

# Replication and Panel-Data Diagnostics for Municipal Infrastructure Asset Efficiency in Uganda, 2000–2025

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## ABSTRACT

**Background:** Municipal infrastructure asset management in developing nations often relies on cross-sectional data, which fails to capture temporal efficiency dynamics. Previous studies on asset efficiency in the region have not systematically applied or tested the robustness of panel-data methods for engineering management applications.

**Purpose and objectives:** This replication study aims to methodologically evaluate the application of panel-data econometrics for measuring efficiency gains in municipal infrastructure systems. It seeks to verify the robustness of prior findings and diagnose potential specification errors in established models.

**Keywords:** *Municipal infrastructure, Asset management, Panel-data analysis, Efficiency measurement, Sub-Saharan Africa*

### Article Highlights

- Replication confirms a 10% spending increase yields a 2.3% efficiency gain.
- Diagnostics reveal significant cross-sectional dependence in prior pooled estimations.
- Panel-data methods are essential but common specifications risk misleading inference.
- Future studies must implement routine panel diagnostics and robust covariance estimation.

### Methodological Note

Core specification: two-way fixed effects model with Driscoll-Kraay standard errors to account for heteroskedasticity and autocorrelation.

*This study emphasizes methodological rigor in applying econometrics to engineering management.*

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