Evaluating the correlation between myriad Climatic variables and GDP: A Comprehensive Analysis of historical trends and future projections on Gross Domestic Product

Homework-3
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Written by
Roshni Govind, Vibha Visvanathan, Pranav Dharmadhikari

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1. Introduction

This study delves into the intricate relationship between Gross Domestic Product (GDP) and climatic variables, with a specific emphasis on temperature and precipitation. The exploration of these pairwise comparisons aims to unveil the interactions between economic prosperity and environmental conditions. Through a thorough analysis, the objective is to identify patterns, correlations, and potential implications, contributing to a deeper understanding of the impact of climate change on economic indicators.

2. Pairwise Comparisons

We first explore the pairwise comparisons between GDP and climatic variables, focusing on temperature and precipitation.

2.1 GDP vs. Temperature

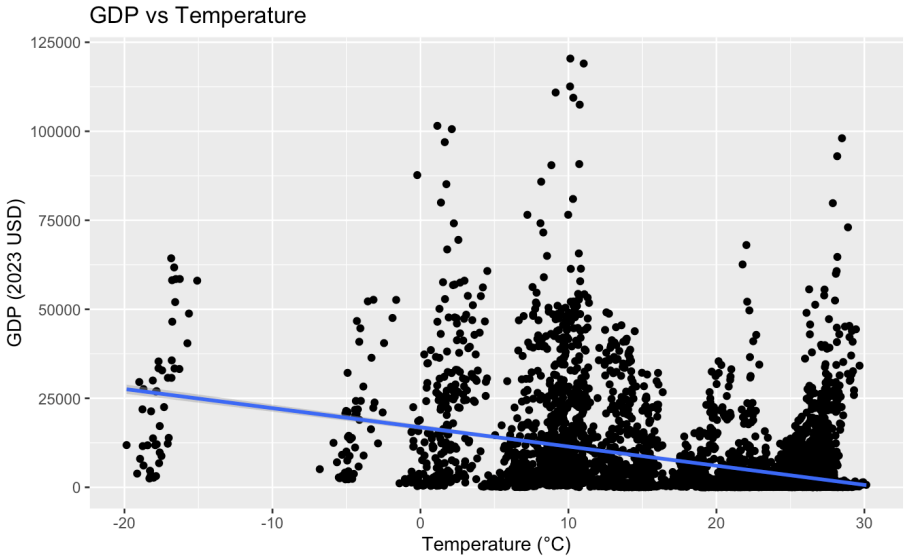

Figure 2.1.1 *GDP vs Temperature graph*

The GDP and temperature have a strong negative correlation, as shown by the correlation coefficient of r = -0.3869: as the temperature rises, GDP decreases. This trend is well-illustrated by the scatterplot, which shows that GDP decreases as temperatures rise.

The moderately strong coefficient of -0.3869 indicates a significant relationship between the two variables, even though correlations do not prove causation.

2.2 GDP vs. Precipitation

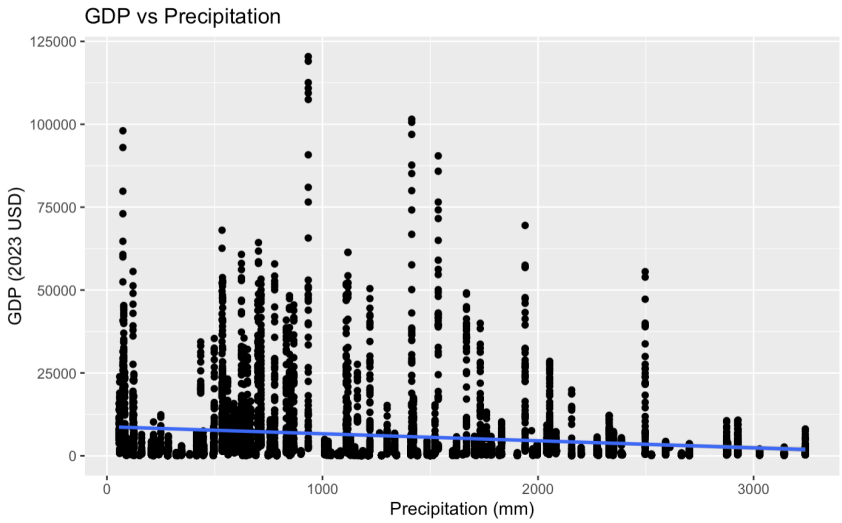

Figure 2.2.1 *GDP vs Precipitation graph*

GDP and precipitation have a weakly negative correlation (r = -0.1461), according to the correlation coefficient. Precipitation shows a slight decreasing trend in tandem with GDP, but the correlation is much weaker than the one between GDP and temperature.

The scatter plot demonstrates how precipitation varies for all GDP levels over the whole range, however the data also shows a slight downward slope. This is in contrast to the temperature scatterplot, which made the GDP's downward drift very apparent.

3. Visual Representations

3.1 Historical Changes in GDP

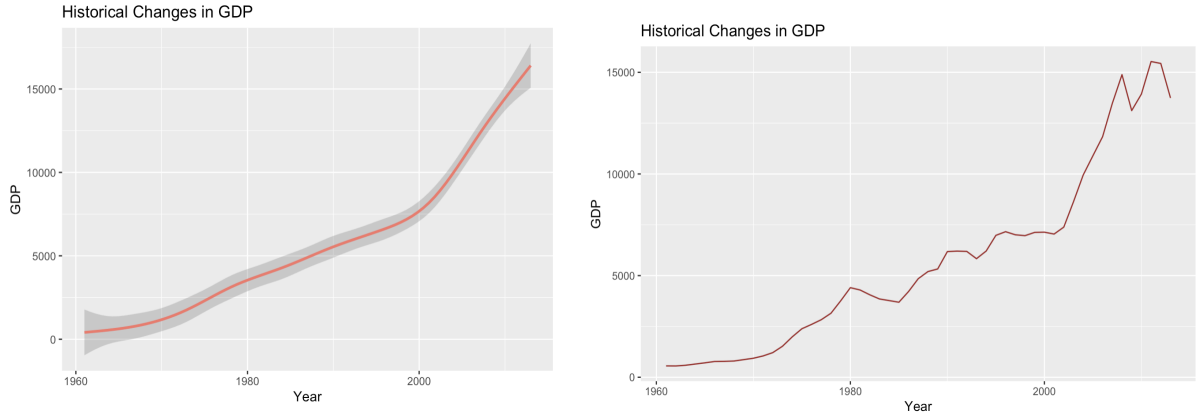

Figure 3.1.1 & Figure 3.1.2 *Historical Changes in GDP*

The plot illustrates a pronounced upward trajectory, indicating a steady increase in GDP over the years. However, the growth pattern observed in the second graph reveals a uniform trend between 1990 and 2000. It's important to note that the source of this rise cannot be attributed to a specific country, as the averages are computed across all countries. Nevertheless, the overall trend over time demonstrates a consistent upward movement, reflecting substantial positive economic developments.

3.2 Historical Changes in Temperature

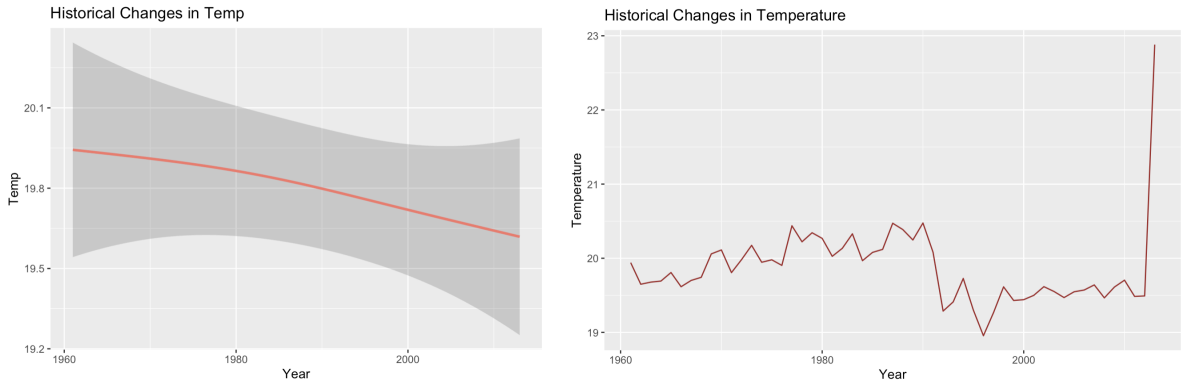

Figure 3.2.1 & Figure 3.2.2 *Historical Changes in Temperature*

The variations in temperature over the years exhibit substantial fluctuations; particularly notable is a consistent dip from 1990 to approximately 1997. This observed pattern could indicate a suggestive cooling trend in the climate. While the decline is gradual and not sharply steep, it implies a sustained and relatively steady temperature reduction.

3.3 Historical Changes in Precipitation

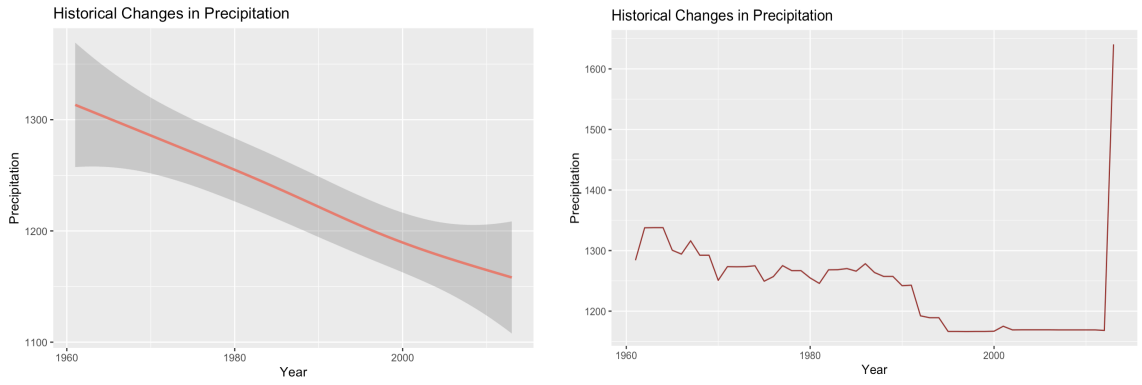

Figure 3.3.1 & Figure 3.3.2 *Historical Changes in Precipitation*

The plot depicting the relationship between the years and precipitation initially reveals a moderately descending slope, leveling off after a certain period. This trend suggests a potential decrease in the

amount of rainfall or other forms of precipitation. The noticeable steepness of the slope implies a swift decline in precipitation levels.

4. Model Estimates

The linear regression model yields several key insights:

1. The intercept of -5.233 indicates the estimated GDP when all independent variables equal 0. The coefficients show temperature has the most significant effect on GDP - a 1 unit increase in temperature decreases GDP by approximately 5.233, holding other variables constant. Precipitation and year have more minor effects, with 1 unit increase decreasing and GDP increasing by 2.464 and 2.715, respectively.
2. The p-values for the intercept, temperature, and year are statistically significant (less than 0.05), meaning these variables have a demonstrable effect on GDP. However, the p-value of precipitation shows no significant impact on GDP.
3. The R-squared value of 0.2 indicates the model explains only 20% of the variance in GDP. This means a large portion of GDP variability remains unaccounted for by the predictors.

In summary, the model confirms temperature as the most impactful variable with a significant adverse effect on GDP. However, the low R-squared suggests other unmodeled factors substantially influence economic growth.

5. Future Predictions of GDP based on climatic conditions

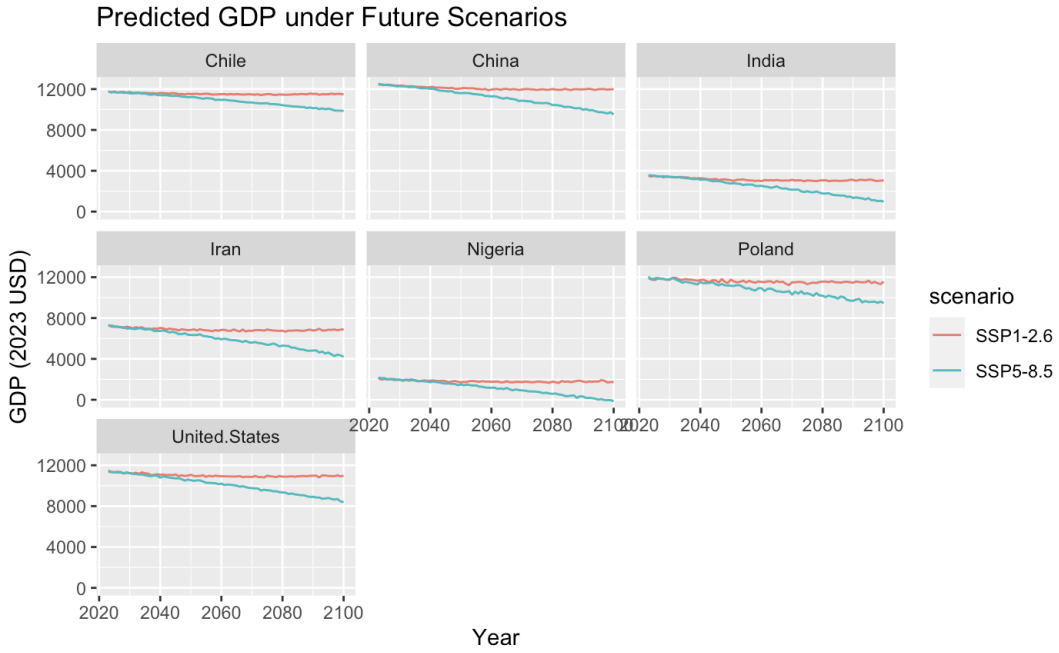

Figure 5.1 *Future Predictions of GDP based on climatic conditions*

The forecast for future years, based on upcoming data, delineates the trajectory of GDP changes across different countries under the scenarios of SSP1 and SSP5, representing minimum and maximum impact, respectively. A prevailing trend in numerous nations indicates a diminishing GDP value over the next 80 years.

Specifically, the projections for the period 2023 to 2100 underscore distinct patterns in GDP evolution under the influence of the two scenarios. SSP5 reveals a marked and rapid decline in the coming years for most countries, suggesting that heavy reliance on fossil fuel development might adversely impact temperature levels and, consequently, may not be the most advantageous scenario for enhancing the overall GDP of the specified countries in the dataset. Conversely, the gradual and sustainable trajectory of SSP1 results in a steady increase, as evident in the diagram. This measured growth is poised to yield more favorable outcomes over an extended period compared to the alternative scenario, which points to an immediate decrease in the future.

6. Future Scope and Evaluation:

Suggestions for additional data or analyses that may be useful for evaluating the impact of climate change on gross domestic product (GDP):

- Expand the set of climate variables under examination beyond temperature alone to also include precipitation patterns, extreme weather events, drought, sea level rise, and other variables that can impact key sectors.
- Consider factors such as population growth, migration patterns, education levels, inequality, strength of institutions, and other socioeconomic factors that can exacerbate or mitigate climate impacts.
- Account for investments into climate resilience and green technology adoption, which could dampen economic declines from climate change. Analyze impact variability based on such adaptation measures.

7. Conclusion

Our research concludes that there is an inverse relationship between GDP and temperature and GDP and precipitation meaning that GDP tends to decline as temperatures/precipitation rises. But in the case of Precipitation vs GDP, the effect is less noticeable. Historical patterns show a drop in precipitation with a steep negative slope as compared to the temperature swings. Historical data also suggests a steady increase in GDP. According to the linear regression model, the most significant factor adversely affecting GDP is temperature. Forecasts for the future point to a general decline in GDP, particularly a steep decline in scenarios involving the rapid expansion of fossil fuels i.e. SSP5-8.5 which represents a future which is characterized by rapid and fossil-fueled development as compared to SSP1-2.6 which indicates a shift towards a more sustainable future. We suggest adding more climate variables, taking socioeconomic aspects into account, and evaluating the effects of adaptation strategies for future research. In conclusion, our research highlights how critical it is to address climate change in order to promote sustainable economic growth.