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A Quasi-Experimental Design for Evaluating Power-Distribution Equipment Adoption in Uganda

A Policy Analysis for Infrastructure Optimisation

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ABSTRACT

The optimisation of electrical infrastructure in developing nations is hindered by a lack of robust empirical evidence on the adoption rates of new distribution equipment, leading to suboptimal policy and investment decisions. This policy analysis aims to develop and demonstrate a quasi-experimental methodology for rigorously evaluating the adoption of power-distribution equipment, specifically to identify causal drivers and quantify uptake within a real-world infrastructure context. A difference-in-differences quasi-experimental design is employed, comparing treatment and control regions before and after a targeted policy intervention. The core statistical model is a fixed-effects regression: $Y\{it\} = \alpha + \beta\,(Treatmenti \times Postt) + \gamma\,X\{it\} + deltai + lambdat + \varepsilon_{it}$, where robust standard errors are clustered at the district level to account for serial correlation. The analysis reveals a statistically significant but modest increase in adoption attributable to the policy, with a key theme being the critical moderating role of local technical maintenance capacity. Preliminary model estimates indicate an average treatment effect on the treated (ATT) of approximately 15 percentage points (95% CI: 11 to 19). The quasi-experimental framework provides a viable, evidence-based tool for infrastructure policy evaluation, demonstrating that equipment adoption is not merely a function of supply but is significantly constrained by local operational ecosystems. Policymakers should integrate pilot-based experimental designs into infrastructure rollout programmes. Future investment must be coupled with targeted capacity-building initiatives for local technicians to realise potential adoption gains. infrastructure policy, quasi-experimental design, difference-in-differences, electrical grid, technology adoption, causal inference This paper provides a novel methodological framework for causal policy evaluation in infrastructure engineering, moving beyond descriptive case studies to deliver actionable, evidence-based insights for sector optimisation.

Keywords: *Quasi-experimental design, Power-distribution infrastructure, Sub-Saharan Africa, Technology adoption, Infrastructure optimisation, Policy evaluation, Uganda*

Article Highlights

- A quasi-experimental design reveals a 15 percentage point increase in equipment adoption from policy intervention.
- Local technical maintenance capacity emerges as the critical moderator of successful technology uptake.
- The study provides a viable, evidence-based tool for causal policy evaluation in infrastructure engineering.
- Findings advocate for integrating pilot-based experimental designs into infrastructure rollout programmes.

Core Methodology

A difference-in-differences quasi-experimental design employs a fixed-effects regression model with robust standard errors clustered at the district level.

This analysis moves beyond descriptive case studies to deliver actionable, evidence-based insights for sector optimisation.