

# A Multilevel Regression Framework for Efficiency Diagnostics in Senegalese Manufacturing Systems

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## ABSTRACT

**Background:** Efficiency diagnostics in manufacturing systems within developing economies often rely on single-level analyses, which fail to account for the hierarchical structure of plant data. This limitation obscures the distinct influences of firm-level management and sector-wide technological factors on performance.

**Purpose and objectives:** This working paper develops and applies a multilevel regression framework to decompose efficiency variances in Senegalese manufacturing, aiming to quantify the proportion of performance variation attributable to firm versus within-firm effects.

**Keywords:** *Multilevel modelling, Efficiency diagnostics, Sub-Saharan Africa, Manufacturing systems, Hierarchical data analysis*

### Article Highlights

- Firm-level heterogeneities dominate efficiency variation in Senegalese manufacturing.
- Multilevel modelling decomposes variance between firm and plant-level effects.
- Random intercept for capital intensity shows significant positive association with output.
- Findings advocate for firm-wide capability building over sector-level interventions.

### Methodological Note

Uses a two-level hierarchical linear model with restricted maximum likelihood estimation and robust standard errors.

*This working paper presents a novel diagnostic framework for hierarchical manufacturing data.*

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