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A Multilevel Regression Analysis for Cost-Effectiveness Diagnostics in South African Manufacturing Plant Systems (2000–2026)

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ABSTRACT

Background: Persistent inefficiencies in manufacturing plant systems undermine industrial competitiveness and policy efficacy. Existing cost-effectiveness analyses often fail to account for the hierarchical structure of plant data, where operational units are nested within firms and regions, leading to potentially biased estimates.

Purpose and objectives: This policy analysis develops and applies a novel multilevel regression framework to diagnose cost-effectiveness in manufacturing systems. It aims to quantify the variance attributable to different organisational levels and identify key leverage points for policy intervention.

Keywords: *Multilevel regression, Cost-effectiveness analysis, Manufacturing systems, Industrial policy, Sub-Saharan Africa, Policy evaluation, Engineering economics*

Article Highlights

- A novel multilevel regression framework decomposes cost drivers across plants, firms, and regions.
- Regional industrial ecosystems account for the largest share of variance in manufacturing cost inefficiency.
- Findings challenge firm-centric policy models, advocating for interventions at the regional network scale.

Methodological Insight

The analysis employs a three-level random intercepts model to partition variance and identify cost drivers at plant, firm, and regional levels.

This analysis provides a diagnostic tool for targeting industrial policy across spatial and organisational scales.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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