

PANEL DATA REGRESSION USING SPSS TO ANALYZE INDUSTRIAL PRODUCTIVITY ACROSS STATES IN INDIA (2013–2022)

1. Background and Problem Statement

A public policy institute aimed to investigate the determinants of industrial productivity variation across Indian states over time. The dataset spanned ten years and included variables such as electricity usage, number of factories, worker skill levels, and capital investment across 15 major states. The challenge was to isolate both time-specific and state-specific effects using SPSS's panel data regression capabilities to produce interpretable and policy-relevant results.

2. Objectives

- Identify the key predictors of industrial productivity across Indian states
- Distinguish between fixed effects and random effects for longitudinal consistency
- Examine whether capital investment has a stronger impact in high-skill states
- Generate a clean and publication-ready SPSS output with interpretations aligned with policymaker needs

3. Methodology

3.1 Data Structure and Preparation

- Time Period: 2013–2022
- Entities: 15 states
- Variables: Productivity index (DV), electricity consumption, capital investment, skilled labor ratio, number of factories (IVs)
- Data Cleaning: Handled missing values with mean imputation; standardized variables for interpretation
- SPSS Restructure: Converted wide-format data to long format using “VARSTOCASES”

3.2 Analytical Approach in SPSS

- Descriptive statistics and correlation matrix to check multicollinearity
- Applied Linear Mixed Models (MIXED procedure) in SPSS to model panel data

- Compared Fixed Effects vs. Random Effects using Hausman-like diagnostics
- Included interaction term: Capital Investment $\times$ Skilled Labor Ratio

3.3 Model Diagnostics

- Checked for heteroskedasticity with residual plots
- Checked for autocorrelation using Durbin-Watson statistics
- Conducted robustness checks with cluster-robust standard errors

4. Results

- The Random Effects model was more efficient based on AIC/BIC comparison
- Capital investment ($\beta = 0.46$, $p < .001$) and skilled labor ($\beta = 0.31$, $p < .01$) had significant positive effects
- The interaction term was significant ($\beta = 0.11$, $p < .05$), showing that capital yields higher returns in skill-rich states
- State fixed effects captured unique productivity baselines across regions
- The model explained 78% of within-state variation and 66% of between-state variation

5. Interpretation and Insights

- States with higher skill ratios see stronger productivity gains from capital input
- Uniform investment strategies may be sub-optimal; state-specific planning is necessary
- Energy consumption had a non-significant effect after adjusting for capital and labor
- The findings support decentralized industrial planning, particularly in workforce training

6. Deliverables

- Cleaned SPSS dataset in long format
- SPSS syntax file for reproducibility (panel modeling, interaction, diagnostics)
- APA-formatted report with graphs, tables, and model summaries
- Policy brief summarizing the actionable insights for each state

7. Stakeholder Relevance Academic:

- Useful case for applied econometrics and panel data modeling with SPSS
- Suitable for coursework in labor economics or regional development studies

Corporate / Government:

- Valuable input for government agencies planning targeted industrial investments
- Can inform state-level skill development programs and capital allocation policies

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