

Final Report

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Introduction and Data

Climate change is one of the world's most pressing issues, and it is unique in the way it will affect every country in the world, regardless of their contribution to the issue. Because of this, questions of who should pay for carbon abatement, climate mitigation and adaptation inevitably arise during international climate negotiations. To inform these decisions, we sought to answer the question: Is economic development correlated with increased greenhouse gas emissions? To answer this central question, we explored the relationship between key indicators of economic development and countries' greenhouse gas (GHG) emissions using descriptive statistics and hypothesis testing.

The data used in our analysis is from the World Bank's public datasets: the World Bank Corporate Scorecard and the World Development Indicators. The four variables analyzed in our research were GHG emissions per capita – our outcome variable, and gross domestic product (GDP) per capita, GDP per capita growth (over one year), and countries' Gini Index – our predictor variables. All data used is from 2022, as this was the year with the most data points for all four variables. GDP per capita is measured in 2025 US dollars. GDP per capita growth is measured as the percent change in a country's GDP per capita from 2021 to 2022. The Gini Index provides relative scores of economic inequality ranging from 1 to 100, with 100 indicating perfect inequality and 1, perfect equality. GHG emissions per capita are measured as a country's total emissions (in tons) per person of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons and sulphurhexafluoride emissions standardized to CO equivalent values.

Initial data analysis and scatter plot visualization indicated a possible, very weak, negative linear relationship between the Gini index and GHG emissions, as shown in Figure 1 below. Figure 2 shows an apparent positive correlation between GDP per capita and GHG emissions per capita. Intuitively, you would expect that if GHG emissions per capita increase as GDP per capita increases, then emissions will also increase as GDP growth increases. However, Figure 3 shows no clear linear relationship between GHG emissions per capita and the percent change in GDP per capita.

Figure 1: Gini Index vs GHG Emissions Per Capita

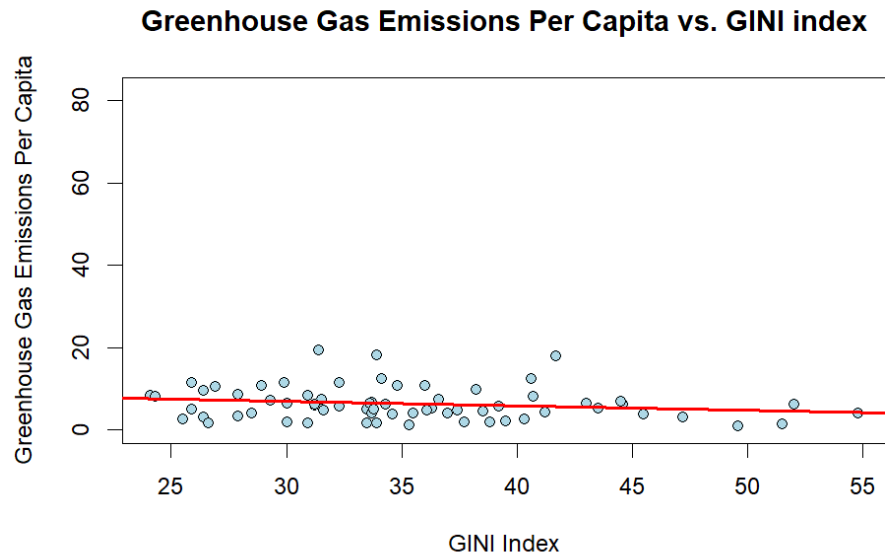


Figure 2: GDP Per Capita vs GHG Emissions Per Capita

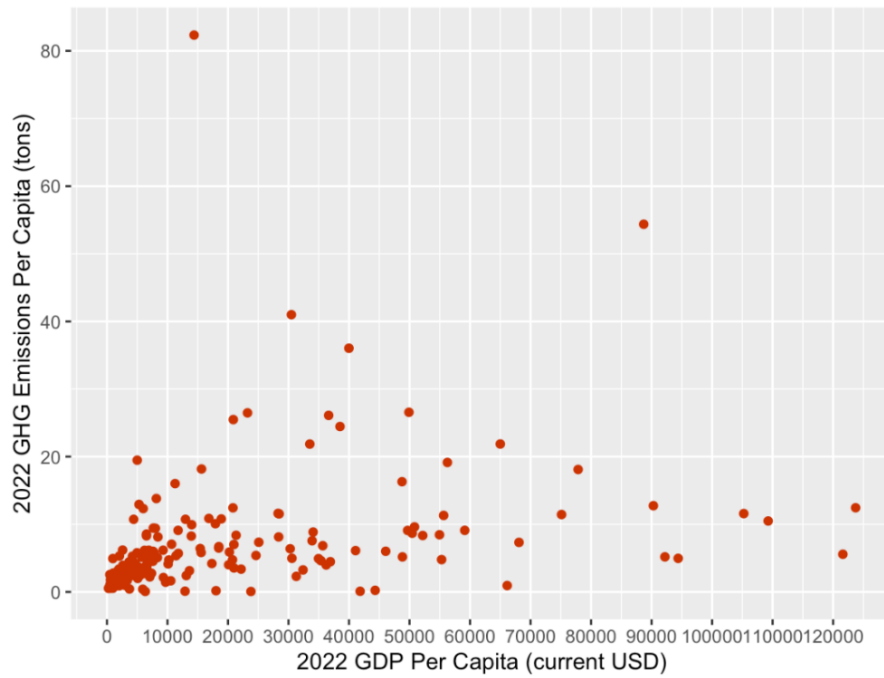
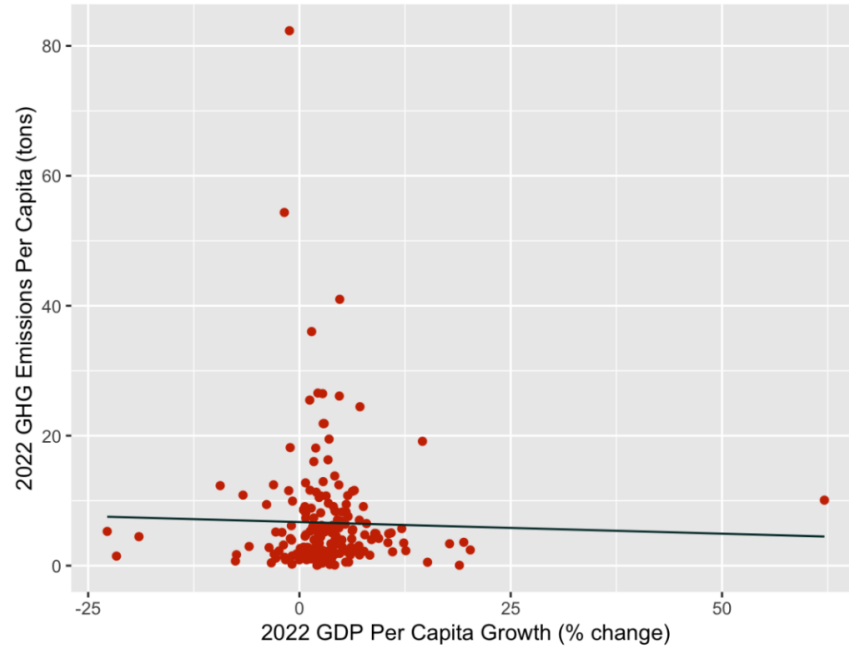


Figure 3: GDP Per Capita Growth vs GHG Emissions Per Capita



Methodology

The first part of the process in hypothesis testing was to create the data set with all the variables. Initially, there were three original data sets for each of the variables to be tested: GINI index, GDP per capita, and GDP per capita growth. To be as current as possible but also consistent, for each variable only the data from the year 2022 was selected. The data was then cleaned, filtered to remove any invalid or missing entries, and then merged into a new Excel file that was used to perform the hypothesis tests and linear regressions.

The hypothesis test used for this research was a one-tailed t-test which uses the t-statistic to determine if the correlation differs significantly from zero. This test assumes that the data/observations are randomly sampled, independent, continuous, and normally distributed. For each of the variables the following hypotheses were used:

- **Null hypothesis:** ($H_0 = 0$) There is no correlation between the variable and the greenhouse gas emissions per capita.
- **Alternative hypothesis:** ($H_0 > 0$) There is a positive correlation between the variable and greenhouse gas emissions per capita.

More specifically, a right-tailed t-test was chosen because the expectation was for there to be a positive relation between the independent variables and greenhouse gas emissions per capita. This aligns with the premise of this research project which was to determine whether countries with more wealth also tend to produce higher levels greenhouse gas emissions.

Results

Discussion & Conclusion