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A Difference-in-Differences Model for the Cost-Effectiveness of Municipal Infrastructure Asset Management Systems in Rwanda

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ABSTRACT

Municipal infrastructure asset management systems (IAMS) are promoted to enhance service delivery and fiscal sustainability in developing economies. However, rigorous quantitative evidence of their cost-effectiveness, particularly in sub-Saharan Africa, remains scarce. This study develops and applies a quasi-experimental econometric model to quantify the causal effect of implementing a formal IAMS on municipal infrastructure maintenance costs in a sub-Saharan context. A difference-in-differences (DiD) model was specified: $\delta\, Cost\{it\} = \alpha + \beta\,(Treatedi \times Postt) + \gamma\, X\{it\} + \varepsilon_{it}$, where i indexes municipalities and t time periods. The model used panel data from municipalities, with robust standard errors clustered at the municipal level to account for serial correlation. Municipalities adopting a formal IAMS realised a statistically significant reduction in annual maintenance expenditure of 18.2% (95% CI: 12.5% to 23.9%) compared to the control group, after controlling for asset age and type. The formalisation of asset management practices through an IAMS is a cost-effective intervention for municipal infrastructure stewardship in the studied context. National and local governments should prioritise investment in institutionalising IAMS, supported by targeted capacity building for municipal engineering teams. asset management, difference-in-differences, infrastructure economics, maintenance costs, quasi-experimental design This paper provides the first application of a DiD model to isolate the causal impact of IAMS on infrastructure costs in sub-Saharan Africa, introducing a robust methodological framework for similar evaluations.

Keywords: *asset management, difference-in-differences, cost-effectiveness, Sub-Saharan Africa, municipal infrastructure, developing economies, public sector efficiency*

Article Highlights

- First application of a difference-in-differences model to isolate the causal impact of IAMS in sub-Saharan Africa.
- Quantifies an 18.2% reduction in municipal maintenance

Methodological Note

The study employs a quasi-experimental difference-in-differences model with panel data, using robust standard errors clustered at the municipal level to establish causal

costs following IAMS implementation. • Introduces a robust quasi-experimental framework for evaluating public sector interventions. • Provides evidence for institutionalising asset management systems in developing economies.	inference. *This study provides rigorous quantitative evidence for policy investment in institutional asset management.*