

A Bayesian Hierarchical Model for Evaluating the Adoption Rates of Industrial Machinery Systems in Ghana

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ABSTRACT

Background: The modernisation of industrial sectors in developing economies is contingent on the effective adoption of advanced machinery systems. However, reliable, quantitative frameworks for assessing the penetration and utilisation rates of such capital-intensive technologies are lacking, hindering strategic investment and policy formulation.

Purpose and objectives: This study develops and applies a novel Bayesian hierarchical model to evaluate the adoption rates of industrial machinery fleets, specifically within the construction and manufacturing sectors. The objective is to provide a robust methodological tool that quantifies adoption levels while accounting for sectoral and regional heterogeneity.

Keywords: *Bayesian hierarchical modelling, technology adoption, industrial machinery, Sub-Saharan Africa, developing economies, manufacturing modernisation*

Article Highlights

- Bayesian hierarchical model quantifies machinery adoption, accounting for sectoral and regional heterogeneity.
- Firm size and access to specialised maintenance are the most influential predictors of adoption.
- Findings challenge uniform policy approaches, highlighting the need for regionally tailored initiatives.
- Provides a robust statistical framework for measuring technology penetration in capital-intensive sectors.

Methodological Contribution

The study employs a Bayesian hierarchical logistic regression with sector and region as random effects, estimated via Hamiltonian Monte Carlo, to capture latent heterogeneity in adoption probabilities.

This study offers a novel quantitative framework for assessing industrial technology uptake in Sub-Saharan Africa.



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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