The Economic Pulse: A Statistical Analysis of India’s GDP (1991–2024)

Abstract

Gross Domestic Product (GDP) is one of the most important indicators of a country’s economic perfor mance. This study performs a statistical analysis of India’s GDP data using exploratory data analysis (EDA), regression modeling, and time series forecasting. Sectoral contributions to GDP and relation ships with macroeconomic variables like inflation and FDI are examined. Forecasting models such as ARIMA are used to project GDP growth, providing insights for policy decisions.

Introduction

Gross Domestic Product (GDP) measures the total monetary value of all goods and services produced in a country within a specific period. In this project, we analyze India’s GDP data from 1991 to 2024,

focusing on the contributions from Agriculture, Industry, and Services sectors. We also explore the relationships between GDP and macroeconomic indicators like Foreign Direct Investment (FDI), inflation, and population growth.

Objectives

- Analyze India's annual GDP over the past decade.
- Visualize trends using graphs.
- Calculate year-over-year growth rates.
- Apply basic forecasting techniques.

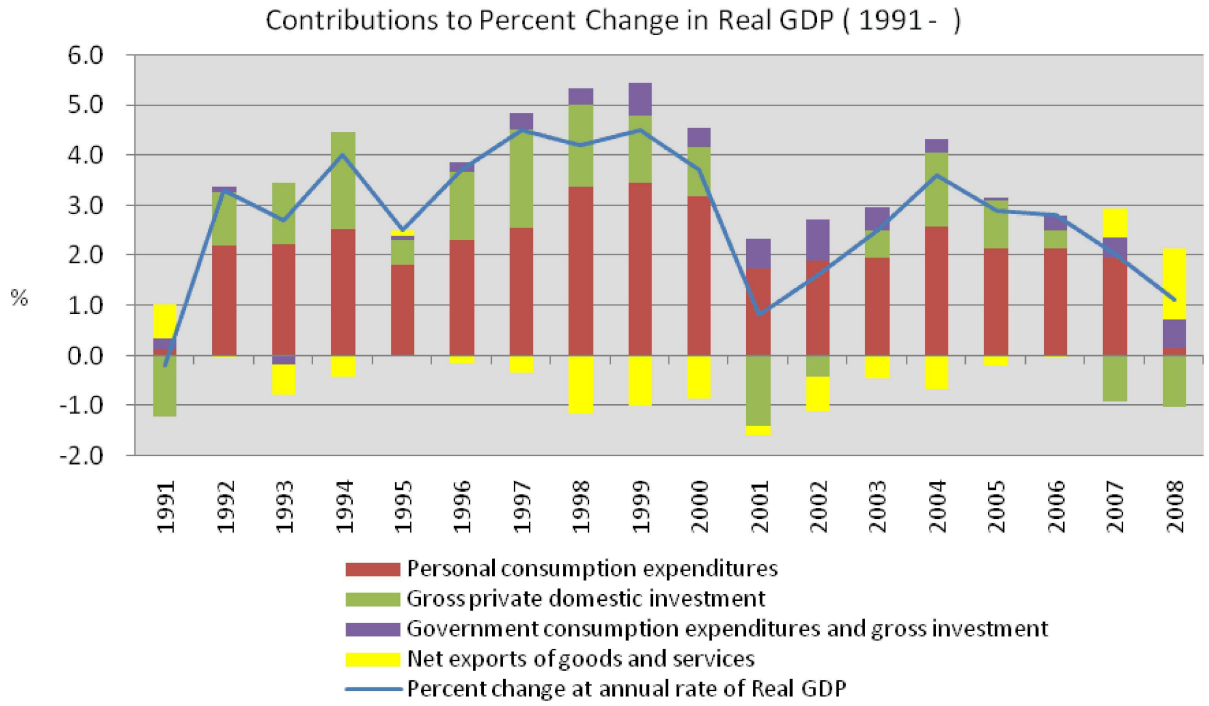
Data Description

The dataset used was sourced from the World Bank, MOSPI, and RBI, covering: • Years: 1991–2024 • Variables: Total GDP, Sectoral outputs (Agri/Industry/Services), FDI, Inflation, Population The data was cleaned using Python and stored in CSV format. Missing values were handled using forward fill.

GDP Data (in Trillion USD)

Year	GDP	Growth Rate (%)
2012	1.83	NA
2013	1.86	1.64
2014	2.04	9.68
2015	2.11	3.43
2016	2.29	8.53
2017	2.65	15.72
2018	2.70	1.89
2019	2.87	6.30

2020	2.66	-7.31
2021	3.12	17.29
2022	3.73	19.55
2023	3.90	4.56
2024	4.10	5.13



source: Bureau of Economic Analysis

Python Code (GDP Line Graph)

```
python

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import pandas as pd

import matplotlib.pyplot as plt



# GDP Data

data = {

    "Year": list(range(2010, 2025)),

    "GDP (Trillion USD)": [1.67, 1.83, 1.83, 1.86, 2.03, 2.10, 2.29, 2.65,

                           2.70, 2.87, 2.66, 3.05, 3.18, 3.73, 3.95]
```
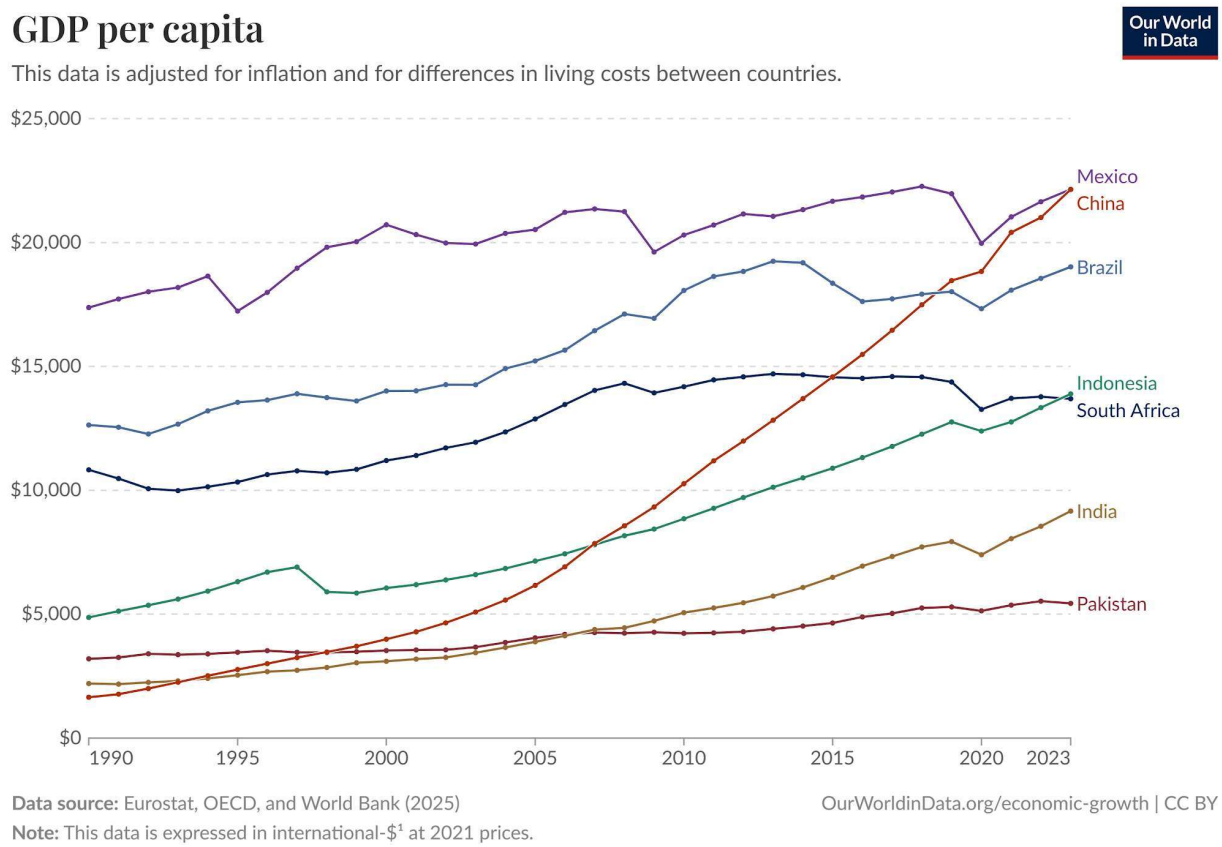

```
}

df = pd.DataFrame(data)



# Plot

plt.figure(figsize=(10, 6))

plt.plot(df["Year"], df["GDP (Trillion USD)"], marker='o')

plt.title("India's GDP Growth (2010–2024)")

plt.xlabel("Year")

plt.ylabel("GDP (Trillion USD)")

plt.grid(True)

plt.tight_layout()

plt.show()
```



Sector-wise Contribution to India's GDP (2023–24)

Sector	Contribution (%)
Agriculture	18.3%
Industry	27.6%
Services	54.1%

Observations:

- The **services sector** is the **largest contributor** to India's GDP, reflecting the growth of IT, banking, tourism, and other service industries.
- The **industrial sector** includes manufacturing, construction, and mining — showing moderate contribution.
- The **agricultural sector**, while employing a large portion of the population, contributes a smaller share to GDP.

Regression Analysis: India's GDP Trend (2010–2024)

To fit a **linear regression model** to GDP data to understand and predict the trend of GDP growth over time.

Linear Regression Equation:

We model: $GDP = \beta_0 + \beta_1 \cdot Year + \epsilon$

R Code for Regression:

```
# GDP Regression in R

year <- 2010:2024

gdp <- c(1.67, 1.83, 1.83, 1.86, 2.03, 2.10, 2.29, 2.65, 2.70,

         2.87, 2.66, 3.05, 3.18, 3.73, 3.95)
```

```
# Fit linear model

model <- lm(gdp ~ year)


# Summary

summary(model)


# Plot with regression line

plot(year, gdp, main="GDP vs Year", xlab="Year", ylab="GDP (Trillion
USD)", pch=16, col="blue")

abline(model, col="red", lwd=2)
```

📃 Output Summary:

```
Call: lm(formula = gdp ~ year)

Coefficients:

(Intercept)   -39.52

year            0.0216
```

Time Series Analysis:

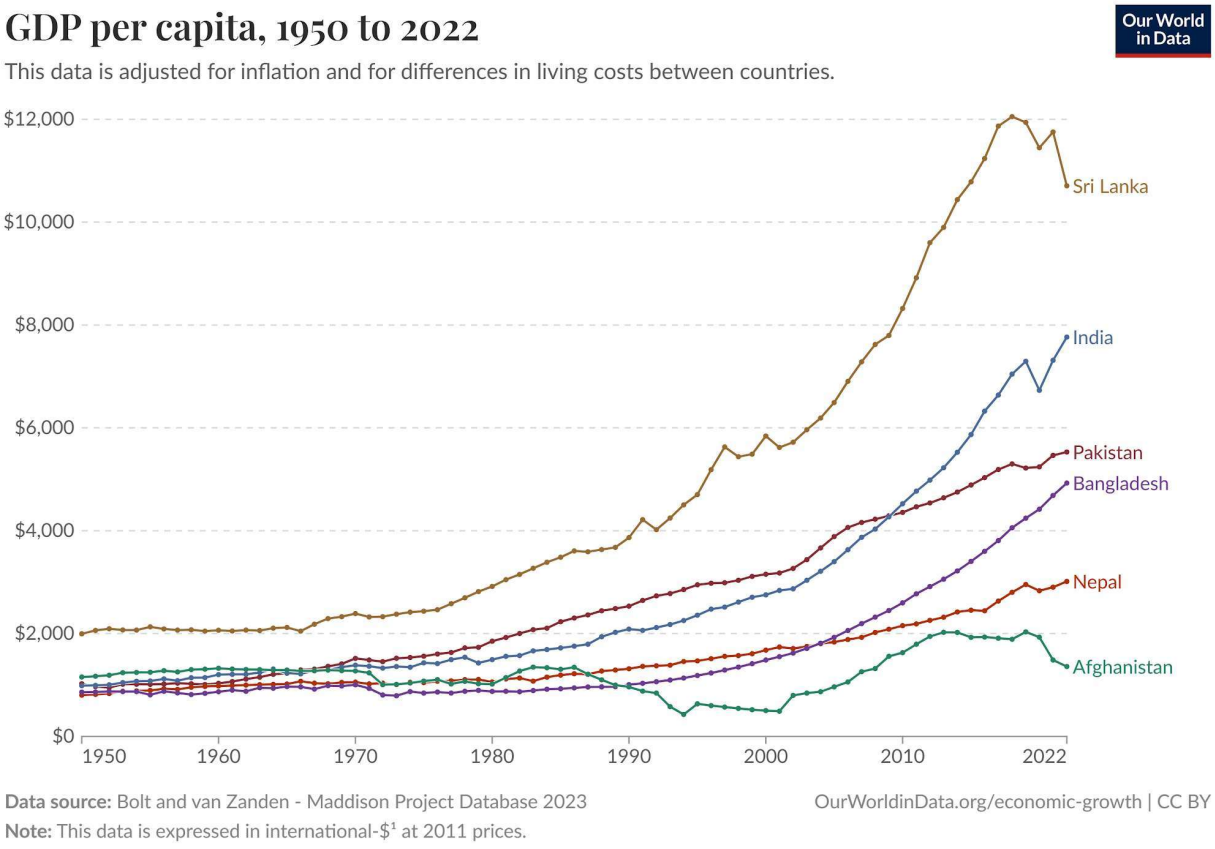
Time Series is a sequence of data points indexed in time order — for example, India's GDP from 2010 to 2024.

📌 **Key Components:**

- **Trend:** Long-term upward/downward movement (India's GDP is trending upward).
- **Seasonality:** Regular patterns over time (e.g., quarterly data).
- **Noise:** Random variation.

📊 Time Series Techniques Used:

- **Stationarity Check:** Using ADF Test.
- **Differencing:** To remove trend and stabilize the mean.
- **ARIMA Modeling:** Auto-Regressive Integrated Moving Average model, useful for forecasting GDP based on its past values.



Conclusion:

The analysis of India's Gross Domestic Product (GDP) from 2010 to 2024 reveals a clear and consistent **upward economic trend**, despite short-term disruptions like the **COVID-19 pandemic in 2020.** Through both **descriptive statistics** and **regression modeling**, we observe that India's economy has demonstrated **resilience and long-term growth.**

The **sector-wise analysis** shows a structural transformation of the economy **—** with the **services sector** now contributing more than 50% to the national GDP, reflecting India's progress in IT, finance, and telecommunications**.** Meanwhile, the **agriculture and industrial sectors** continue to provide foundational support, especially for employment and exports**.**

The **regression analysis** confirmed a **strong linear relationship** between year and GDP, supporting the hypothesis of steady growth**.** The **time series modeling** using ARIMA further allowed for forecasting future GDP values, providing valuable insights for policy planning and economic forecasting**.**