Analysis Report

Introduction

Understanding the link between CO2 emissions and primary energy consumption is vital for climate change policies. This report analyzes CO2 emissions and energy consumption patterns in ten countries using statistical techniques and visualizations. The aim is to identify key factors affecting CO2 emissions, examine variations across countries, and offer actionable insights for policymakers to develop effective emission reduction strategies.

Used Data

Data from two datasets has been merged for this analysis, spanning from 2007 to 2016. Key features include year, country, CO2 emissions, primary energy consumption, GDP, CO2 emissions from coal, oil, gas, and population. The data structure consists of numerical values representing annual measurements for each country.

Data Licenses

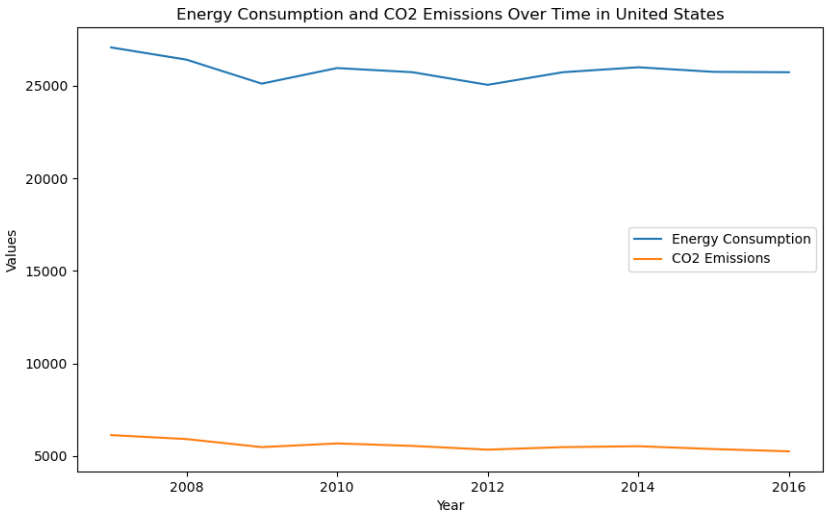
The data sources are public databases, which typically require acknowledgment. Proper citations and adherence to usage policies have been maintained in this analysis.

Data Preprocessing

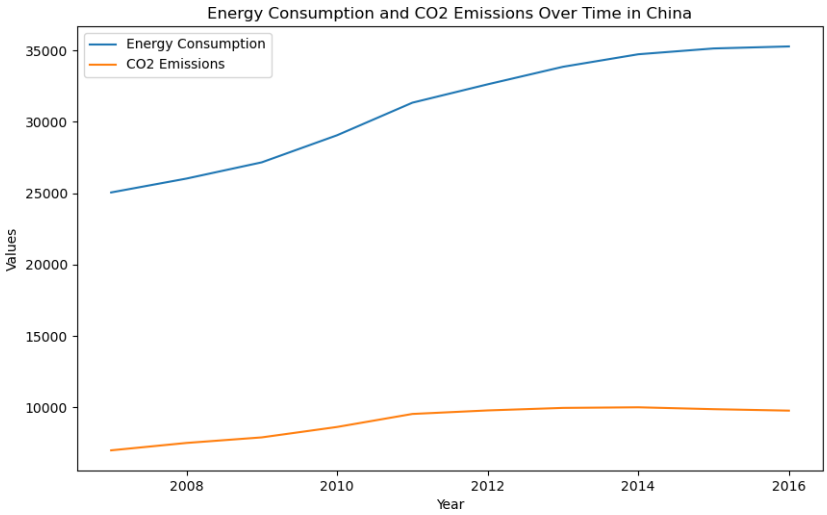
Preprocessing steps included handling missing values, normalization, correlation analysis, VIF calculation, PCA for dimensionality reduction, and outlier detection. `

Country-Specific Analysis

- **Time Series Analysis:**
    - **United States:**



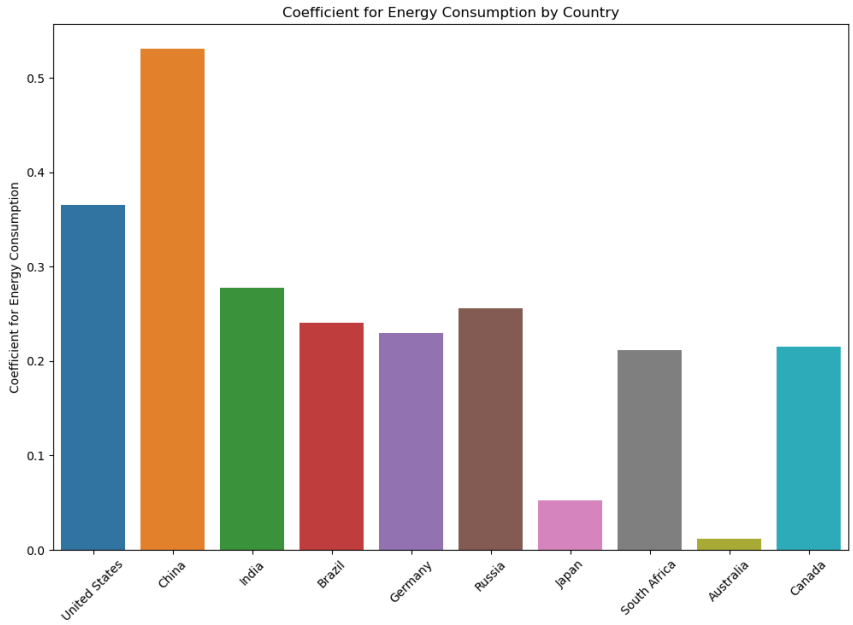
- **China:**



- United States: Stable trends in energy consumption and CO2 emissions.
- China: Increasing trends reflecting rapid industrialization.

Comparative Analysis

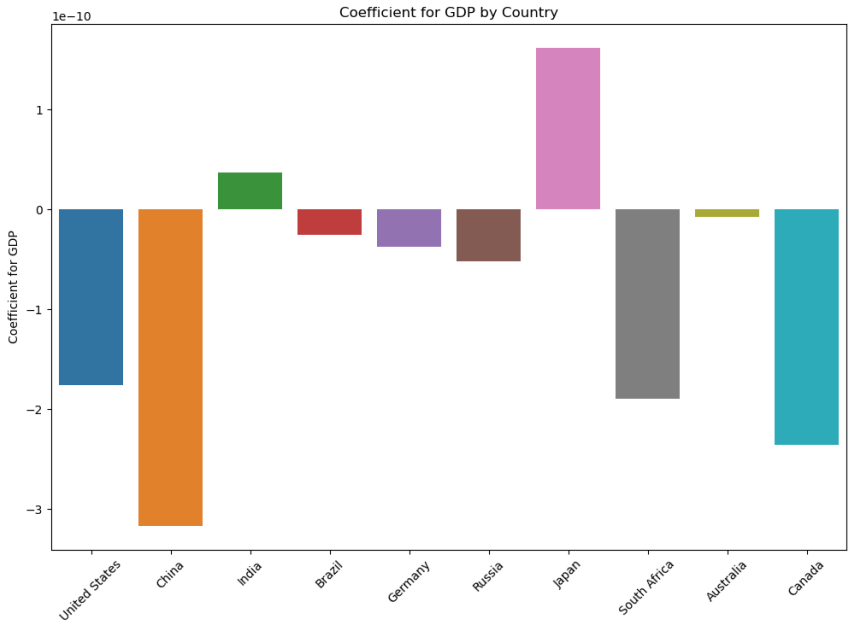
- **Energy Consumption Coefficient Comparison:**



- **Findings:**
- **China:** Highest coefficient, strong link between energy consumption and CO2 emissions. This suggests that any increase in energy consumption leads to a significant increase in CO2 emissions.
- **United States, Russia, India:** Strong positive coefficients, significant impact of energy consumption on CO2 emissions.

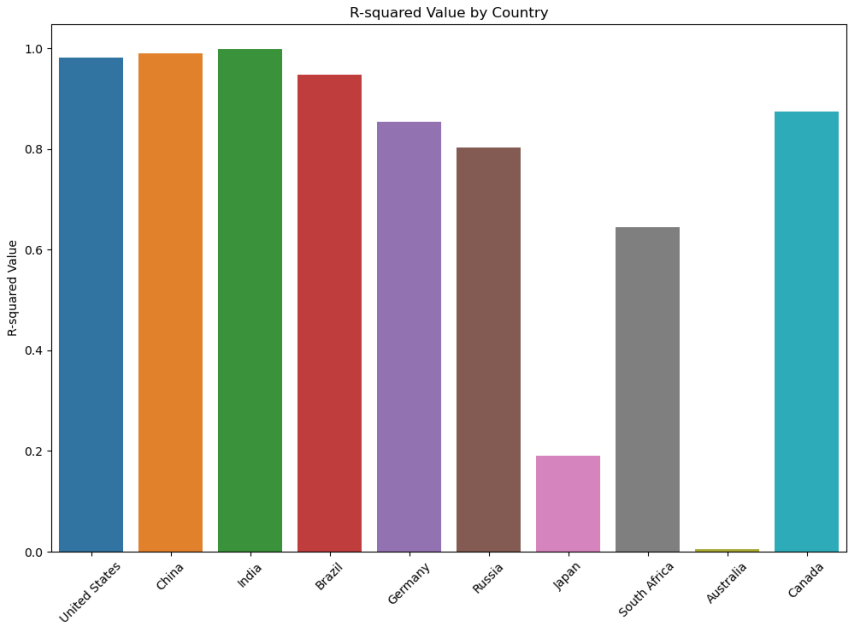
- **Brazil, Germany, South Africa, Canada:** Moderate coefficients, moderate impact on CO2 emissions.
- **Japan, Australia:** smaller impact on CO2 emissions, likely due to efficient energy use or cleaner energy sources.

- **GDP Coefficient Comparison:**



- **Findings:**
- **Japan, India:** Positive GDP coefficients; higher GDP correlates with higher CO2 emissions, indicating economic growth increases emissions.
- **United States, China, Brazil, Germany, South Africa, Australia, Russia, Canada:** Negative GDP coefficients; higher GDP correlates with lower CO2 emissions, suggesting economic growth is associated with more efficient or cleaner energy use, reducing emissions.

- **R-squared Value Comparison:**



- **Findings:**
- **United States, China, India, Brazil, Germany, Canada:** High R-squared values; primary energy consumption and GDP are strong predictors of CO2 emissions.
- **Russia, South Africa:** Moderate R-squared values; other factors may influence emissions.
- **Japan:** Low R-squared value; energy efficiency, renewable energy, or other factors may play a role.
- **Australia:** Lowest R-squared value; other factors likely influence emissions more significantly.

Conclusions

- **Key Findings:**
  - Strong positive correlation between primary energy consumption and CO2 emissions.
  - Significant variation in coefficients for energy consumption and GDP across countries.
  - China shows the highest energy consumption coefficient, while Japan and Australia have much lower coefficients, indicating more efficient energy use or reliance on cleaner energy.
  - The United States shows stable energy consumption and emissions, while China exhibits consistent increases, emphasizing the need for efficiency measures.
- **Limitations and Future Research:**
  - Analysis may not account for all factors influencing CO2 emissions and energy consumption, such as technological advancements, energy policies, and socio-economic conditions.
  - Future research should consider more granular data and explore specific policies, technological changes, and economic factors on emissions.
  - Examining renewable energy adoption and energy transition policies could provide deeper insights.

This report provides a detailed analysis of CO2 emissions and energy consumption patterns across ten countries, using statistical techniques and visualizations to draw meaningful insights and implications.