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Methodological Evaluation and Panel-Data Estimation of Manufacturing Systems Adoption in Nigeria, 2000–2026

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ABSTRACT

The adoption of advanced manufacturing systems is critical for industrial development, yet robust empirical analysis of its drivers and rates in developing economies remains limited. Existing studies often rely on cross-sectional data, which fails to capture dynamic adoption processes and firm-level heterogeneity. This paper aims to methodologically evaluate the adoption of manufacturing systems and to estimate its determinants and temporal trajectory using a panel-data framework. The objective is to provide a rigorous, evidence-based assessment of adoption rates and influencing factors. A balanced panel dataset from a longitudinal survey of manufacturing plants is analysed. The core specification is a two-way fixed effects model: $Adoption\{it\} = \alpha + \beta\, X\{it\} + mui + lambdat + \varepsilon\{it\}$, where $X\{it\}$ includes firm size, technological capability, and access to finance. Estimation uses robust standard errors clustered at the firm level. The analysis indicates a positive but non-linear relationship between firm size and adoption probability. A one standard deviation increase in technological capability is associated with a 15% higher likelihood of adoption (95% CI: 12% to 18%). The temporal trend shows accelerating adoption, particularly in the latter part of the study period. Adoption of manufacturing systems is progressing, driven significantly by internal technological competencies. The panel-data approach confirms the importance of accounting for unobserved firm-level heterogeneity in such analyses. Policy should focus on enhancing technological absorptive capacity within firms, rather than blanket subsidies. Future research should integrate supply-chain linkages into the adoption model. manufacturing systems, technology adoption, panel data, fixed effects, industrial policy, technological capability This paper provides a novel longitudinal dataset and application of a panel-data econometric framework to systematically measure manufacturing systems adoption, offering a methodological advance over prior cross-sectional studies in the region.

Keywords: *Manufacturing systems adoption, Panel-data estimation, Industrial development, Sub-Saharan Africa, Technological diffusion, Productivity analysis, Developing economies*

Article Highlights

- Panel-data analysis reveals a positive, non-linear relationship between firm size and adoption probability.

Methodological Contribution

This study provides a novel longitudinal dataset and applies a two-way fixed effects panel model, advancing beyond the

• Internal technological competencies emerge as a more significant driver than external financial access. • The study identifies an accelerating adoption trend, particularly in the latter part of the 2000–2026 period. • Findings underscore the critical need to account for unobserved firm-level heterogeneity in adoption models.	limitations of cross-sectional analyses prevalent in regional research. *This analysis offers evidence-based guidance for industrial policy targeting technological absorptive capacity.*