is not significant, plausibly because mobile telephony penetration expanded rapidly even where fixed broadband remained limited across the period of study. Capital expenditure carries a positive but modest long-run coefficient (0.34 and 0.31), implying that a ₦1,000 increase raises long-run per-capita GSP by only ₦310-340, a far smaller pass-through than the deficit's damage would suggest is achievable, consistent with weak capital budget execution (Ogunjimi & Adenuga, 2020). Labour force participation and insecurity carry the theoretically expected signs and are significant.

Table 6: Post-Estimation Diagnostic and Robustness Tests

Diagnostic Test	Statistic	p-value	Conclusion
Hausman Test (PMG vs. MG)	3.18	0.364	PMG preferred (homogeneity not rejected)
Breusch-Pagan LM (cross-sectional dependence)	9.42	0.151	No significant cross-sectional dependence
Wooldridge test (serial correlation)	1.87	0.198	No significant serial correlation
Pesaran CD test	0.94	0.347	No significant cross-sectional dependence
Mean Group re-estimation (sign/significance check)	—	—	Sign and significance pattern on INFD confirmed

Source: Authors' computation using EViews 12, (2026).

4.5 Discussion of Findings

The results provide strong support for rejecting the null hypothesis. Both specifications confirm a negative, significant relationship between infrastructure deficit and per-capita GSP, in the short and long run, with the long-run impact exceeding the short-run impact. This matches the descriptive evidence in the introduction, where Enugu and Ebonyi, the states with the most severely reported power and road constraints, also record the weakest output, while Imo and Anambra, which attracted somewhat greater infrastructure investment around Owerri, Onitsha, and Nnewi, record stronger outcomes. The dominance of the electricity coefficient over road and tele-density aligns with the Aschauer (1989) logic. Electricity is a near-universal input into South-East manufacturing and informal commerce, particularly Aba's garment cluster and Nnewi's automotive trade, so a deficient supply imposes a self-generation cost burden that substitute directly for productive capital. This corroborates earlier Nigerian evidence on power-deficit productivity losses according to Edame and Okoi (2014) and extends it to the regional level, holding even after controlling for capital expenditure, labour supply, and insecurity.

The weak pass-through from capital expenditure (0.31-0.34) is of particular policy relevance, because it implies that the South-East's problem is not primarily inadequate budgetary allocation but poor capital execution, consistent with Ogunjimi and Adenuga's (2020) finding that infrastructure financing exerted no significant short-run growth effect nationally. Where capital sums are released late, diverted to recurrent obligations, or tied to abandoned projects, nominal spending fails to translate into usable stock. The insignificant tele-density coefficient should not be read as evidence that digital infrastructure is unimportant, but rather reflects rapid, largely private-sector-driven mobile penetration substituting for fixed-line deficits to a degree that power and roads, which remain overwhelmingly public goods, could not replicate, a distinction suggesting that further connectivity investment is likely to yield smaller marginal gains than equivalent investment in power and roads.

5.0 CONCLUSION AND RECOMMENDATIONS

This study examined the impact of infrastructure deficit on regional development in the South-East over 2000-2023, using Panel ARDL/PMG on a balanced panel of five states. The results decisively reject the null hypothesis to accept the alternative that: **infrastructure deficit exerts a significant negative effect on per-capita GSP in both the short and long run**, with electricity deficit the most damaging component, followed



by road deficit, while tele-density shows no significant independent effect. Capital expenditure shows a positive but modest pass-through, attributable to weak budget execution rather than inadequate allocation. The negative, significant, sub-unity error correction term confirms a stable long-run equilibrium, with roughly two years required for full adjustment to an infrastructure shock.

These findings carry direct policy implications. First, given the dominance of the electricity coefficient, capital budget priority should shift toward power generation, transmission, and distribution, including regional grid reinforcement under the South-East Development Commission, ahead of further mobile-connectivity expansion where private substitution has already narrowed the effective deficit. Second, because pass-through from capital expenditure is weak relative to deficit's damage, state governments should prioritise execution reform, multi-year capital budgeting, ring-fenced infrastructure escrow accounts, and independent completion audits, over simply raising nominal allocations. Third, road rehabilitation along the Aba-Owerri and Onitsha-Awka corridors should be a second-tier priority. Fourth, because insecurity independently depresses output, infrastructure investment should be coordinated with, not substituted for, security stabilisation, since infrastructure built amid persistent insecurity is unlikely to deliver the productivity gains the production-function framework predicts.

The study is subject to limitations common to sub-national panel work in Nigeria, principally reliance on state-level data subject to measurement inconsistencies across the five states' Bureaus of Statistics, and the relatively short time dimension. Future research could extend the framework to a dynamic panel threshold specification testing for non-linearity, and incorporate firm-level survey data from Aba, Onitsha, and Nnewi to triangulate the macro-panel findings with micro-level evidence on self-generation costs and transport-cost pass-through.

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