

India CPI Inflation Case Study

PROJECT OVERVIEW

This case study focuses on CPI Inflation variations across India between January 2013 and May 2023 for Rural, Urban and Semi-Urban area. In India, the Consumer Price Index is used to measure inflation, it involves a fixed basket of good and services. This basket is comprehensive and includes a wide array of items that an average Indian consumer uses. These items are not limited to just food and clothing but extend to transportation, medical care, electricity, education, and almost every other category that involves expenditure on money. The CPI is calculated by comparing the general price level in the markets during a particular time-period with a base year. The items in the CPI basket are classified across various categories like food and beverages, clothing, housing, fuel and light and recreation among others.

$$\text{CPI} = (\text{Cost of Basket in Current Year} / \text{Cost of Basket in Base Year}) \times 100$$

BUSINESS PROBLEMS

1. Based on the latest month's data, Identify the contribution of different broader categories (*food, energy, transportation, education, etc.*) towards the CPI basket.
2. A trend of Y-o-Y increase in CPI (rural + urban) inflation starting 2017 for the entire basket of products combined. Identify the year in which highest inflation and what does cause it ?
3. With India's retail inflation reaching a 3-month high of 5.55% in November 2023, largely due to a sharp rise in food prices. Analyse the following for 12 months ending May '23:
 - Investigate trends in the prices of broader food bucket category and evaluate month-on-month changes. Highlight month with highest and lowest food inflation
 - Identify the absolute changes in inflation over the same 12 months period and identify the biggest individual category contributor (only within broader food category) towards inflation
4. Investigate how the onset and progression of the COVID-19 pandemic affected inflation rates in India. Analyse the impact of key pandemic milestone (*first lockdown*) on the CPI inflation %, especially focus on categories like healthcare, food, and essential services. compare the inflation trend before and after milestone to see if there is a change in inflation % before and after.
5. Investigate how major global economic events (like imported crude oil price fluctuations) have influenced India's inflation. This can include an analysis of imported goods and their price trends.
 - For the purpose of this analysis, focus only on the imported oil price fluctuations for years 2021 to 2023 (Month-on-month)

- Identify trends in oil price change with change in inflation prices of all the categories and identify category whose inflation prices strongly changes with fluctuations in imported oil price.

DATASET DESCRIPTION

There one table showing CPI Index for various categories on various time periods is as follows

- **All_India_Index_Upto_April23:** Dataset has attributes such as Sector, Year, Month, Cereals and products, Meat and fish, Egg, Milk and products, Oils and fats, Fruits, Vegetables, Pulses and products, Sugar and Confectionery, Spices, Non-alcoholic beverages, Prepared meals, snacks, sweets etc., Food and beverages, Pan, tobacco and intoxicants, Clothing, Footwear, Clothing and footwear, Housing, Fuel and light, Household goods and services, Health, Transport and communication, Recreation and amusement, Education, Personal care and effects, Miscellaneous and General index

ASUMPTIONS

- Broader categories are created by grouping individual categories are as follow :
 - **Food:** Cereals and products, Meat and fish, Egg, Milk and products, Oils and fats, Fruits, Vegetables, Pulses and products, Sugar and Confectionery, Spices, Non-alcoholic beverages, (Prepared meals, snacks, sweets, etc.), Food and beverages
 - **Energy:** Fuel and light
 - **Transportation and Communication:** Transport and communication
 - **Housing and Utilities:** Housing, Household goods and services
 - **Clothing and Personal Care:** Clothing, Footwear, Clothing and footwear, Personal care and effects
 - **Health:** Health
 - **Education:** Education
 - **Recreation and Entertainment:** Recreation and amusement
 - **Addictive Substances:** Pan, tobacco and intoxicants
 - **Miscellaneous:** Miscellaneous
- Considered Mar'20 as the onset of COVID (milestone).
- **Percentage Change:** To understand inflation or deflation trends, calculate the percentage change in CPI between two periods (e.g., year-over-year or month-over-month). This shows how much prices have increased or decreased relative to the earlier period.
- For example, to calculate the monthly inflation rate between two consecutive months:
 - **Monthly Inflation rate** = $((\text{CPI in current month} - \text{CPI in previous month}) / \text{CPI in previous month}) \times 100$
- **Annual Inflation Rate:** For longer periods, such as yearly inflation, use the CPI values at the start and end of the period. This helps in understanding the overall inflation experienced over the year.
 - **Annual Inflation rate** = $((\text{CPI at end of year} - \text{CPI at start of year}) / \text{CPI at start of year}) \times 100$

- Any month can be considered as start of the year, then end of the year month will be considered 12 months after the month you have selected for start of the year.

- The dataset provided is a CPI inflation index extracted from GOI website
- Each number represents the index value for that month and category There are missing values in the dataset – use suitable imputation technique (like moving averages), if required
- The CPI is an index and not a direct measure of price levels, but rather a relative indicator used to measure inflation or the average change in prices over time. Consumer Price Index (CPI) values cannot be summed across different months to derive meaningful insights or aggregate measures.
- The **General Index** gives you the overall inflation for the month for all the categories combined

EXPLORATORY DATA ANALYSIS (EDA) & DATA CLEANING

- Removed discrepancies such as Marcrcch instead of March throughout the dataset.
- Check empty and null values across all data sets.
- Imputed all missing values by moving average of quarterly values in which missing values resided for each individual category and sector.
- Imputed missing value in Housing category for Rural sector by average of CPI's of Housing in Urban and Semi-Urban categories for each month.
- Check datatypes of attributes of dataset and make them appropriate.

ADVANCE ANALYSIS

1. For the latest month, May 2023 contributions of various broader categories towards the calculation of CPI are shown below.

Sector	Rural	Urban	Rural & Urban
Food	10%	10%	10%
Energy	10%	10%	10%
Transportation and communication	9%	9%	9%
Housing and Utilities	10%	10%	10%
Clothing and Personal Care	10%	10%	10%
Health	10%	10%	10%
Education	10%	10%	10%
Recreation and Entertainment	10%	10%	10%
Addictive Substances	11%	11%	11%
Miscellaneous	10%	10%	10%

Fig. 1: Category-wise inflation rates for the latest month of May 2023 for all three sectors.

2. Analyse the inflation rate in terms of Rate of CPI based on CPI of month January of each year for the duration of 2017-2023 for Rural & Urban combined sector.

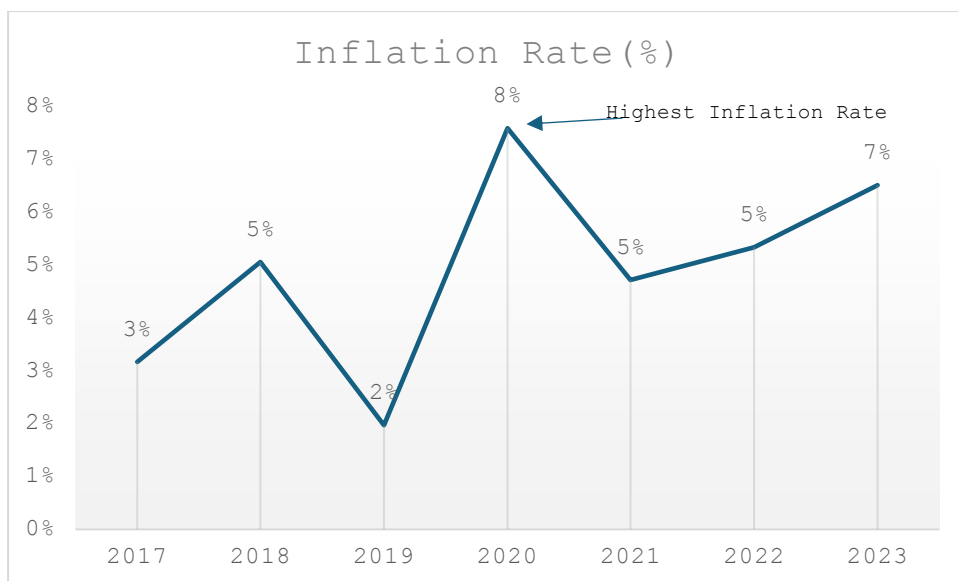


Fig. 2.1: Inflation rate during 2017-2023 for Rural & Urban.

3. Inflation during June 2022 to May 2023 is shown below.

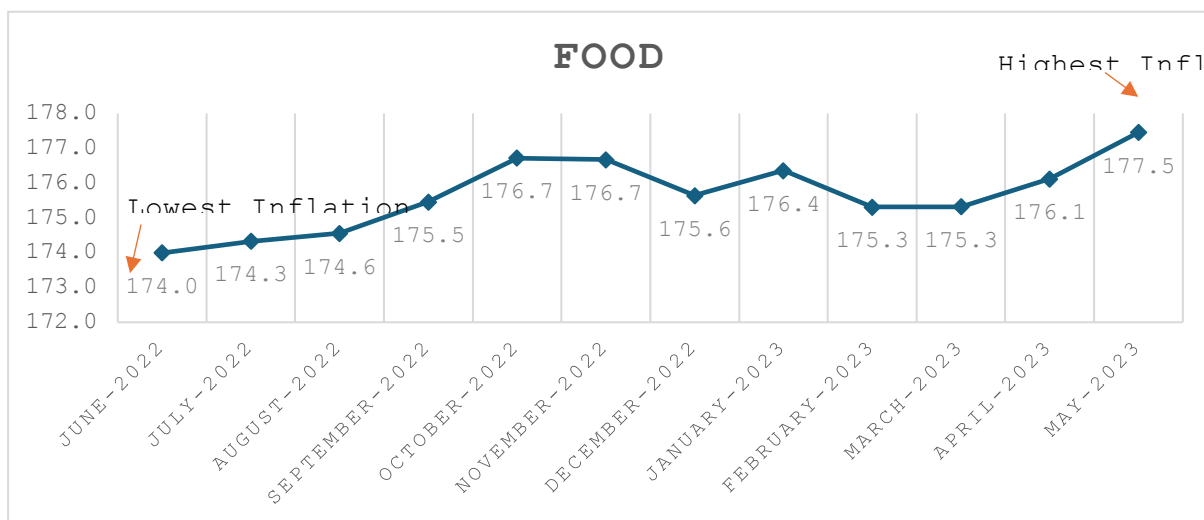


Fig. 3.1: Inflation during June 2022- May 2023 for Rural & Urban combined sector.

Contribution of various categories in Inflation during June 2022 to May 2023

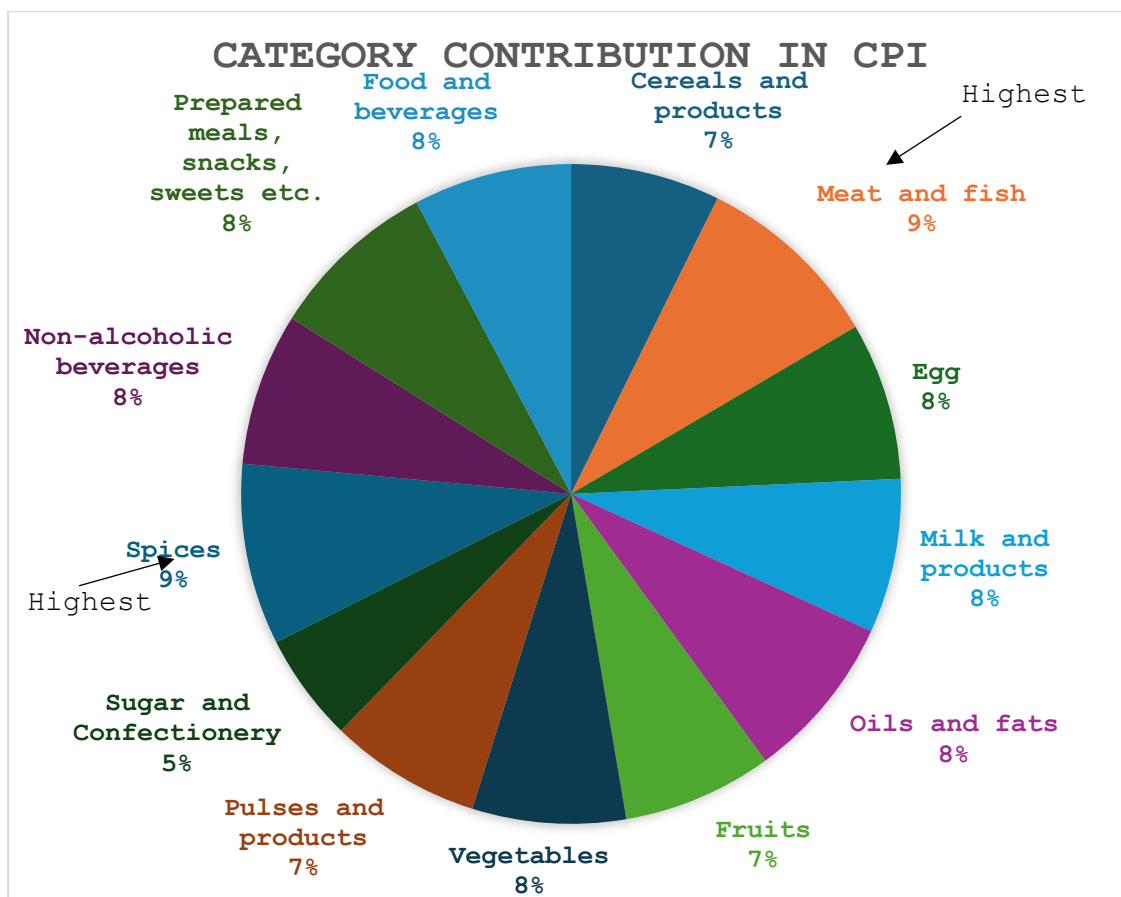


Fig. 3.2: Contribution of individual category in inflation during June 2022- May 2023 for Rural & Urban combined sector.

4. Analysed inflation trend of Rural and Urban combined before and after the covid, considering March 2020 as milestone.

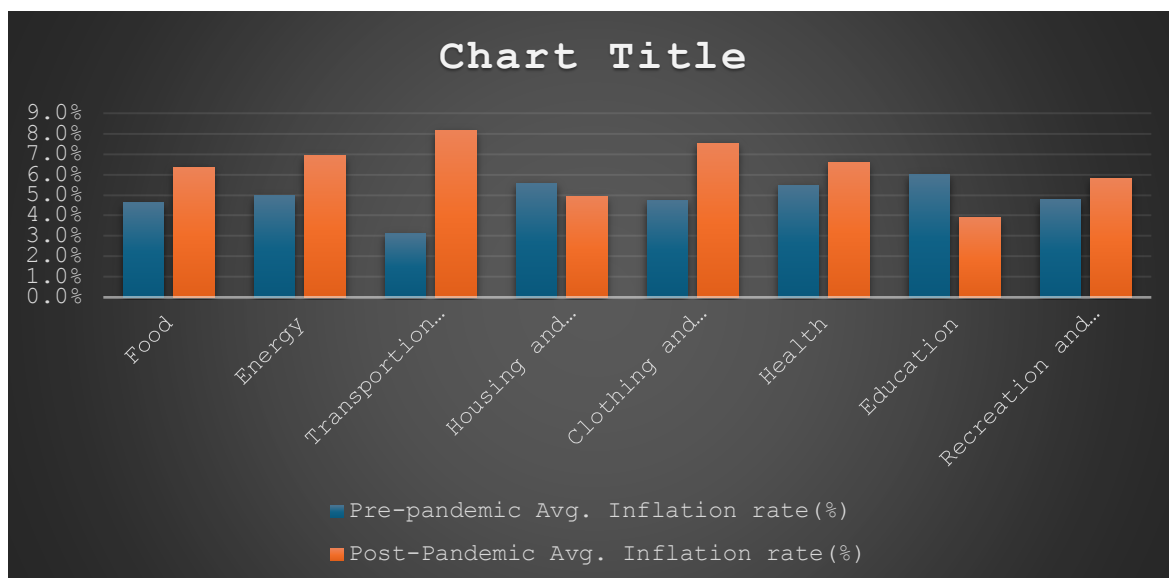


Fig. 4.1: Inflation across various broader categories before and after COVID pandemic.

5. Analysed impact of imported crude oil on Inflation across various category during Jan 2021 to May 2023 using correlation between Imported oil price and Categorical CPIs.

Categories	Area	Correlation (2021-2023)
Cereals and products	Rural & Urban	0.44
Meat and fish	Rural & Urban	0.80
Egg	Rural & Urban	-0.09
Milk and products	Rural & Urban	0.53
Oils and fats	Rural & Urban	0.74
Fruits	Rural & Urban	0.56
Vegetables	Rural & Urban	0.32
Pulses and products	Rural & Urban	0.33
Sugar and Confectionery	Rural & Urban	0.59
Spices	Rural & Urban	0.52
Non-alcoholic beverages	Rural & Urban	0.67
Prepared meals, snacks, sweets etc.	Rural & Urban	0.64
Food and beverages	Rural & Urban	0.71
Pan, tobacco and intoxicants	Rural & Urban	0.53
Clothing	Rural & Urban	0.67
Footwear	Rural & Urban	0.70
Clothing and footwear	Rural & Urban	0.67
Personal care and effects	Rural & Urban	0.56
Housing	Rural & Urban	0.59
Household goods and services	Rural & Urban	0.66
Fuel and light	Rural & Urban	0.71
Health	Rural & Urban	0.62
Transport and communication	Rural & Urban	0.77
Recreation and amusement	Rural & Urban	0.72
Education	Rural & Urban	0.60
Miscellaneous	Rural & Urban	0.68

Table 5.1: Correlations between Imported crude oil and various individual categories.

KEY INSIGHTS

- Broader category "Addictive Substances" has highest contribution in CPI calculation for all three sectors (Rural, Urban and Semi-Urban) for latest month of May 2023.
- Highest inflation rate is recognized during 2019-2020 due to covid-19 impact.
- Highest inflation recorded in May 2023, and lowest inflation recorded on June 2022 during latest year June 2022 – May 2023 for Rural & Urban combined.
- Highest contribution in inflation for broader food category recorded by Meat and Fish, after that Spices also impacted on inflation over the duration from June 2022 to May 2023.
- Lowest contribution in inflation for broader food category recorded by Sugar and Confectionery over latest 12-month trend.
- Inflation increased mostly in Transportation and Communication after that clothing and personal care.

- More inflation increased in Food and Energy.
- Inflation Increased moderately in Health and Recreation and Entertainment categories.
- There is some deflation slightly in Education and Housing and Utilities.