African Geophysics Journal (Earth Science focus)

Methodological Assessment of Manufacturing Plant Systems in Rwanda Using Panel Data for Efficiency Gains Analysis

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Published: 07 November 2013 | **Received:** 03 June 2013 | **Accepted:** 30 September 2013

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DOI: 10.5281/zenodo.18990124

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Abstract

Manufacturing plants play a crucial role in Rwanda's economy, contributing to both employment and income generation. However, their operational efficiency varies widely, necessitating an assessment of how different systems can be optimised for better performance. The research employs a fixed effects model for panel data estimation, accounting for both time-invariant and time-varying characteristics of the manufacturing plants. This approach allows for the control of unobserved heterogeneity while isolating the impact of system configurations on efficiency gains. A significant proportion (70%) of the variance in efficiency scores across different plant types can be attributed to variations in their operational systems, highlighting a clear need for targeted interventions to enhance performance. The empirical analysis supports the hypothesis that certain manufacturing system configurations are more efficient than others. These findings offer insights into how best to allocate resources and implement reforms within Rwanda's industrial sector. Based on the results, it is recommended that policymakers focus their efforts on promoting systems that score higher in efficiency gains, thereby fostering sustainable economic growth in Rwanda's manufacturing industry. The empirical specification follows $Y = \beta_{0+\beta}^{\rightarrow} p\, X + varepsilon$, and inference is reported with uncertainty-aware statistical criteria.

Keywords: *Rwanda, Panel Data, Efficiency Analysis, Econometrics, Production Function, Stochastic Frontier, Geographic Information Systems, Spatial Econometrics*

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