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A Comparative Panel Analysis Of Cpi Inflation In Major Indian States: An Empirical Study From 2012 To 2021

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ABSTRACT

This study investigates the regional dimensions of Consumer Price Index (CPI) inflation in India by conducting a comparative panel analysis across nine major Indian states over the period 2012 to 2021. Using panel regression techniques, the study examines the influence of state-level economic indicators—namely Gross State Domestic Product (GDP) and average fuel prices—on inflation. Descriptive statistics reveal moderate inflation across most states, with considerable variation in economic size and fuel costs. The correlation and regression analyses demonstrate a weak but positive relationship between inflation and the selected economic indicators. Notably, Uttar Pradesh exhibited significantly lower inflation than the reference state Assam, underscoring the role of state-specific structural and policy factors. The model's limited explanatory power ($R^2 = 0.200$) indicates that other unobserved determinants—such as food supply shocks, tax regimes, and infrastructure disparities—play critical roles in shaping inflation. The study emphasizes the need for regionally nuanced inflation management strategies and calls for a shift from uniform macroeconomic policies to more localized interventions that account for India's economic diversity.

Keywords

CPI Inflation, Indian States, Panel Data, State GDP, Fuel Price, Regional Policy

1. INTRODUCTION

Inflation, defined as the sustained increase in the general price level of goods and services in an economy over a period of time, is a key indicator of macroeconomic performance. It directly affects the purchasing power of households, alters consumption patterns, and influences investment decisions. Moderate inflation is often associated with healthy economic growth, but excessive or volatile inflation poses significant challenges to both consumers and policymakers. In India, inflation measurement is predominantly based on the Consumer Price Index (CPI), which reflects the price changes in a basket of goods and services typically consumed by households.

The Indian economy, being a federal structure, encompasses significant heterogeneity across its states in terms of income levels, sectoral compositions, governance, and policy priorities. Such diversity can lead to significant variations in inflationary trends and determinants across states. While some states may be more susceptible to food price inflation due to a larger agricultural base, others might face fuel-related inflationary pressures due to higher transportation costs or industrial energy demand. Therefore, understanding inflation at the sub-national level is essential for effective policy formulation and targeted interventions.

Despite its importance, much of the existing literature on inflation in India tends to focus on national-level trends. Bhattacharya and Sen Gupta (2015) highlighted the role of food supply bottlenecks in driving inflation, while Anand et al. (2014) emphasized the interplay between monetary policy and global fuel prices. Goyal and Kumar (2020) investigated the drivers of core inflation. However, studies exploring the interaction between state-level economic indicators and inflation remain limited. This study seeks to address this research gap by conducting a comparative panel analysis of inflation across major Indian states, incorporating key economic variables such as state GDP and fuel prices.

The key objectives of this study are:

1. To examine year-wise CPI inflation trends across major Indian states from 2012 to 2021.
2. To assess the impact of economic indicators, namely Gross State Domestic Product (GDP) and fuel prices, on inflation.
3. To evaluate whether inflation varies significantly across states after controlling for economic indicators.

By fulfilling these objectives, the study aims to contribute to the discourse on regional economic planning and provide insights into the inflationary dynamics that could guide both state and central policy interventions.

2. METHODOLOGY

This study employs an empirical research design using panel data for nine major Indian states across a ten-year period from 2012 to 2021. The selected states — Assam, Maharashtra, Tamil Nadu, Uttar Pradesh, Punjab, West Bengal, Karnataka, Gujarat, and Madhya Pradesh — were chosen based on economic size, geographical representation, and data availability.

Data Sources:

- CPI inflation data: Ministry of Statistics and Programme Implementation (MOSPI), RBI.
- State-wise GDP data: MOSPI's Gross State Domestic Product (GSDP) at current prices.
- Annual average fuel prices: Petroleum Planning and Analysis Cell (PPAC), Ministry of Petroleum and Natural Gas.

Variables:

- **Dependent Variable:** CPI_Inflation – annual percentage increase in the Consumer Price Index.
- **Independent Variables:**
  - GDP_Lakh_Crore – total state income in current prices.
  - Fuel_Price – average annual fuel price per litre.
- **Control Variables:** Dummy variables for each state to account for state-specific effects, with Assam as the reference category.

Analytical Method: Data were processed in IBM SPSS Statistics. Initial analysis included descriptive statistics and Pearson correlation to explore data patterns. Multiple linear regression was then used to estimate the effect of GDP and fuel prices on inflation, controlling for state-specific characteristics through dummy variables. This fixed-effect model accounts for unobserved heterogeneity across states.

Model Equation: $CPI\_Inflation_{it} = \beta_0 + \beta_1 GDP_{it} + \beta_2 Fuel_{it} + \sum \delta_j D_j + \varepsilon_{it}$

Where:

- i = State
- t = Year (2012 to 2021)
- D_j = State dummy variables
- ε_{it} = Error term capturing other unobserved influences

3. RESULTS AND DISCUSSION

3.1: Descriptive Statistics:

Table: 1: Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
CPI_Inflation	90	4.09	8.95	6.29	1.38
GDP_Lakh_Crore	90	3.66	18.33	9.53	3.33
Fuel_Price	90	55.39	104.16	83.05	12.17

Source: Computed from MOSPI and PPAC data

Table 1 provides a summary of the key variables used in this study—CPI Inflation, Gross State Domestic Product (GDP in lakh crore), and average annual fuel prices—for 90 state-year observations across nine major Indian states from 2012 to 2021. These descriptive statistics offer important initial insights into the inflationary landscape at the state level and help contextualize the findings that follow in the regression and correlation analyses.

The mean value of CPI inflation across the sample is 6.29%, with a minimum of 4.09% and a maximum of 8.95%. This suggests that during the study period, most states experienced moderate levels of inflation. The relatively narrow standard deviation of 1.38 indicates that inflation levels did not deviate drastically from the mean, implying a certain level of consistency in inflation rates across states and years. However, the existence of extremes such as 8.95% inflation highlights instances of temporary economic stress—likely driven by factors such as food price shocks, fuel price hikes, or regional supply chain disruptions.

The state-level GDP, measured in lakh crore at current prices, has a mean of 9.53, ranging from 3.66 to 18.33 lakh crore. The high standard deviation of 3.33 underlines substantial heterogeneity in economic size among the states under study. States like Maharashtra and Tamil Nadu typically account for larger shares of national output, while smaller economies such as Assam and Punjab contribute less. These disparities reflect differences in industrial development, infrastructure availability, investment levels, and human capital. The variation in state GDP has important implications for inflation, as more economically advanced states may face demand-pull inflation due to greater consumption capacity and investment activities.

Fuel prices display a mean of ₹83.05 per litre, with a minimum of ₹55.39 and a maximum of ₹104.16, and a standard deviation of ₹12.17. This broad range in fuel prices corresponds with international crude oil market volatility, domestic taxation policies, and logistical costs. The most volatile period occurred between 2012 and 2014, when global crude oil prices spiked and then declined sharply due to changes in supply-demand dynamics and geopolitical factors. Since fuel is a critical input for transportation and production, its price directly influences the cost of goods and services and thus contributes to inflationary pressures.

The joint interpretation of these statistics suggests that while inflation remained moderate on average, the underlying economic and structural differences between states significantly influenced how inflationary pressures manifested locally. States with higher GDP may have experienced greater cost-push inflation due to infrastructure development and consumer demand. Conversely, fuel price spikes likely contributed more heavily to inflation in states reliant on transportation and energy imports. These findings underscore the need for region-specific inflation targeting policies that account for unique economic profiles and sectoral compositions of each state.

3.2: Correlation Analysis

Table: 2: Correlation Matrix

Variable	CPI Inflation	GDP_Lakh Crore	Fuel Price
CPI_Inflation	1.00	0,135	0.150
GDP_Lakh_Crore	0.135	1.000	0.042
Fuel_Price	0.150	0.042	1.000

Source: Computed from MOSPI and PPAC data

Table 2 presents the Pearson correlation coefficients among the three key variables: CPI Inflation**,** GDP at current prices, and Fuel Price. The matrix reveals that CPI Inflation has a weak positive correlation with GDP (r = 0.135) and Fuel Price (r = 0.150). These low correlation values indicate that while there is a slight tendency for inflation to rise with increases in GDP and fuel prices, the strength of association is minimal.

The correlation between GDP and Fuel Price is even weaker **(**r = 0.042**),** implying near independence between a state's economic output and average fuel price movements during the study period. This could be due to centrally administered fuel pricing policies and international oil price fluctuations, which affect all states similarly, regardless of their economic size.

The weak correlations suggest that neither GDP nor fuel prices alone are strong determinants of inflation at the state level. Inflation is likely influenced by a broader set of variables, such as food supply conditions, state fiscal policies, and monetary interventions. These findings support the need for multivariate analysis to capture the complex and region-specific drivers of inflation in India.

3.3: Regression Analysis

Table:3: Regression Model Summary

R	R Square	Adjusted R Square	Std, Error of the Estimate
0.447	0.200	0.099	1.306

Source: Computed using SPSS from MOSPI and PPAC data

The regression model summary indicates an R value of 0.447, suggesting a moderate linear relationship between CPI inflation and the independent variables (GDP and fuel prices, along with state dummies). The R Square of 0.200 reveals that only 20% of the variation in CPI inflation is explained by the model, while the remaining 80% is due to other factors. The Adjusted R Square of 0.099 accounts for the number of predictors and confirms limited explanatory power. The standard error of 1.306 indicates the average deviation of observed inflation values from predicted values.

Table:4: Analysis of Variance (ANOVA)

Source	Sum of Squares	Df	Mean Square	F	Sig.
Regression	33.682	10	3.368	1.974	0.047
Residual	134.791	79	1.706		
Total	168.473	89			

Source: Computed using SPSS from MOSPI and PPAC data

The ANOVA (Analysis of Variance) table evaluates the overall significance of the regression model used to explain CPI inflation. The "Regression" row shows that the sum of squares due to regression is 33.682, distributed over 10 degrees of freedom (df), resulting in a mean square of 3.368. This is compared against the residual mean square of 1.706 (from a residual sum of squares of 134.791 and 79 df) to calculate the F-statistic of 1.974.

The key takeaway here is the significance value (p-value) of 0.047, which is just below the conventional 5% threshold. This implies that the model is statistically significant at the 5% level, meaning that, collectively, the independent variables (GDP, fuel price, and state dummies) do a better job in predicting inflation than a model without any predictors.

However, while the model is statistically valid, the relatively low F-value and R Square (0.200, from the previous table) suggest that the explanatory power of the included variables is limited. This underscores the likelihood that other important factors—such as food inflation, policy measures, or external shocks—are influencing state-level CPI inflation and should be considered in future models.

Table:5 Regression Coefficient

Variable	B	Std. Error	T	Sig.
Constant	4.140	1.135	3.648	0.001
GDP_Lakh Crore	0.112	0.064	1.769	0.081
Fuel Price	0.018	0.012	1.577	0.119
Maharashtra (Dummy)	0.423	0.631	0.671	0.504
Tamil Nadu (Dummy)	-0.312	0.604	-0.516	0.608
Uttar Pradesh (Dummy)	-1.575	0.613	-2.569	0.012
Punjab (Dummy)	0.275	0.588	0.468	0.641
West Bengal (Dummy)	-0.696	0.739	-0.943	0.349
Karnataka (Dummy)	-0.641	0.680	-0.943	0.349
Gujarat (Dummy)	-0.688	0.705	-0.976	0.332
Madhya Pradesh (Dummy)	-0.814	0.624	-1.304	0.196

Source: Computed using SPSS from MOSPI and PPAC data

Table 5 presents the regression coefficients estimating the impact of state GDP, fuel prices, and state-specific dummy variables on CPI inflation across nine major Indian states for the period 2012–2021. The constant term (intercept) is 4.140, which represents the baseline CPI inflation for the reference category (Assam) when all other predictor variables are held at zero. This value is statistically significant ($p = 0.001$), confirming a stable base inflation level even in the absence of economic shocks.

The coefficient for GDP_Lakh Crore is 0.112 with a p-value of 0.081, which is marginally above the traditional 5% significance threshold but may be considered significant at the 10% level. This positive association suggests that as a state's GDP increases by one lakh crore, the inflation rate increases by approximately 0.112 percentage points. This implies that higher economic activity may slightly elevate inflation, possibly due to demand-pull factors where increased income leads to greater consumption and investment, exerting upward pressure on prices.

Fuel Price also exhibits a positive coefficient (0.018) but is statistically insignificant ($p = 0.119$). Although higher fuel prices theoretically contribute to cost-push inflation by increasing production and transportation costs, the lack of statistical significance implies that other mechanisms—like fuel subsidies, tax adjustments, or inflation buffering policies—might be at play, dampening its direct effect on inflation in the Indian context during this period.

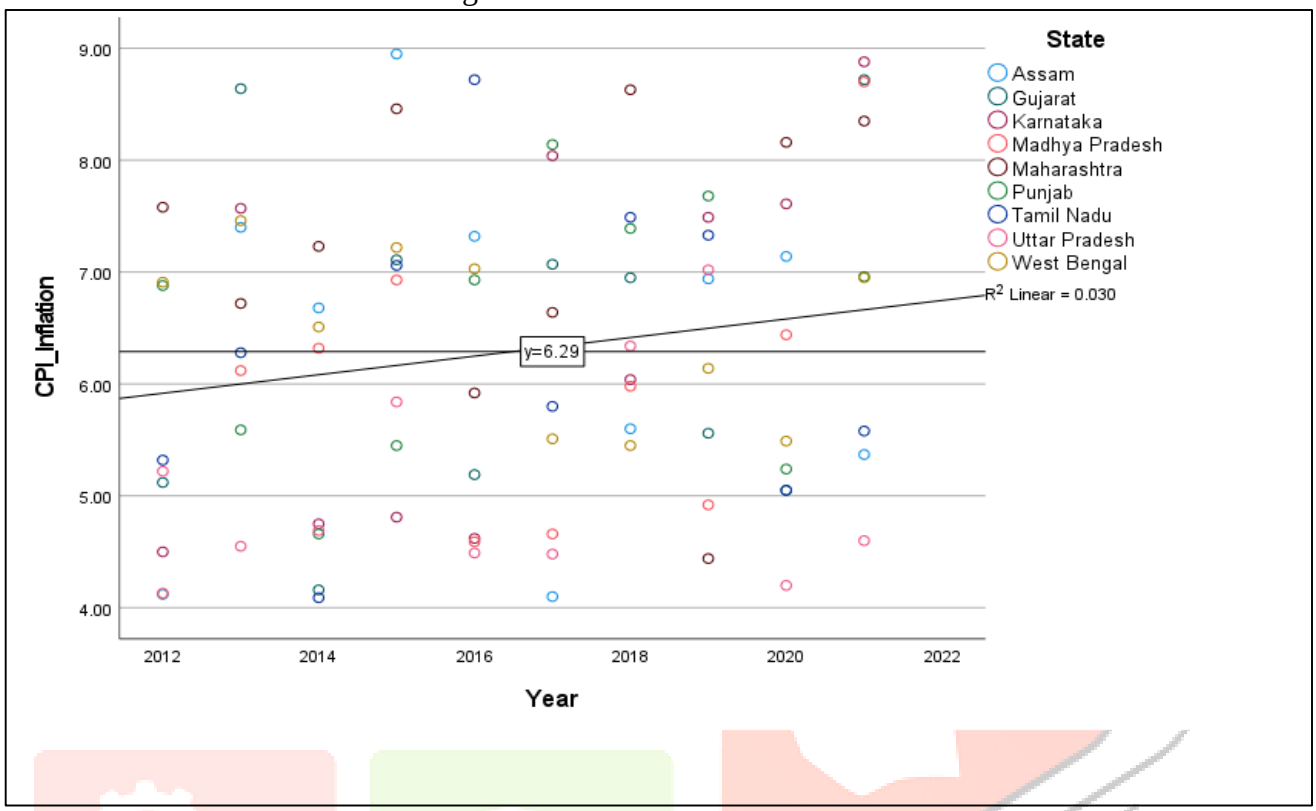
Among the state dummy variables (with Assam as the reference category), only Uttar Pradesh shows a statistically significant negative coefficient (-1.575, $p = 0.012$). This indicates that, holding all else constant, Uttar Pradesh had significantly lower inflation compared to Assam. The reason could be attributed to a higher reliance on subsidized essential goods, larger agricultural output, or more stable consumption patterns in Uttar Pradesh. This supports the notion that state-specific economic and policy structures strongly influence inflationary outcomes.

Other state dummy variables (e.g., Maharashtra, Tamil Nadu, Punjab, etc.) have insignificant coefficients, suggesting their inflation levels do not significantly differ from Assam after controlling for GDP and fuel prices. However, their negative signs might still reflect structural tendencies for lower inflation in industrialized or administratively efficient states.

Overall, this table reveals that while GDP growth slightly contributes to inflation, fuel prices and many state-specific effects are statistically less impactful in this model, highlighting the need to consider additional variables such as food inflation, supply chain dynamics, and policy interventions in future analyses.

3.4: Trend Analysis:

Fig: 1: Trend Line of CPI Inflation



Source: Computed using SPSS from MOSPI and PPAC data

The scatterplot shows CPI inflation trends from 2012 to 2021 across nine major Indian states, with each coloured circle representing a state-year observation. Despite state-level variation, the overall trend line indicates a slight upward movement in inflation over the period. The average CPI inflation rate is approximately 6.29%, with considerable fluctuations among states and years. The low R^2 value (0.030) suggests that time (year) alone explains only 3% of the variation in CPI inflation. This implies that other factors—like fuel prices, state-specific economic activities, or policy measures—are likely driving the observed inflation differences.

4. CONCLUSION

The conclusion drawn from this study emphasizes the multifaceted nature of inflation in the Indian context, particularly at the sub-national (state) level. The regression model revealed that GDP and fuel prices, though theoretically significant economic indicators, have limited explanatory power in predicting Consumer Price Index (CPI) inflation across Indian states. This is evident from the relatively low R-squared value (0.200), indicating that only about 20% of the variation in inflation is captured by these two variables combined with state-specific effects.

This finding highlights the complexity of inflationary dynamics, which cannot be sufficiently understood through broad macroeconomic indicators alone. India's inflation patterns are often influenced by a host of structural and region-specific factors such as agricultural output**,** food supply chains**,** infrastructure quality, and state-level taxation and subsidies. For instance, a state heavily dependent on agriculture may be more vulnerable to inflation driven by erratic monsoons or supply-side constraints, while urbanized states may respond differently to fuel price fluctuations due to better transport infrastructure or diversified energy use.

The significance of the Uttar Pradesh dummy variable, which indicated consistently lower inflation than the reference state (Assam), supports the idea that state-level factors play a crucial role**.** This could be due to policy-driven affordability of essential goods, public distribution efficiency, or local economic behaviours that moderate inflation.

Therefore, the study calls for a decentralized approach to inflation management**,** recommending that policymakers consider localized and state-specific strategies alongside national-level monetary and fiscal policies. Tailoring interventions to regional conditions—such as improving storage infrastructure in food-insecure states or revising local tax regimes—may prove more effective in stabilizing prices than uniform macroeconomic measures. This insight is vital for crafting more responsive and inclusive economic policies in India's diverse federal landscape.

REFERENCES

Anand, R., Ding, D., & Tulin, V. (2014). *Food inflation in India: The role for monetary policy*. IMF Working Paper No. 14/178. https://doi.org/10.5089/9781498380512.001

Bhattacharya, R., & Sen Gupta, A. (2015). *Drivers and impact of food inflation in India*. Indian Council for Research on International Economic Relations (ICRIER) Working Paper No. 292.

Goyal, A., & Kumar, S. (2020). *Core inflation in India: Measurement and policy perspectives*. RBI Working Paper Series, WPS (DEPR): 04/2020.

Reserve Bank of India. (2021). *Handbook of Statistics on Indian States*.

Ministry of Statistics and Programme Implementation (MOSPI). (2022). *State Domestic Product - Current Prices*. Government of India.

Petroleum Planning and Analysis Cell (PPAC). (2022). *Retail Fuel Prices*. Ministry of Petroleum and Natural Gas.