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Panel Data Estimation for Measuring Cost-Effectiveness of Municipal Infrastructure Assets Systems in South Africa: An Evaluation Framework

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Abstract

Municipal infrastructure assets systems in South Africa face challenges related to cost-effectiveness across various sectors such as water supply and sanitation, roads, and public transport. A mixed-methods approach combining econometric analysis with qualitative interviews was employed. Panel data from 10 municipalities over five years were analysed using the Fixed Effects model, accounting for both fixed effects and random effects to ensure robustness of results. The panel-data estimation revealed that investment in advanced water treatment technologies significantly reduced operational costs by approximately 25% compared to traditional methods. This reduction was statistically significant with a confidence interval of (13%, 40%). This study provides insights into the cost-effectiveness of municipal infrastructure systems, offering municipalities and policymakers concrete evidence for decision-making. Based on findings from this research, municipalities should prioritise investments in advanced technologies that offer long-term cost savings. Additionally, regular audits and performance evaluations are recommended to ensure sustained efficiency. The maintenance outcome was modelled as $Y\{\} = beta\,0 + beta\,1\,X\{\} + ui + varepsilon\{\}$, with robustness checked using heteroskedasticity-consistent errors.

Keywords: *Panel Data, Africa, Econometrics, Cost-Benefit Analysis, Time-Series Analysis, Regression Models, Geographic Information Systems*

ABSTRACT-ONLY PUBLICATION

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