

A Time-Series Forecasting Model for Manufacturing Efficiency Gains

A Policy Analysis of Ghanaian Plant Systems (2000–2026)

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ABSTRACT

Manufacturing efficiency is a critical determinant of industrial growth and structural development. In many developing economies, a persistent gap exists between policy ambitions for industrial transformation and the empirical measurement of efficiency gains at the plant level, hindering effective policy evaluation. This policy analysis aims to develop and evaluate a novel time-series forecasting model to quantify manufacturing efficiency gains, providing a robust methodological tool for assessing the impact of industrial policies on plant-level systems. The analysis employs a state-space modelling framework, integrating plant-level operational data. The core forecasting model is specified as $yt = \mu t + \beta Xt + \text{epsilont}$, where μ_t is a local linear trend component. Model parameters were estimated using maximum likelihood, with inference based on robust standard errors to account for heteroskedasticity. The model identifies a positive but decelerating trend in technical efficiency gains across the studied period, with a notable structural break. Forecasts indicate that, under current policy conditions, the rate of annual efficiency improvement is likely to plateau at approximately 1.2% within the forecast horizon, with a 95% confidence interval of [0.8%, 1.6%]. The proposed model provides a statistically rigorous tool for policy analysis, revealing that existing industrial policies are insufficient to sustain earlier rates of efficiency growth. This underscores a need for targeted interventions. Policy should shift towards incentivising advanced process innovation and capability building within plants. Monitoring and evaluation frameworks must adopt such dynamic forecasting models to move beyond static efficiency snapshots. manufacturing efficiency, time-series forecasting, state-space model, industrial policy, plant systems, Ghana This article provides a novel application of state-space forecasting to the policy analysis of manufacturing efficiency, generating a replicable methodology and a critical evidence base for structural engineering and industrial policy.

Keywords: *Time-series forecasting, Manufacturing efficiency, Industrial policy, Sub-Saharan Africa, Policy analysis, Systems evaluation, Ghana*

Article Highlights

- A state-space model reveals a positive but decelerating trend in technical efficiency gains.
- Analysis identifies a structural break, highlighting a shift in the efficacy of industrial policy.
- The model provides a statistically rigorous tool for dynamic policy evaluation beyond static snapshots.
- Findings underscore the insufficiency of current policies to sustain historical growth rates.

Forecast Horizon

The study forecasts manufacturing efficiency trends for Ghanaian plant systems from 2000–2026, revealing a likely plateau in annual improvement rates.

This analysis provides a replicable methodology for evaluating industrial policy impact on plant-level systems.

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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