Methodological Evaluation and Yield Improvement in Senegalese Manufacturing

A Difference-in-Differences Analysis

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ABSTRACT

Manufacturing productivity in West Africa remains below global benchmarks, with systemic inefficiencies in plant operations. A rigorous, quantitative methodology for isolating the causal effect of specific interventions on production yield is lacking in the regional engineering literature. This study aims to develop and apply a robust quasi-experimental framework to evaluate the impact of a targeted process optimisation programme on the operational yield of manufacturing plants. The objective is to provide a methodological standard for causal inference in industrial engineering contexts within the region. A difference-in-differences model was employed, leveraging panel data from treatment and control groups of plants. The core specification is $Y\{it\} = \alpha + \beta\,(Treat_i \times Post_t) + gamma_i + delta_t + \varepsilon\{it\}$, where Y_{it} is yield. Inference is based on cluster-robust standard errors at the plant level. The intervention generated a statistically significant average treatment effect, increasing yield by 7.3 percentage points (95% CI: 5.1 to 9.5). The parallel trends assumption was validated using pre-intervention data, and results were robust to several sensitivity checks. The applied econometric model successfully isolated the causal impact of the process optimisation, confirming its efficacy. This provides empirical validation for the engineering interventions deployed. Manufacturing firms should adopt similar quasi-experimental frameworks for programme evaluation. Policymakers should support the collection of high-frequency panel data to facilitate such analyses across the industrial sector. industrial engineering, causal inference, productivity, quasi-experiment, process optimisation, West Africa This paper provides a novel application of the difference-in-differences methodology to manufacturing yield analysis in a West African context, establishing a template for rigorous impact evaluation in structural and industrial engineering.

Keywords: *Manufacturing productivity, Sub-Saharan Africa, Difference-in-differences, Yield improvement, Industrial policy, Plant-level analysis, Senegal*

Article Highlights

- Difference-in-differences model applied to Senegalese manufacturing plant panel data.
- Process optimisation programme caused a significant 7.3 pp yield improvement.
- Method validates parallel trends and robustness for causal claims.
- Provides a template for rigorous impact evaluation in industrial engineering.

Core Methodology

Difference-in-differences model: Y_it = α + β(Treat_i × Post_t) + γ_i + δ_t + ε_it, with inference using plant-clustered robust standard errors.

This study demonstrates the application of econometric causal inference to industrial process evaluation.

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