The Efficacy of Environmental Policy and its Impact on GDP

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Introduction

Since the Industrial Revolution, humanity has been burning fossil fuels and emitting CO_2 at an ever-increasing rate. CO_2 and other greenhouse gases absorb heat from Earth's surface and can reflect it back—trapping the heat and causing temperatures to rise.

US Real GDP rose from ~$15.3 billion in 1800 to ~$18.4 trillion in 2021.

US Annual CO_2 emissions has climbed from ~250,000 tonnes to over 5 billion tonnes in that same time.

The relationship between progressive environmental policies and GDP needs to be studied for sustainable economic growth.

*US Real GDP is measured in 2011 Dollars

Introduction: Environmental Policy

Since the discourse on climate change and CO2 emissions has risen, there have been many calls to pass legislation that aims not only to reduce CO2 emissions but also preserve other aspects of the environment. Intuitively, one would expect this to hinder economic growth. We examine this in our paper.

Practical Problem: Environmental policies are often blocked from being passed due to the discourse that surrounds potential negative effects on the economy.

Preliminary Data Analysis - Global Emissions

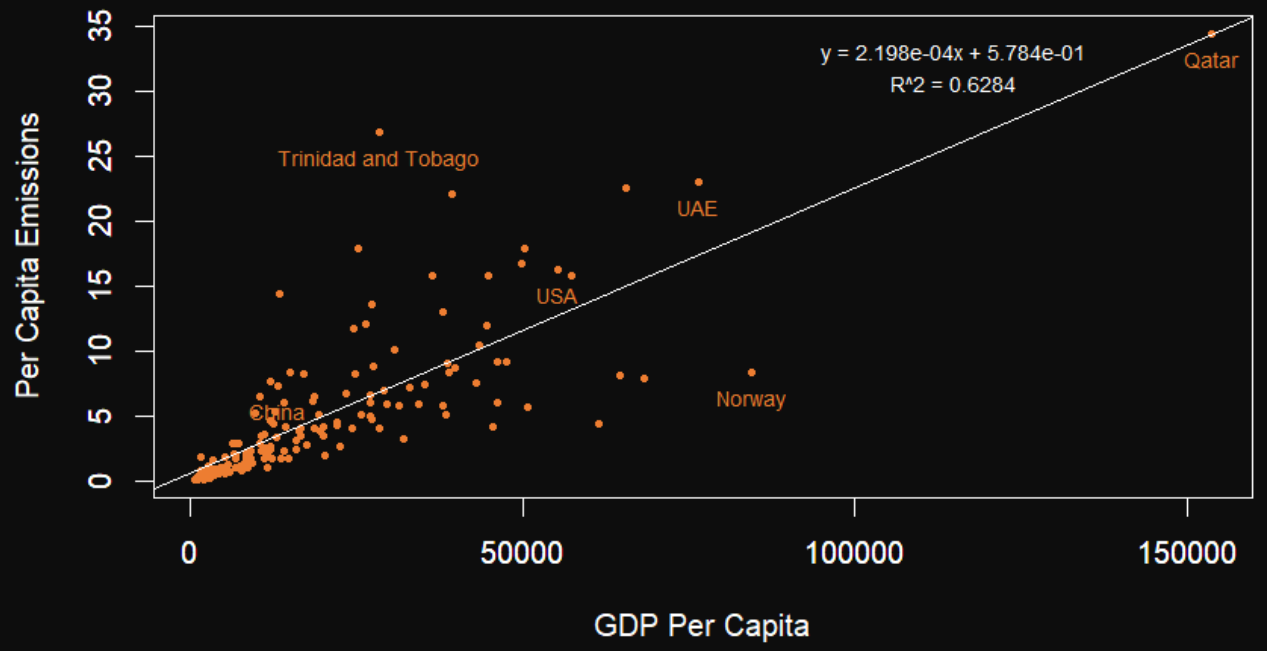


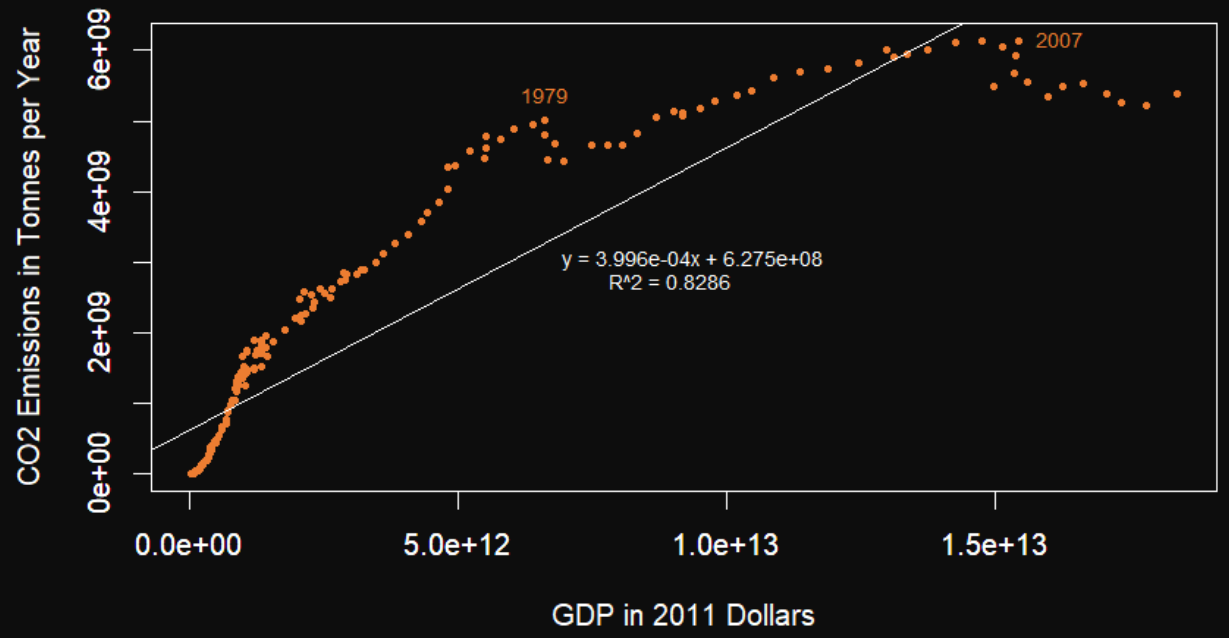
Figure 1:

World per Capita Emissions vs GDP per Capita by Country

Preliminary Data Analysis - US Emissions

Figure 2:

CO2 Emissions, in Tonnes per Year, vs GDP, adjusted for 2011 dollars, from years 1800 - 2018



Research Question

- **Research Question:** To what extent do environmental policies impact GDP and how effective are they?
  - Significance: Answering this question and determining the relationship between the two can help inform policy-making and in certain cases promote environmental policies for economic growth.

- **Research Problem:** How can we measure the efficacy of environmental policies for analysis on their relationship with GDP?

A Measure for Environmental Policies – EPI

- EPI refers to the **Environmental Performance Index** (EPI), a comprehensive and quantitative measure that assesses the environmental performance of countries around the world.
- The EPI is a composite index that combines multiple environmental indicators into a single score. Divided into two large categories: Environmental Health and Ecosystem Vitality.
- Can act as a measure for efficacy and presence of environmental policies in a country.
- Includes a range of indicators that directly reflect the presence of environmental policies - air quality management, water quality and sanitation, climate and energy policies.

Composition of the EPI

Statistical Weightings Used for the 2016 EPI

EPI	Objective	Issue category	Indicator
EPI	Environmental health (50%)	Health impacts (33%)	Environmental risk exposure (100%)
		Air quality (33%)	Household air quality (30%)
			Air pollution - Average exposure to PM2.5 (30%)
			Air pollution - PM2.5 exceedance (30%)
			Air pollution - Average exposure to NO_2 (10%)
		Water and sanitation (33%)	Unsafe sanitation (50%)
			Drinking water quality (50%)
	Ecosystem vitality (50%)	Water resources (25%)	Wastewater treatment (100%)
		Agriculture (10%)	Nitrogen use efficiency (75%)
			Nitrogen balance (25%)
		Forests (10%)	Tree cover loss (100%)
		Fisheries (5%)	Fish stocks (100%)
		Biodiversity and habitat (25%)	Terrestrial protected areas (national biome weights) (20%)
			Terrestrial protected areas (global biome weights) (20%)
			Marine protected areas (20%)
			Species protection (national) (20%)
			Species protection (global) (20%)
		Climate and energy (25%)	Trend in carbon intensity (75%)
			Trend in CO_2 emissions per KWH (25%)

Note. Source: EPI (2016a; 2016b).

Model Specification

Variables used: GDP per Capita, EPI, ΔGDP per capita, ΔEPI.

Control variables to potentially use: Population (accounted for in capita), Index for Geographic Characteristics, Energy Consumption, Literacy rate, Political Stability (Corruption indices), Fragile States Index, Unemployment Rate, Press Freedom Index.

Model 1 (Cross Sectional):

$$GDP = B0 + B1EPI + ui$$

Model 2 (Panel):

$$\Delta GDP = B0 + B1\Delta EPI + ui$$

Data

- C02 emissions by GDP per Capita – Data received from Our World in Data, for population, GDP, and C02 emissions.
    - https://ourworldindata.org/grapher/co2-emissions-vs-gdp
- Uses EPI: released by Yale Center for Environmental Law & Policy (YCELP) and Center for International Earth Science Information Network (CIESIN) at Columbia University.
    - https://epi.yale.edu/

Regression 1

Table 1: EPI in 2018 vs GDP per Capita

Table 1:

	Dependent variable:
	GDP.per.capita
epi18	1,019.800***
	(96.959)
Constant	-38,786.710***
	(5,724.193)
Observations	145
R^2	0.436 Adjusted
R^2	0.432
Residual Std. Error	15,640.570 (df = 143)
F Statistic	110.624*** (df = 1;
143)	
Note:	*p<0.1;* ***p<0.05;****p<0.01*

Regression 2

Table 2: Average Change in EPI vs Average Change in GDP from 2016-2018

Table 2:

	Dependent variable:
	meanGDPGrowth
meanEPIGrowth	-2,654,507,655.000*
	(1,521,966,818.000)
Constant	3,289,743,731.000
	(10,201,480,188.000)
Observations	113
R^2	0.021
Adjusted R^2	0.014
Residual Std. Error	62,843,479.000 (df = 114)
F Statistic	3.042* (df = 1; 144)
Note:	*p<0.1;*
***p<0.05;**p<0.01*	

Results

- The slope coefficient in the first model is positive and statistically significant at the 1% level
- This suggests a positive correlation between EPI and GDP per capita
- The slope coefficient in the second model is negative and statistically significant at the 10% level
- Although less significant, this does suggest that an increase in EPI has a negative effect on GDP

Conclusion

- The positive relationship between EPI and GDP per Capita in our cross-sectional analysis suggests that more stringent environmental policies are more often found in countries with higher GDP
- The negative relationship between change in EPI and change in GDP suggests that developing and tightening environmental policies can have a negative effect on GDP
- Further analysis on this negative relationship on specific portions of EPI (air pollution, nitrogen balance CO2 emissions) will be made to identify the most effective types of legislation

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