

A Bayesian Hierarchical Model for Manufacturing Systems Efficiency Diagnostics in the Ethiopian Industrial Sector (2000–2026)

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ABSTRACT

Background: The industrial sector in Ethiopia has undergone significant expansion, yet systematic, data-driven diagnostics of manufacturing systems efficiency remain underdeveloped. Existing methods often fail to account for plant-level heterogeneity and the hierarchical structure of industrial data, limiting actionable insights for engineering management.

Purpose and objectives: This study aims to develop and validate a novel Bayesian hierarchical model to diagnose efficiency in manufacturing systems, quantifying gains and identifying key drivers of performance variation across plants and subsectors.

Keywords: *Bayesian hierarchical modelling, manufacturing systems efficiency, industrial diagnostics, Sub-Saharan Africa, data envelopment analysis, stochastic frontier analysis, productivity measurement*

Article Highlights

- Bayesian hierarchical model quantifies plant- and subsector-level efficiency variation.
- Superior model fit over conventional non-hierarchical diagnostic approaches.
- Provides a robust probabilistic framework for prioritising industrial interventions.
- First application yielding tailored efficiency estimates for Ethiopian manufacturing.

Methodological Contribution

Introduces a novel Bayesian hierarchical stochastic frontier model, specifically formulated for the diagnostic analysis of manufacturing systems with multi-level data structures.

This study presents a probabilistic diagnostic tool for engineering management and industrial policy.

ABSTRACT-ONLY PUBLICATION

This is an abstract-only publication. The complete research paper with full methodology, results, discussion, and references is available upon request.

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