

International Environmental Policy Agreements and their Effect on Reduction of Greenhouse Gases

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Regression Results

VARIABLES	(1) Total Greenhouse Gas Emission	(2) Total Greenhouse Gas Emission	(3) % Change Greenhouse Gas Emission	(4) % Change Greenhouse Gas Emission
GDP 1990	-19.86 (19.87)	-88.13*** (31.25)	-0.092 (0.15)	-0.73*** (0.25)
% Change GDP		6,132.124** (2,601.90)		64.488*** (23.19)
Renewable Resources 1990	-6,566.07 (13,436.41)	-20,336.491 (13,135.19)	12.20 (99.12)	-89.92 (95.89)
% Change Renewable Resources		-737,128.21 (2,978,694.67)		717.24 (21,835.84)
Fossil Fuel 1990	-5,153.27 (13,212.69)	-17,410.87 (12,894.01)	24.81 (97.92)	-48.13 (94.35)
% Change Fossil Fuels		-1,496,921.99 (2,733,874.28)		-2,532.43 (20,035.21)
Crude Oil Production 1990	9.02*** (2.50)	8.03*** (2.36)	0.019 (0.018)	0.009 (0.017)
% Change Crude Oil Production		4,039.96*** (872.16)		30.77*** (6.48)
Industry 1990	-3,880.96 (13,891.72)	-24,259.43 (17,596.12)	-2.14 (102.99)	-161.92 (94.35)
% Change Industry		835.54 (5,886.87)		7.47 (42.96)
Constant	1,022,534.50 (1,396,451.33)	2,782,593.91** (1,389,572.22)	3.82 (10,310.42)	11,908.93 (10,166.03)
Observations	82	75	80	73
R-squared	0.163	0.387	0.027	0.306

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

VARIABLES	(1) Natural log of Greenhouse Gas Emission	(2) Natural log of Greenhouse Gas Emission	(3) Natural log of Greenhouse Gas Emission	(4) Natural log of Greenhouse Gas Emission
GDP 1990	-0.000164 (0.000)	-0.0000172 (0.000)	-0.0000168 (0.000)	-0.0000373 (0.000)
% Change GDP		-0.001 (0.002)		0.002 (0.003)
Renewable Resources 1990	-0.028*** (0.010)	-0.027*** (0.010)	-0.025* (0.013)	-0.032** (0.014)
% Change Renewable Resources		4.426* (2.400)		0.960 (3.146)
Fossil Fuel 1990	-0.024** (0.010)	-0.021** (0.010)	-0.021 (0.013)	-0.025* (0.014)
% Change Fossil Fuels		4.367** (2.166)		1.270 (2.888)
Crude Oil Production 1990 (in millions)	0.0106*** (0.000)	0.00201*** (0.000)	0.0104*** (0.000)	0.00949*** (0.000)
% Change Crude Oil Production		0.001** (0.001)		0.002** (0.001)
Industry 1990			-0.011 (0.013)	-0.030 (0.019)
% Change Industry				-0.003 (0.006)
Constant	13.86*** (0.97)	13.78*** (0.98)	14.03*** (1.35)	15.09*** (1.47)
Observations	112	108	82	75
R-squared	0.281	0.347	0.235	0.310

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

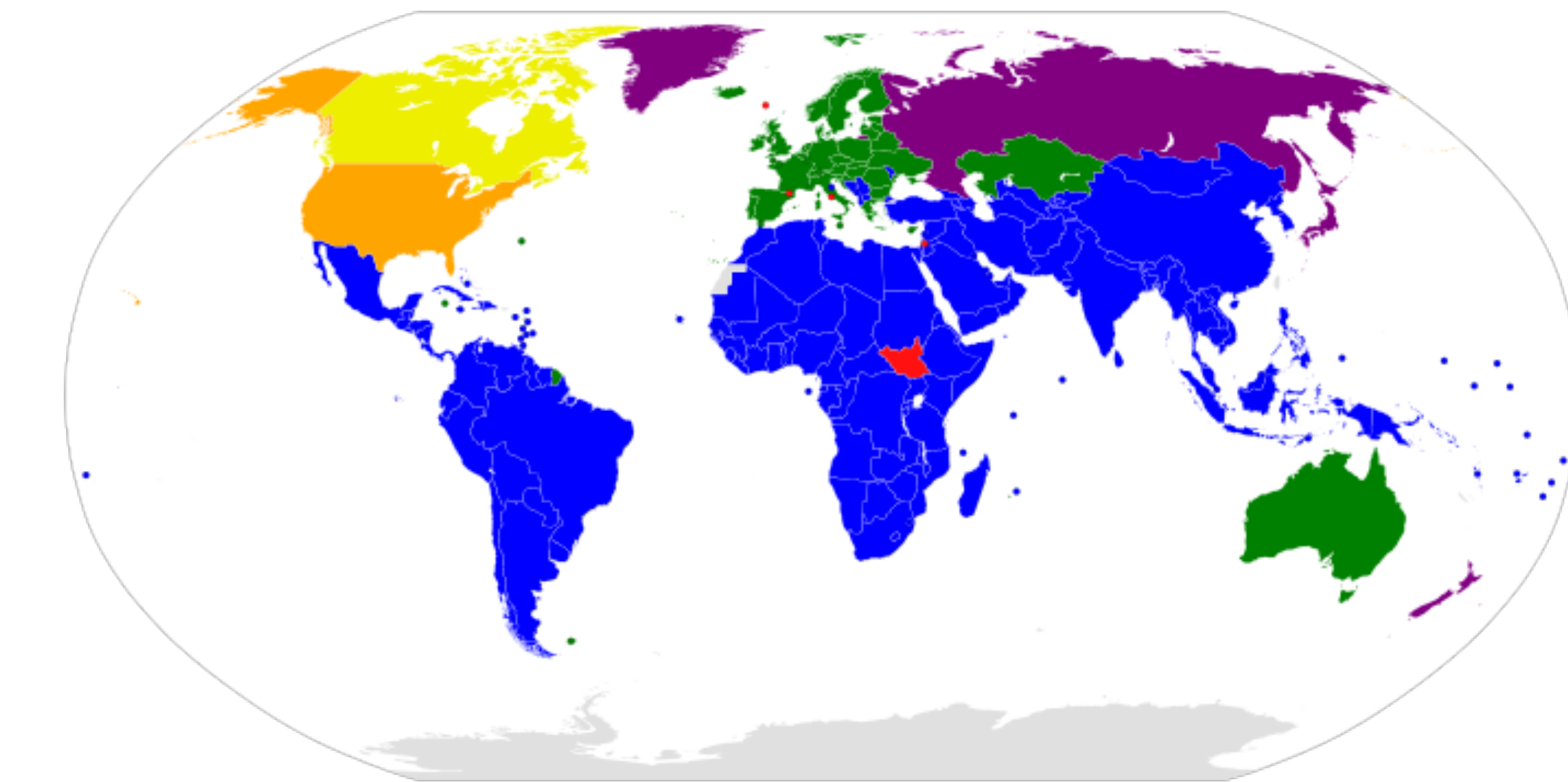
Abstract

The emission of greenhouse gases is the primary source of environmental degradation leading to climate change. The gases released by one country create externalities that affect all other countries since the effects of pollution are not localized. Several international conferences have resulted in agreements aiming to hold countries accountable for reducing emissions. These conferences have been held with the expectation of limiting climate change to less than two degrees Celsius annual increase in global temperature. A visual depiction of this trend is featured to the right. Before 2005, there were different, antagonistic schools of thought, resulting in failed consensus on how to handle these problems. The Kyoto Protocol, signed in 1997, is widely recognized as a failure in its inability to lead to major reduction of emission. Its failure can be partly contributed to this debate among countries. Exponentially growing developing economies such as China, India and Brazil claimed that reduction should be confined to the developed world, arguing that greenhouse gas emission was vital to their success in growing their GDP, as they are currently the largest developing economies, and do not want their growth to be restricted by these restraints. This thesis analyzes the measured change in emissions since 1990 across over 100 countries to determine how the GDP of a country in 1990 and the change of GDP since affect the change in emissions. The model controls for energy production and usage, and the changes of these numbers since 1990. All data are collected from The World Bank except oil production, which is obtained from the Organisation for Economic Cooperation and Development (OECD). This analysis aims to contribute to research on the progress of limiting greenhouse gas emission and conversion to renewable energy sources. It also draws attention to the relationship between emissions and GDP as major emerging market economies are likely to be the largest source of future emissions. They can choose to develop using technologies that are more environmentally friendly than the technologies that have been used historically.

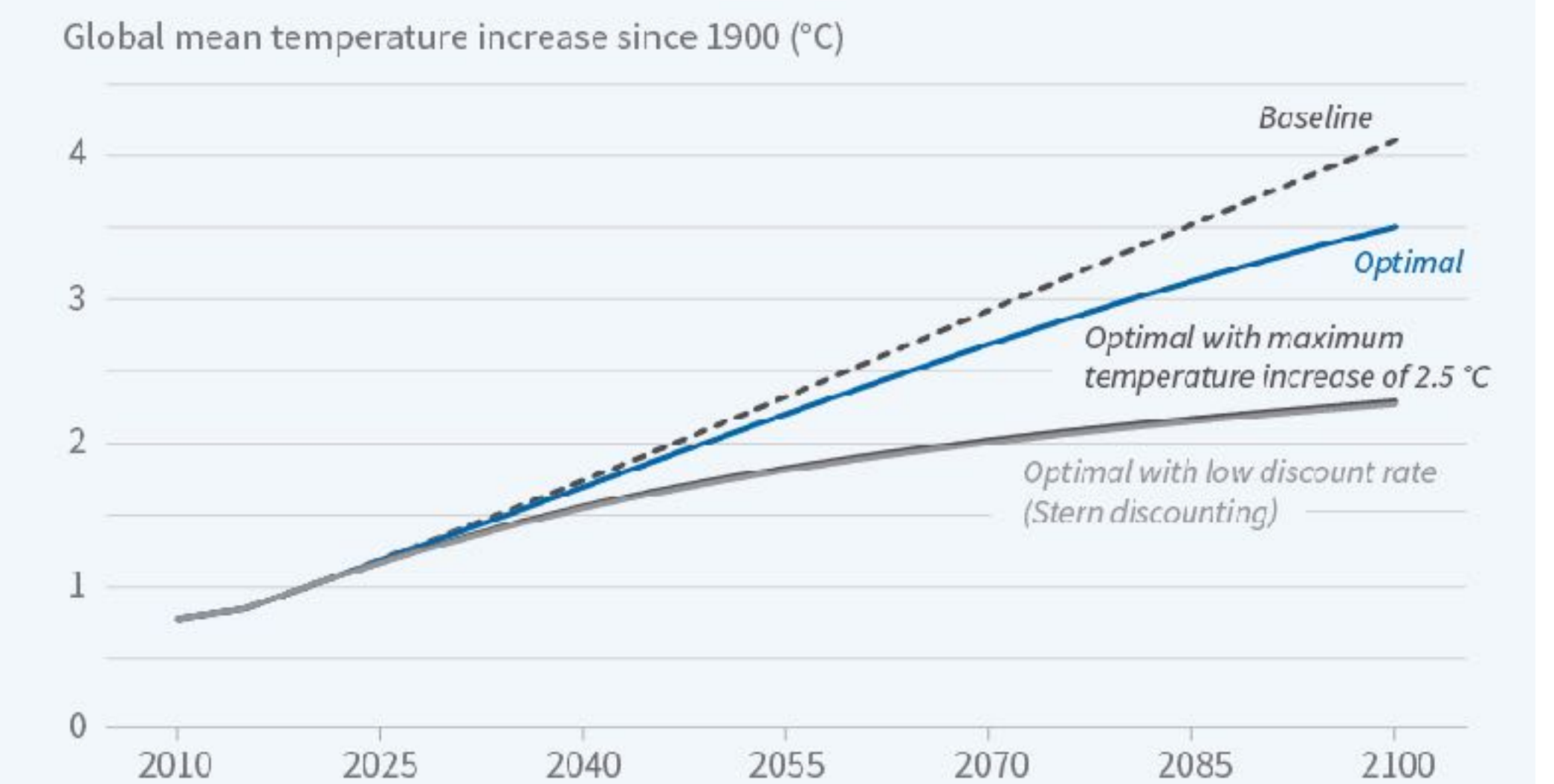
International Policy Agreements

VARIABLES	(1) Percent Change GDP
GDP 1990	0.01*** (0.001)
Urban Population 1990	1.41*** (0.49)
% Change Urban Population	0.294 (0.365)
Crude Oil Production 1990	-0.000 (0.000)
% Change Crude Oil Production	-0.032 (0.03)
Renewable Resources 1990	1.19** (0.59)
% Change Renewable Resources	-74.12 (138.80)
Fossil Fuel 1990	1.29** (0.57)
% Change Fossil Fuels	-73.85 (126.29)
Constant	-168.32*** (63.91)
Observations	115
R-squared	0.670

The Kyoto Protocol was signed December 1997 with 84 signatories. The map on the right depicts the countries involved. Purple countries are Annex B parties with binding targets only in the first period, which began in 2008 and ended in 2012 when the second period began. Green countries are Annex B parties with binding targets in the second period. Blue countries do not have binding targets. Yellow countries had binding targets in the first period but withdrew. Orange depicts the United States who was a signatory that had never been ratified. Red depicts UN members who did not participate in the agreement. The Protocol is recognized as a failure in its effectiveness of emission reduction by the major emitters. The Copenhagen Accord advocated for the continuation of the Protocol but without the binding goals. Dellink and others (2011) found the goals they advocated for in this agreement are not ambitious enough in limiting average global temperature increase to below two degrees Celsius. They found that to limit temperature increase to this extent it would cost around 0.3% of GDP from Annex B and non-Annex B countries and 0.5-0.6% of global real income to achieve, but do not observe the countries individual goals to be at this level of commitment.



Temperature Change in Different Scenarios



Source: W. D. Nordhaus, NBER Working Paper No. 22933

Conclusion

The main regression results are presented above. The first column of the first table displays the results with the current greenhouse gas emission levels as the dependent variable run with the 1990 levels and no percent change variables. The coefficient indicates that if the oil production of one country is 1 unit (thousand metric ton) higher, current greenhouse gas emission increases by 9.023 kilotons. GDP per capita from 1990 is insignificant in this regression. The second regression on this table depicts the results when percent changes are included. The R-squared increases to 0.387 meaning that with the percent changes, 38.7% of current levels of greenhouse gas emission can be explained by the independent variables in this study. Here both GDP per capita variables, 1990 value and percent change, are statistically significant. The coefficient indicates that if the per capita GDP of one country in 1990 increases by \$US 1, current greenhouse gas emission decreases by 88.127 kilotons, this is holding percent change in per capita GDP constant. The coefficient indicates that if this percent change increases by 1 percentage point then current greenhouse gas emission increases by 6,132.12 kilotons. The mean of greenhouse gas emission is 288,126 which means that this growth is about 2.13% of the average emission per country. Since this is holding 1990 levels of per capita GDP constant, this relationship reflects the impact economic growth has on greenhouse gas emissions both in real and percent change terms. What this implies is that countries with a strong economy today and countries with a growing country have different effects on emission. Countries which had a stronger economy in 1990 have lower rates of emission today and countries whose GDP has grown have high rates of emission. The results of the regression in column 4 show that countries that started with a higher per capita GDP have a smaller percent change of emission while countries who have high percent growth of per capita GDP are emitting more. The regressions depicted on second show the results when the dependent variable is the natural log of current levels of greenhouse gas emission. The purpose of this is to capture exponential growth of emission. This is all consistent with the previous model. The most significant coefficient results from the final regression are that of percent of energy that comes from renewable resources in 1990. The coefficient indicates that with a one percentage point increase of energy coming from renewable resources, percent change of per capita GDP increases by 1.19 percentage points, significant at the 5% level. This result provides evidence that conversion to sustainable energy sources does not have a negative effect on growth of per capita GDP. The increase usage of sustainable energy sources has a possible correlation with GDP growth, even when controlling for initial level of per capita GDP.

Mexico and Brazil Case Study

When looked at in the cases of two countries who began 1990 with similar per capita GDP we can see the relationship between GDP growth and increased emission, for example Mexico and Brazil. The two countries are both located in South America and began 1990 with per capita GDP that varied by only 15.3 US dollars. Brazil had a per capita GDP increase of 4.6% greater than Mexico, this reflects a greater real change as well since Brazil began with the higher per capita GDP. Both countries experienced growth of urbanization, increase in percent of energy coming from fossil fuels and decrease of percent of energy coming from renewable resources. The decrease for energy coming from renewable energy sources for Brazil was from 94.5% to 73.1% while for Mexico it was only 24% to 17%. However, the percent increase of greenhouse gas emissions for Brazil is about double the percent change for increase of greenhouse gas emissions for Mexico, reflecting a higher real increase as well. This is true regardless of Mexico's lower percent usage of renewable energy sources and growing industrial economy. This case study directly shows a link between fast growing economies and greenhouse gas emission. Brazil does have a higher percent growth of urbanization, which could be grounds for future research on sustainable growth.

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