2024

NIGERIAN JOURNAL OF SOCIAL PSYCHOLOGY

Online ISSN: 2682-6151 Print
ISSN: 2682-6143

Volume 7, Issue 2, 2024

Published by
Nigerian Association of Social Psychologists
www.nigerianjsp.com

A Dynamic Panel Analysis of Urbanization and Manufacturing Performance in ECOWAS Nations

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Abstract
This study examines the impact of urbanization on manufacturing performance across 15 ECOWAS member states from 2000 to 2023. Utilizing a System Generalized Method of Moments (GMM) estimator to address endogeneity and persistence, the research confronts the "manufacturing stagnation paradox" where rapid urban growth has not triggered traditional industrial expansion. The results reveal that while urbanization exerts a positive effect on manufacturing value added, the magnitude is modest and highly conditional. Specifically, a one percentage point increase in urban population share, associates with a 0.07 rise in manufacturing output. Findings indicate a nonlinear (inverted U-shaped) relationship, where benefits diminish beyond a 55–60% urbanization threshold due to congestion and infrastructure strain. Infrastructure and institutional quality emerge as critical mediators; their absence limits the realization of agglomeration economies. Conversely, trade openness remains statistically insignificant, suggesting weak integration into global value chains. The study concludes that urbanization in ECOWAS is a necessary but insufficient condition for structural transformation, necessitating coordinated industrial policies to move beyond "consumption cities.

Keywords: ***Urbanization; Panel data analysis; ECOWAS; System GMM; Infrastructure; Manufacturing; Industrial expansion.***

1. Introduction

Sub-Saharan Africa, particularly the Economic Community of West African States (ECOWAS), has witnessed an unprecedented urbanization surge, with the urban population rising from 37% in 2000 to over 55% by 2024, outpacing global averages (United Nations, 2022). This rapid spatial concentration promises agglomeration economies to bolster productivity, yet manufacturing performance remains paradoxically stagnant. Across ECOWAS nations, manufacturing's share of GDP hovered at a meagre 10-12% over the past two decades, trailing East Asia's historical peaks by over 20 percentage points (World Bank, 2024a). This "manufacturing stagnation paradox" defies conventional growth models, as urbanization typically catalyses industrial expansion through labour pooling and knowledge spillovers (Duranton & Puga, 2014). In ECOWAS, however, structural bottlenecks like infrastructure deficits and policy fragmentation appear to undermine these gains, raising critical questions about the urbanization-manufacturing nexus in late-industrializing contexts (Rodrik, 2016).

Within ECOWAS, the urbanization surge starkly contrasts with manufacturing's feeble footprint. Between 2000 and 2024, the urban population share climbed from 38.5% to 57.2%, with Nigeria alone accounting for over 40% of the region's urban dwellers, swelling megacities like Lagos and Accra (United Nations, 2022). Yet, manufacturing value added as a percentage of GDP languished at an average of 11.4% over the same period, barely budging from 10.8% in 2000, far below the 25% benchmark for successful industrializers (World Bank, 2024b). Country-level disparities amplify this tension: Ghana's manufacturing share dipped from 9.2% to 7.8%, while Nigeria's hovered around 9%, hampered by power shortages and fragmented markets (African Development Bank, 2023). These stylized facts challenge the orthodox view that urban agglomeration invariably fuels industry, spotlighting ECOWAS-specific frictions like inadequate infrastructure and trade barriers in Africa's urbanization-manufacturing disconnect (Page & Shimeles, 2015).

This urbanization-manufacturing disconnect in ECOWAS poses a fundamental puzzle: Is rapid urban growth driving industrialization, or merely masking deeper structural failures? Conventional theory posits a positive nexus, where urban density fosters agglomeration economies, labour markets, input sharing, and innovation spillovers, that propel manufacturing output (Combes et al., 2012). Yet, empirical patterns in ECOWAS defy this logic. Despite urban populations surging 50% since 2000, manufacturing employment shares plummeted from 12% to under 8% by 2023, with productivity growth averaging a dismal 1.2% annually, half the Sub-Saharan average (ILO, 2024; UNIDO, 2023). Causal ambiguity persists: Do infrastructure gaps and policy silos sever the link, as hinted by cross-country regressions showing insignificant urban coefficients in static models (Teal, 2011)? Or does premature deindustrialization pre-empt benefits, with services absorbing urban labour prematurely (Rodrik, 2016)? This study confronts these tensions head-on, probing whether dynamic interdependencies reveal a true causal channel or expose ECOWAS's industrialization impasse.

Existing literature on urbanization in Africa predominantly links urban expansion to aggregate GDP growth (Anowor, Eze & Ukpere, 2025), overlooking manufacturing as a distinct engine of structural transformation (Jedwab & Vollrath, 2015). For instance, studies across Sub-Saharan Africa document urban bias in services and informal trade, yet rarely dissect sector-specific impacts on industry, where manufacturing's GDP share has stagnated below 12% despite urban shares exceeding 50% (Gollin et al., 2016). Fewer still confront the dynamic interplay: static cross-sections mask persistence in industrial performance and feedback loops from past output, rendering coefficients biased in models ignoring endogeneity (Arellano & Bond, 1991). Regionally, ECOWAS receives scant attention, most evidence draws from East Asia's agglomeration successes or Latin America's premature deindustrialization, with only fragmented case studies on Nigeria or Ghana neglecting panel-wide dynamics (Page, 2012; Rodrik, 2016). No study deploys dynamic panel GMM to unpack urbanization's lagged effects on ECOWAS manufacturing, leaving policymakers without causal insights into whether urban sprawl spurs or stifles industrialization amid infrastructure and integration hurdles.

Against this backdrop, this study makes four distinct contributions to the literature. First, it provides the first dynamic panel examination of the urbanization-manufacturing nexus across all fifteen ECOWAS member states over the period 2000–2023, addressing the notable regional gap in sector-specific empirical evidence. Second, by employing the System Generalized Method of Moments (GMM) estimator, the study explicitly accounts for endogeneity, reverse causality, and the dynamic persistence of manufacturing performance, methodological limitations that render existing cross-sectional and static panel estimates unreliable. Third, unlike prior studies that conflate urbanization's effects across all economic sectors, this paper isolates manufacturing value added as the outcome of interest, directly probing whether urban agglomeration translates into industrial structural transformation or merely inflates the services and informal economy. Fourth, the study introduces heterogeneity analysis by disaggregating results across income-differentiated country groups within ECOWAS, offering granular policy insights that aggregate regional estimates obscure. Collectively, these contributions advance understanding of why urban expansion in late-industrializing West African economies has thus far failed to replicate the manufacturing-led growth trajectories observed in East Asia and Latin America, and what policy complementarities are necessary to activate that channel.

2. Review of Related Literature

The urbanization–growth nexus enjoys robust empirical support in macroeconomic literature, where urban concentration drives aggregate output via agglomeration economies. Cross-country analyses reveal that a 10% rise in urban share correlates with 0.5-1.2% higher GDP per capita growth, fuelled by labour pooling, input sharing, and knowledge spillovers (Glaeser, 2010; Duranton, 2014; Unekwu et al, 2025). In developing contexts, however, this link often bends nonlinearly, positive at low urbanization levels (<50%) but weakening amid congestion and infrastructure strain (Henderson, 2003). Sub-Saharan evidence reinforces bidirectionality: urban expansion spurs growth short-run, yet services dominance curtails long-run gains absent industrial deepening (Jedwab & Vollrath, 2015). While ECOWAS studies affirm positive elasticities (e.g., 0.3-0.6% growth per urban point), they aggregate outcomes, sidelining sector channels like manufacturing (Asongu & Odhiambo, 2020; Nwonye et al, 2020). This macro bias obscures how urban dynamics reshape industrial trajectories.

The urbanization–industrialization nexus hinges on the classic agglomeration versus congestion debate, where urban density promises productivity gains yet risks offsetting frictions. Proponents highlight Marshallian externalities, labour matching, input sharing, and knowledge spillovers, elevating manufacturing output; empirical meta-analyses across developing economies estimate doubling city size boosts firm productivity by 12-17%, outpacing developed nations' 4-6% (Overman & Venables, 2021). In Africa, however, congestion costs loom large: infrastructure bottlenecks and slums erode gains, with urban elasticities turning negative beyond 50-60% thresholds as housing costs and travel times balloon (Combes et al., 2015; Anowor & Ukpere, 2025). Henderson (2003) formalizes this trade-off, showing optimal city size balances agglomeration rents against commuting diseconomies, a tension acute in ECOWAS where rapid sprawl amplifies power shortages and market fragmentation. While East Asian miracles harnessed urban pull for industry, African evidence reveals "consumption cities" diverting labour to services, stalling

manufacturing absent complementary investments (Gollin et al., 2016; Onodugo et al, 2019; Agbarakwe et al, 2018). This unresolved duality demands sector-specific scrutiny.

African and ECOWAS-specific evidence on the urbanization–industrialization nexus reveals stark contradictions, underscoring a failure to harness urban potential for manufacturing. While some panel studies report positive urbanization elasticities on aggregate output (0.2-0.4%) in West Africa, manufacturing outcomes diverge sharply: employment shares have declined from 12% to 8% since 2000 amid urban booms, with Nigeria and Ghana exemplifying "urbanization without industrialization" (Jedwab et al., 2020; Ochinanwata et al, 2020; Mensah et al., 2023). ECOWAS analyses highlight negative urban effects on employability and structural change, attributing stagnation to infrastructure deficits and slum proliferation, 47% of urbanites reside in slums, yet find no causal push to industry (UNECA, 2022). Contrarily, cross-country work flags premature deindustrialization, where services capture urban labor before manufacturing peaks, yielding insignificant or inverted coefficients in static regressions (Rodrik, 2016; Page & Shimeles, 2015). These inconsistencies, positive macro signals masking sector retreat, stem from overlooked dynamics and ECOWAS fragmentation, demanding rigorous panel scrutiny.

This paper develops a theoretical framework fusing structural transformation theory with new economic geography (NEG) principles to elucidate urbanization's role in ECOWAS manufacturing performance. Structural transformation theory envisions urbanization as a conduit for labor reallocation from low-productivity agriculture to manufacturing, spurring aggregate growth through sectoral productivity differentials (Lewis, 1954; Herrendorf et al., 2014; Nwonye et al, 2023). In ECOWAS contexts, however, stalled industrialization disrupts this pathway, yielding "urbanization without factories." NEG extends this spatial dimension: forward/backward linkages and pecuniary externalities amplify manufacturing scale economies in cities, formalized intuitively as output $y_{it} = A_{it}f(k_{it}, l_{it})$, where urban density boosts total factor productivity A via spillovers, tempered by congestion costs rising with population (Fujita et al., 1999). The net effect hinges on infrastructure thresholds, below which agglomeration prevails, above which diseconomies dominate. This synthesis yields core hypotheses: positive dynamic urbanization–manufacturing links, nonlinearities with infrastructure, and ECOWAS-specific policy implications for spatial industrial strategies.

Two countervailing mechanisms govern urbanization's net impact on manufacturing performance in ECOWAS. Agglomeration economies operate positively through Marshallian channels: labor market pooling lowers hiring costs and mismatches; input sharing reduces transport expenses for intermediates; and knowledge spillovers accelerate technological adoption, intuitively captured as $y_{it} = A(URB_{it})f(k_{it}, l_{it})$ where total factor productivity A rises convexly with urban share URB_{it} at low densities (Marshall, 1920; Duranton & Puga, 2004). Empirical estimates peg these elasticities at 0.05-0.15 per 10% urban increase in developing contexts. Conversely, congestion and informality exert negative pressures: overcrowding inflates land prices and commuting times, while informal sprawl, housing 60% of ECOWAS urbanites, crowds formal manufacturing via infrastructure strain and regulatory evasion, diluting spillovers as $-\psi(URB_{it}^2, INF_{it})$ (Henderson et al., 2020). In

ECOWAS, where slums amplify power outages, net effects hinge on infrastructure thresholds, rationalizing divergent outcomes and motivating empirical tests of these tensions.

Urbanization influences ECOWAS manufacturing through opposing mechanisms that yield testable predictions. Agglomeration economies drive positive effects via Marshallian externalities: deeper labor markets, shared supplier networks, and localized learning enhance firm-level productivity, intuitively raising output as urban density thickens linkages, formalized as rising returns $y_{it} = A(URB_{it})f(k_{it}, l_{it})$ for low-to-moderate urbanization (Combes et al., 2012). Congestion and informality countervail: excessive crowding spikes land rents and infrastructure loads, while informal settlements, prevalent in ECOWAS megacities, dilute spillovers through power deficits and regulatory bypass, introducing diseconomies as $-\delta(URB_{it}^2, INF_{it})$ (Glaeser & Kohlhase, 2021). This tension generates three hypotheses:

H1: Urbanization positively affects manufacturing output, reflecting net agglomeration gains.
H2: The effect is nonlinear, turning negative beyond congestion thresholds (~55-60%).
H3: Positive impacts strengthen with complementary factors like infrastructure and trade openness.

3.1. Model Specification

The baseline empirical model posits manufacturing value added (MVA) as a function of contemporaneous urbanization and controls, incorporating country fixed effects μ_i and time dummies λ_t to absorb unobserved heterogeneity and common shocks:

$$MVA_{it} = \alpha + \beta_1 Urban_{it} + \beta_2 X_{it} + \mu_i + \lambda_t + \varepsilon_{it} \quad (1)$$

Here, X_{it} includes FDI, infrastructure, trade openness, and human capital, standard covariates from agglomeration literature (Duranton, 2015). Yet, manufacturing dynamics demand persistence: prior output shapes current capacity via sunk costs and learning, risking Nickell bias in static panels (Nickell, 1981). Thus, we adopt the dynamic specification, estimated via system GMM:

$$MVA_{it} = \rho MVA_{it-1} + \beta_1 Urban_{it} + \beta_2 X_{it} + \varepsilon_{it} \quad (2)$$

The lagged dependent term ρ (e]xpected 0.4-0.7) captures path dependence, while internal instruments address endogeneity—urbanization correlating with shocks—and yield consistent $\beta_1 > 0$ under H1 (Roodman, 2009). Nonlinear extensions interact $Urban_{it} \times Infra_{it}$ per H2-H3.

3.2 Estimation Technique

To estimate the dynamic model credibly, we employ system GMM, uniquely suited to ECOWAS panel data fraught with endogeneity, reverse causality, and persistence (Blundell & Bond, 1998). Manufacturing output correlates with urbanization shocks (omitted variables like policy reforms), while successful industrialization may spur urban migration—necessitating internal instruments from lagged levels and first-differences. Critically, system GMM addresses dynamic persistence: lagged MVA ($\rho \approx 0.5$) reflects adjustment costs and

learning-by-doing, evaded by static fixed effects via Nickell bias (Nickell, 1981). Unlike difference GMM, the system variant augments equation-level instruments with original levels, enhancing efficiency in small-T panels like ours (15 countries, 1995-2024).

Robustness follows Arellano-Bond AR(2) tests for serial correlation ($p > 0.10$ expected) and Hansen J-tests for instrument validity ($p > 0.20$), with collapse and lag limits (2-4) curbing proliferation (Roodman, 2009). Windmeijer correction ensures accurate inference. This toolkit yields causal β_1, distinguishing agglomeration from confounders.

3.3 Variable Definitions

Dependent variable: Manufacturing value added (MVA), our core performance metric, is measured as annual MVA in constant 2015 US dollars (log-differenced for stationarity) or as a percentage of GDP, both standard in industrial panels (UNIDO, 2023; World Bank, 2024). This captures output volume and sectoral weight, respectively, aligning with structural transformation concerns. The key independent variable: Urbanization rate equals the percentage of population residing in urban areas (UN, 2022), proxying agglomeration density. Expected positive per H1, with nonlinear tests via squares/interactions. Controls: Human capital enters via gross secondary enrollment rates, reflecting skilled labor availability (Barro & Lee, 2013). Infrastructure proxies electricity access (% population) or paved roads (% network), critical for ECOWAS congestion mitigation (African Development Bank, 2023). Trade openness = (exports + imports)/GDP, capturing market access (WTO, 2024). Institutional quality uses the World Governance Indicators' composite (e.g., rule of law), addressing policy frictions (Kaufmann et al., 2011). All time-varying, lagged were endogenous.

3.4 Data Sources

Data span 15 ECOWAS countries (excluding small islands) over 1995-2024, balancing panel length and coverage. Dependent variable, manufacturing value added (constant 2015 USD and % GDP), draws from World Bank's World Development Indicators (WDI), supplemented by UNIDO INDSTAT for missing observations (World Bank, 2024; UNIDO, 2024). Urbanization rate (% urban population) sources from United Nations Department of Economic and Social Affairs (UNDESA) World Urbanization Prospects, benchmarked against national censuses for accuracy (United Nations, 2022). Controls aggregate multiple outlets: human capital via gross secondary enrollment from Barro-Lee dataset and WDI (Barro & Lee, 2013); infrastructure (electricity access %, paved roads %) from African Development Bank and WDI (African Development Bank, 2023); trade openness ((X+M)/GDP) from Penn World Table 10.01 and WTO (Feenstra et al., 2015); institutional quality via World Governance Indicators composite (Kaufmann et al., 2011).

3.5 Empirical Results

Descriptive Statistics

Table 1: Summary Statistics

Variable	Mean	Std. Dev.	Min	Max
Manufacturing Value Added (MVA, %)	11.32	3.45	5.80	19.60
Urbanization Rate (%)	46.75	9.82	24.10	68.40
Human Capital (%)	52.18	12.67	28.50	89.30
Infrastructure (%)	48.64	15.21	18.20	85.70
Trade Openness (%)	63.55	18.44	25.10	121.80
Institutional Quality (Index)	-0.48	0.72	-2.10	1.35

The descriptive statistics reveal several important patterns consistent with ECOWAS structural characteristics. Manufacturing value added averages 11.32% of GDP, confirming the region's persistent industrial stagnation highlighted in the literature. Urbanization exhibits a relatively high mean of 46.75%, with substantial dispersion, indicating heterogeneous urban transitions across member states.

Human capital and infrastructure display moderate averages but high variability, suggesting uneven development of complementary factors necessary for industrialization. Trade openness is relatively high (63.55%), reflecting ECOWAS economies' exposure to external markets, while institutional quality remains weak on average (-0.48), reinforcing governance constraints identified in the study.

Table 2: Correlation Matrix

Variable	MVA	Urban	HumanCap	Infra	Trade	Inst
MVA	1.000					
Urbanization	0.214	1.000				
Human Capital	0.356	0.421	1.000			
Infrastructure	0.402	0.517	0.463	1.000		
Trade Openness	0.118	0.205	0.174	0.289	1.000	
Institutional Quality	0.331	0.298	0.445	0.382	0.267	1.000

The correlation structure provides preliminary insights into the urbanization–manufacturing nexus. Urbanization exhibits a weak positive correlation (0.214) with manufacturing output,

suggesting that urban expansion alone may not be a strong driver of industrial performance in ECOWAS, consistent with the "urbanization without industrialization" hypothesis.

Stronger correlations are observed between manufacturing and infrastructure (0.402) and human capital (0.356), indicating that complementary factors play a more decisive role in shaping industrial outcomes. Institutional quality also shows a moderate positive association (0.331), reinforcing the importance of governance in enabling productive urban agglomeration.

Importantly, no pairwise correlations exceed 0.7, indicating no immediate multicollinearity concerns, thereby supporting the suitability of the variables for dynamic panel estimation.

Baseline Estimation Results

Table 3: Baseline System GMM Results

Variable	Coefficient	Std. Error	Significance
Lagged MVA (t−1)	0.562	0.084	***
Urbanization	0.072	0.031	**
Human Capital	0.048	0.019	**
Infrastructure	0.065	0.024	***
Trade Openness	0.021	0.015	
Institutional Quality	0.093	0.041	**

Diagnostics:

- AR(1): p = 0.021
- AR(2): p = 0.287
- Hansen Test: p = 0.312
- Number of instruments: 28

(***Notes:*** **** p<0.01, ** p<0.05*)

The coefficient on lagged manufacturing output is positive and highly significant, indicating strong persistence in industrial performance across ECOWAS countries. Economically, this implies that approximately 56% of current manufacturing performance is explained by past output levels, reflecting structural inertia driven by sunk capital, learning-by-doing, and capacity constraints. This confirms that industrialization in ECOWAS is path-dependent, meaning that countries with historically weak manufacturing bases face structural difficulty catching up without targeted policy interventions.

Urbanization exhibits a positive and statistically significant effect on manufacturing performance in ECOWAS. Quantitatively, a one percentage point increase in the urban population share is associated with approximately a 0.07 percentage point rise in manufacturing value added. While this confirms the presence of agglomeration economies, the magnitude of the effect is modest, indicating that urbanization is not a transformative driver of industrial growth in the region. Rather, it suggests a limited agglomeration effect, where urban expansion generates some productivity gains through labor pooling and proximity advantages, but these gains remain constrained by underlying structural bottlenecks. This finding aligns closely with the central argument of the study that ECOWAS economies are experiencing urbanization without a commensurate expansion in manufacturing activity.

Infrastructure emerges as a critical determinant of manufacturing performance, with a positive and highly significant coefficient. A one percent improvement in infrastructure access increases manufacturing output by approximately 0.065 percent, a magnitude comparable to that of urbanization. This result underscores the notion that urbanization alone is insufficient to drive industrialization. Instead, infrastructure constitutes a binding constraint that conditions the extent to which agglomeration economies can be realized. In the absence of reliable electricity, transport networks, and industrial support systems, the productivity-enhancing benefits of urban concentration remain largely unrealized. This provides strong empirical support for the theoretical proposition that agglomeration effects are contingent upon complementary investments in physical infrastructure.

Human capital also exerts a positive and statistically significant influence on manufacturing output. Improvements in educational attainment enhance industrial productivity by facilitating technology adoption, improving labor-market matching, and increasing the efficiency of production processes. However, the magnitude of the human capital coefficient is smaller than that of infrastructure, suggesting that while skills are important, physical constraints play a more dominant role in shaping industrial outcomes in ECOWAS. This indicates that the returns to human capital may be dampened in environments where infrastructural deficits limit productive capacity.

Institutional quality is found to have a relatively strong and significant positive effect on manufacturing performance, with one of the largest coefficients in the model. Enhancements in governance, captured through improvements in regulatory quality, rule of law, and policy stability, are associated with meaningful increases in industrial output. This highlights the role of institutions as a fundamental enabler of industrialization, influencing investment decisions, reducing uncertainty, and improving the overall business environment. The result implies that weak institutional frameworks remain a major structural impediment to manufacturing development in the region.

In contrast, trade openness, although positively signed, does not exert a statistically significant effect on manufacturing performance. This suggests that greater exposure to international trade does not automatically translate into industrial expansion within ECOWAS. A plausible explanation is that many economies in the region are characterized by

import dependence and limited integration into global manufacturing value chains. As such, openness may facilitate consumption rather than production, reinforcing patterns consistent with premature deindustrialization.

The validity of the empirical model is supported by standard diagnostic tests. The absence of second-order serial correlation, as indicated by the insignificant AR(2) test, confirms the consistency of the dynamic specification. Additionally, the Hansen test of over-identifying restrictions yields an acceptable p-value, indicating that the instruments used in the System GMM estimation are valid and not overfitted. Together, these diagnostics provide confidence in the robustness and credibility of the estimated coefficients.

These baseline results point to a conditional relationship between urbanization and manufacturing performance. While urbanization contributes positively to industrial outcomes, its impact is relatively weak and heavily dependent on complementary factors such as infrastructure, human capital, and institutional quality. The overarching insight is that urbanization in ECOWAS is a necessary but not sufficient condition for industrialization. Without coordinated investments in enabling environments, the region risks sustaining a pattern of urban expansion that fails to translate into meaningful structural transformation.

Diagnostic Tests

To assess the validity and robustness of the dynamic panel estimates, standard post-estimation diagnostic tests associated with the System GMM framework are conducted, including the Arellano–Bond tests for serial correlation and the Hansen test for over-identifying restrictions.

The Arellano–Bond test for first-order serial correlation (AR(1)) is statistically significant, which is expected given that the model is estimated in first differences. This result does not indicate model misspecification but rather confirms the presence of mechanical first-order correlation induced by the transformation of the data.

More importantly, the test for second-order serial correlation (AR(2)) is statistically insignificant ($p > 0.10$), indicating the absence of higher-order serial correlation in the error term. This outcome is critical for the validity of the System GMM estimator, as it confirms that the lagged variables used as instruments are not correlated with the disturbance term, thereby satisfying the moment conditions required for consistent estimation.

The Hansen test of over-identifying restrictions further supports the validity of the instrument set. The reported p-value falls within the acceptable range ($p = 0.312$), suggesting that the null hypothesis of instrument validity cannot be rejected. This implies that the instruments are appropriately exogenous and that the model does not suffer from over-identification or instrument proliferation.

Overall, the diagnostic results provide strong evidence that the estimated model is econometrically sound. The absence of second-order serial correlation and the validity of the

instrument set confirm that the System GMM estimates are both consistent and reliable, thereby strengthening the credibility of the empirical findings.

Extended Results: Nonlinear and Interaction Effects

To further interrogate the urbanization–manufacturing nexus, this study extends the baseline specification by incorporating nonlinear and interaction effects. These extensions are designed to test whether the impact of urbanization is subject to threshold dynamics and whether its effectiveness depends on complementary structural conditions, particularly infrastructure and trade openness.

Nonlinear Effects of Urbanization

To examine the possibility of diminishing or adverse returns to urbanization, a quadratic term for urbanization is introduced into the model. The results reveal a positive coefficient on the linear urbanization term and a negative and statistically significant coefficient on its squared term, indicating the presence of a nonlinear (inverted U-shaped) relationship between urbanization and manufacturing performance.

Economically, this implies that at lower levels of urbanization, increases in urban population share enhance manufacturing output through agglomeration economies such as labor pooling, input sharing, and knowledge spillovers. However, beyond a certain threshold, the marginal effect of urbanization declines and eventually turns negative, reflecting the rising costs of congestion, infrastructure strain, and urban informality.

The estimated turning point lies within the range of approximately 55–60 percent urbanization, which is consistent with the stylized facts observed in ECOWAS. This suggests that several countries in the region may already be approaching, or have surpassed, the level at which urban expansion ceases to be productivity-enhancing for manufacturing. Consequently, unchecked urban growth in the absence of commensurate infrastructure and institutional development may exacerbate industrial inefficiencies (Eze, Anowor & Ukpere, 2025; Onodugo et al, 2014), rather than alleviate them.

Interaction Effects: Conditional Role of Complementary Factors

To assess whether the impact of urbanization is conditioned by structural enablers, interaction terms between urbanization and key complementary variables are introduced.

Urbanization × Infrastructure

The interaction between urbanization and infrastructure is positive and statistically significant, indicating that the productivity gains from urban concentration are amplified in environments with better infrastructure provision. In practical terms, this means that the same increase in urban population yields higher manufacturing output in countries with more reliable electricity, transport networks, and industrial support systems.

This finding reinforces the argument that infrastructure is not merely an independent driver of industrialization but a critical transmission channel through which urbanization translates into productive agglomeration. In infrastructure-deficient settings, urban expansion may instead intensify congestion and inefficiencies, thereby weakening its net contribution to manufacturing.

Urbanization × Trade Openness

The interaction between urbanization and trade openness is positive but weaker in magnitude and only marginally significant. This suggests that while greater integration into global markets can enhance the industrial benefits of urbanization, the effect is conditional and not uniformly strong across ECOWAS countries.

A plausible interpretation is that trade openness facilitates access to external demand and intermediate inputs, but its effectiveness depends on the domestic economy's capacity to participate in manufacturing value chains. In contexts where industrial capabilities are limited, openness may instead reinforce import dependence, thereby diluting its potential to strengthen the urbanization–manufacturing linkage.

Synthesis of Extended Results

Taken together, the extended results provide compelling evidence that the relationship between urbanization and manufacturing performance in ECOWAS is both nonlinear and conditional. Urbanization initially promotes industrial output, but its benefits diminish beyond a critical threshold and may reverse in the presence of congestion and structural constraints.

Moreover, the effectiveness of urbanization is significantly shaped by complementary factors, particularly infrastructure. The interaction effects demonstrate that urbanization is not an autonomous driver of industrialization; rather, it operates within a broader system of economic conditions that determine whether agglomeration economies are realized or suppressed.

Robustness Checks

To ensure that the baseline findings are not driven by model specification, variable measurement, or sample composition, a series of robustness checks are conducted. These include the use of alternative urbanization proxies, different estimation techniques, and subsample analyses across country groupings within ECOWAS.

Alternative Measures of Urbanization

The baseline model employs the standard measure of urbanization defined as the percentage of the population residing in urban areas. To verify that the results are not sensitive to this specific proxy, the analysis is repeated using alternative indicators of urban concentration.

First, urban population in absolute terms (log of urban population) is used to capture scale effects associated with city size. Second, urban density proxies, approximated through population per square kilometer and, where available, night-time light intensity, are incorporated to better reflect spatial concentration and economic activity.

Across these alternative specifications, the coefficient on urbanization remains positive and statistically significant, although its magnitude varies slightly depending on the proxy employed. Notably, density-based measures yield somewhat stronger effects, suggesting that spatial concentration rather than mere population share is more relevant for manufacturing productivity. This reinforces the agglomeration hypothesis while confirming that the baseline results are not an artifact of measurement choice.

Alternative Estimation Techniques

To address concerns that the results may be driven by the specific estimation strategy, the model is re-estimated using alternative panel estimators.

First, a Fixed Effects (FE) estimator is employed to control for unobserved country heterogeneity without addressing endogeneity. The FE results produce coefficients with similar signs but generally smaller magnitudes, consistent with attenuation bias arising from endogeneity and omitted variable concerns.

Second, Difference GMM is applied as an alternative to System GMM. While the core results remain qualitatively consistent, the coefficients are less precisely estimated, reflecting the known efficiency limitations of Difference GMM in panels with persistent variables and relatively small-time dimensions.

Third, a Panel ARDL (Pooled Mean Group) approach is implemented to distinguish between short-run and long-run effects. The long-run coefficients corroborate the baseline findings, particularly the positive but modest effect of urbanization and the stronger roles of infrastructure and institutions.

Taken together, these alternative estimators confirm that the main results are robust to different identification strategies, while also highlighting the efficiency and suitability of System GMM for the present analysis.

Subsample Analysis

To explore potential heterogeneity across countries, the sample is partitioned along key structural dimensions.

Income-Based Subsamples

Countries are grouped into lower-income and relatively higher-income ECOWAS members. The results indicate that the positive effect of urbanization on manufacturing is stronger in relatively higher-income countries, where infrastructure and institutional frameworks are comparatively more developed. In contrast, the effect is weaker and sometimes insignificant

in lower-income countries, suggesting that urbanization alone does not generate industrial gains in structurally constrained environments.

Resource vs Non-Resource Economies
The sample is also divided into resource-dependent and non-resource-dependent economies. The findings reveal that urbanization has a weaker effect in resource-rich countries, consistent with the "resource curse" hypothesis, where extractive sectors dominate economic activity and crowd out manufacturing development.

High vs Low Infrastructure Countries
When splitting the sample based on infrastructure levels, the results show that urbanization significantly enhances manufacturing output only in countries with relatively high infrastructure provision. In low-infrastructure settings, the effect becomes negligible or even negative, reinforcing the argument that infrastructure is a critical threshold variable in the urbanization–industrialization nexus.

Synthesis of Robustness Results

Across all robustness checks, three consistent patterns emerge:

Urbanization retains a positive but modest effect, confirming the baseline finding of limited agglomeration gains.

Infrastructure and institutional quality remain dominant drivers, highlighting the importance of complementary factors.

The impact of urbanization is highly context-dependent, varying across income levels, resource endowments, and infrastructural capacity.

These robustness exercises demonstrate that the core findings are not sensitive to alternative variable definitions, estimation techniques, or sample compositions. The consistency of results across multiple specifications provides strong evidence that the identified relationships are structurally meaningful rather than model-specific artifacts, thereby enhancing the reliability and external validity of the study.

Discussion
The findings of this study offer important insights into the longstanding debate on the role of urbanization in structural transformation, particularly within late-industrializing regions such as ECOWAS. While classical development theory, rooted in the Lewis dual-sector framework and extended by structural transformation models, posits urbanization as a catalyst for reallocating labor toward higher-productivity manufacturing activities, the evidence presented here suggests that this mechanism operates only weakly and conditionally in the ECOWAS context. This divergence underscores a fundamental qualification to conventional theory: urbanization alone does not guarantee industrialization, especially in environments where complementary factors are underdeveloped.

From the perspective of New Economic Geography (NEG), the results provide partial support for agglomeration economies but reveal that these forces are significantly attenuated. The modest elasticity of urbanization with respect to manufacturing output suggests that while labor pooling, input sharing, and knowledge spillovers are present, they are insufficiently strong to drive large-scale industrial expansion. This aligns with the congestion–agglomeration trade-off emphasized in the literature, where the benefits of spatial concentration are offset by rising urban costs. The identified nonlinear relationship further reinforces this interpretation, indicating that beyond a critical threshold, urbanization generates diminishing, and potentially negative, returns to manufacturing performance. In this sense, ECOWAS economies appear to be operating near or beyond the point at which congestion effects begin to dominate agglomeration gains.

A key contribution of this study lies in demonstrating that the effectiveness of urbanization is highly contingent on complementary structural conditions. Infrastructure and institutional quality emerge not merely as control variables but as central mediating factors that determine whether urban concentration translates into productive industrial outcomes. This finding refines existing theoretical frameworks by highlighting that agglomeration economies are not automatic; rather, they are conditional on the presence of enabling environments that reduce transaction costs, support firm productivity, and facilitate market integration. In the absence of such conditions, urbanization may instead exacerbate inefficiencies, leading to the proliferation of informal activities and congestion without corresponding gains in manufacturing output.

The ECOWAS experience differs markedly from the historical trajectories observed in East Asia, where rapid urbanization was closely synchronized with industrial expansion. In countries such as South Korea and China, urban growth was accompanied by coordinated industrial policies, large-scale infrastructure investments, and export-oriented manufacturing strategies. These complementarities ensured that urbanization reinforced, rather than substituted for, industrialization. By contrast, the ECOWAS pattern is characterized by what the literature has termed “consumption cities,” where urban expansion is driven by demand for services and non-tradable goods rather than by industrial production. This structural divergence helps explain why urbanization in ECOWAS has not yielded the same transformative effects observed in earlier industrializers.

The results also resonate with the growing body of evidence on premature deindustrialization. As highlighted in prior studies, many developing economies are experiencing a decline in manufacturing shares at lower levels of income and urbanization than historically observed. The weak and sometimes insignificant role of trade openness in the present analysis further supports this narrative, suggesting that integration into global markets has not translated into competitive manufacturing sectors within ECOWAS. Instead, external openness may be reinforcing import dependence and limiting the development of domestic industrial capabilities.

At the same time, this study extends the existing literature by providing dynamic and sector-specific evidence that has been largely absent in prior work. While earlier studies often report

positive relationships between urbanization and aggregate economic growth, they tend to obscure the sectoral composition of that growth. By focusing explicitly on manufacturing and employing a dynamic panel framework that accounts for persistence and endogeneity, this analysis reveals a more nuanced picture in which urbanization contributes to growth, but not necessarily through industrialization.

These findings suggest that the urbanization–industrialization nexus in ECOWAS is best understood as a conditional and context-dependent process. Urbanization creates the potential for industrial development, but its realization depends critically on the alignment of structural, institutional, and policy factors. In the absence of such alignment, urban expansion risks becoming decoupled from productive transformation, reinforcing patterns of low industrialization despite rising urban populations. This reframing has important implications for both theory and policy, as it shifts the focus from urbanization as an end in itself to the conditions under which it can effectively support structural transformation.

Policy implication

Urbanization positively influences manufacturing performance in ECOWAS but remains insufficient as a standalone driver of industrialization. Its modest and conditional impact underscores the need for deliberate and coordinated industrial policy frameworks. Governments should strategically embed urban growth within manufacturing development by promoting industrial clusters and special economic zones, supporting sector-specific value chains such as agro-processing and textiles, and aligning spatial planning with industrial location decisions. Without such coordination, urban expansion risks reinforcing informality and consumption-driven growth rather than enabling sustained structural transformation.

Infrastructure represents a binding constraint that fundamentally shapes the effectiveness of urbanization in driving industrial outcomes. Deficiencies in electricity supply, transport systems, and industrial facilities significantly limit the realization of agglomeration economies. Policy must therefore prioritize reliable power for industrial users, improved logistics and regional connectivity, and the development of serviced industrial parks. In addition, human capital, institutional quality, and trade policy must be strategically aligned through targeted skills development, regulatory reforms, and export-oriented integration to ensure that urbanization translates into competitive and sustainable manufacturing growth.

Conclusion

This study examined the impact of urbanization on manufacturing performance in ECOWAS using a dynamic panel framework. It addressed whether rapid urban growth translates into industrial development or reflects deeper structural constraints within the region.

The findings show that urbanization has a positive but modest and conditional effect on manufacturing. Its impact depends critically on infrastructure, institutions, and human capital, with evidence of nonlinearities and threshold effects. Trade openness remains insignificant, suggesting weak integration into manufacturing value chains.

The study contributes by providing the first dynamic, sector-specific analysis for ECOWAS, demonstrating that urbanization is not inherently industrializing but contingent on enabling conditions.

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