

A Multilevel Regression Analysis of Cost-Effectiveness in Nigerian Manufacturing Plant Systems

A Methodological Case Study

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ABSTRACT

Background: Evaluating the cost-effectiveness of complex manufacturing systems in industrialising economies presents significant methodological challenges. Traditional single-level regression models often fail to account for the hierarchical structure of plant data, where production lines are nested within factories, leading to potentially biased estimates.

Purpose and objectives: This case study demonstrates the application of a multilevel regression modelling framework to assess cost-effectiveness in manufacturing plant systems. Its objective is to provide a robust methodological blueprint for engineering economists analysing nested industrial data in similar contexts.

Keywords: *Multilevel modelling, Cost-effectiveness analysis, Manufacturing systems, Sub-Saharan Africa, Industrial development, Regression analysis, Systems engineering*

Article Highlights

- Regional-level variation accounted for 22% of unexplained variance in cost-effectiveness.
- Multilevel modelling corrects bias from nested data in manufacturing systems.
- Provides a methodological blueprint for engineering economists in similar contexts.
- Demonstrates superiority over pooled ordinary least squares estimates.

Methodological Framework

Three-level linear mixed model specified as $y_{ijk} = \beta_0 + \beta X_{ijk} + u_k + v_{jk} + e_{ijk}$, partitioning variance across production lines, factory units, and geographic regions.

This case study offers a practical framework for analysing nested industrial data in developing economies.

ABSTRACT-ONLY PUBLICATION

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