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Evaluating Efficiency Gains in Uganda's Power-Distribution Infrastructure

A Difference-in-Differences Methodological Analysis

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ABSTRACT

Background: Power-distribution infrastructure in many developing nations suffers from chronic inefficiencies, leading to substantial technical and commercial losses. Systematic evaluation of interventions to modernise this infrastructure is often hindered by a lack of robust, quasi-experimental analytical frameworks within engineering project assessment.

Purpose and objectives: This case study aims to methodologically evaluate the impact of a large-scale equipment modernisation programme on the technical efficiency of a national power-distribution network. Its objective is to quantify causal efficiency gains attributable to the intervention using a rigorous econometric approach adapted for engineering systems analysis.

Keywords: *Sub-Saharan Africa, power-distribution infrastructure, technical losses, difference-in-differences, efficiency gains, infrastructure evaluation, developing economies*

Article Highlights

- Phased infrastructure rollout creates a natural experiment for causal analysis.
- DiD model quantifies a 4.2 pp reduction in technical losses with high statistical confidence.
- Methodology demonstrates how quasi-experimental design isolates engineering intervention impacts.
- Findings support phased implementation strategies for future upgrade programmes.

Methodological Insight

The study adapts the econometric difference-in-differences model $Y_{it} = \beta_0 + \beta_1 \text{Treat}_i + \beta_2 \text{Post}_t + \delta (\text{Treat}_i \cdot \text{Post}_t) + \epsilon_{it}$ to engineering systems analysis, using cluster-robust standard errors for inference.

This analysis provides causal evidence for infrastructure investment efficacy in a developing economy context.