Verifying the validity of the EKC Theory using the national footprint, per capita GDP, and CO2&GHG data set

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Abstract

The research explores if the Environmental Kuznets Curve (EKC) theory is true. The national footprint, per capita GDP, and CO2&GHG data set were used during the research. The data retrieved from the research until now indicates that the EKC curve is true to a certain point, but is inconclusive to be proven as fully true. When more time should pass and more development in countries should occur, there may be more data to revisit the topic.

Economic development is fueled by energy consumption which inevitably leads to environmental degradation as approximately 84 percent of the global energy consumption is still coming from fossil fuels[1].

As an economy develops, its energy consumption increases, resulting in environmental degradation. This is inevitable as economic development leads to increased total production and thus more contamination. Moreover, countries that have achieved a certain level of economic development have more interest in increasing economic growth than in sustaining the environment. These factors combined attribute to a higher increase in environmental contamination.

The Environmental Kuznets Curve (EKC), named after Simon Kuznets who first made the idea of the kuznets curve, is used to describe the relationship between economic growth and environmental quality. The EKC highlights the contrast between the economies in different levels of development. In other words, as a country's economy first develops, there is a negative relationship where the quality of the environment gets worse. However, as it develops and reaches a certain threshold of development, this relationship eases and changes to a positive relationship where the quality of the environment gets better as the economy develops. Even if no perfect theoretical explanation of the curve exists, it is empirically discovered to be true.

This research aims to verify the validity of EKC with a novel approach. While other researchers tried to take a mathematical approach to describe the general formula of the curve, this paper utilizes python so it can plot all the data points and focus on the overall shape of the graph. As the EKC is not a firm fact, but an academically-confirmed phenomenon, focusing on the general shape itself would still achieve the objective. Most of the scholars use the level of Carbon Dioxide or Sulfur Dioxide to describe the level of environmental eradication. Instead, this research makes a shift in approach and employs the amount of built-up land in hectares required to support the Ecological Footprint of the country's total consumption.

The GDP per capita dataset, National Footprint, and CO2&GHG were used. The GDP per capita dataset was used because the EKC itself is a model that shows the relationship between environmental degradation and economic development, whereas the GDP is the most commonly used data to study a country's economic development. Still, there would have been some flaws if only the GDP data were used since a country such as India or China, whose economy is not yet fully developed but has one of the highest GDP in the world, could have acted as an outlier. Thus, the GDP per capita data set was used to

[1] bp. 2021. "Statistical Review of World Energy | Energy economics | Home." BP. https://www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html.

minimize the influence. Moreover, other studies related to the EKC also tend to use the GDP per capita data set.

The National Footprint was used to measure the level of environmental degradation. There is no feasible way for researchers to measure total environmental degradation with a single data set as there are so many different data that could be used. For example, the population of animals, fine dust concentration, or amount of landfills. For this research, the national footprint seemed the most effective since as humanity puts more strains on the environment, more land would be needed so that they would more fulfill the needs of humans. However, industries in developed countries, such as IT industries, do not need as much land as industries developed during the second industrial revolution, such as massive factories. This is because, for example, service-intensive industries that are a huge proportion in developed countries, do not need massive amounts of land. Also, while built-up land is crucial in the beginning stage of economic development, its needs get diminished as the development continues or by newly introduced environmental policies. The data sets, EFProd, EFCons, EFImport, EFExport, were all shown in both total and per capita. For this research, total built_up_land figures were used. This is because per capita data do not correctly represent the total environmental degradation in countries with a high population such as China or India.

The CO2&GHG data set was used because this is the most commonly known data set to measure environmental degradation, a crucial part of this research. While many different types of gas would be emitted, it is almost impossible to measure all so CO2&GHG was used as a representative. Also, many prevalent pieces of research about the EKC, and even environmental degradation, were based on this data. For this reason, this data was regarded as the most effective.

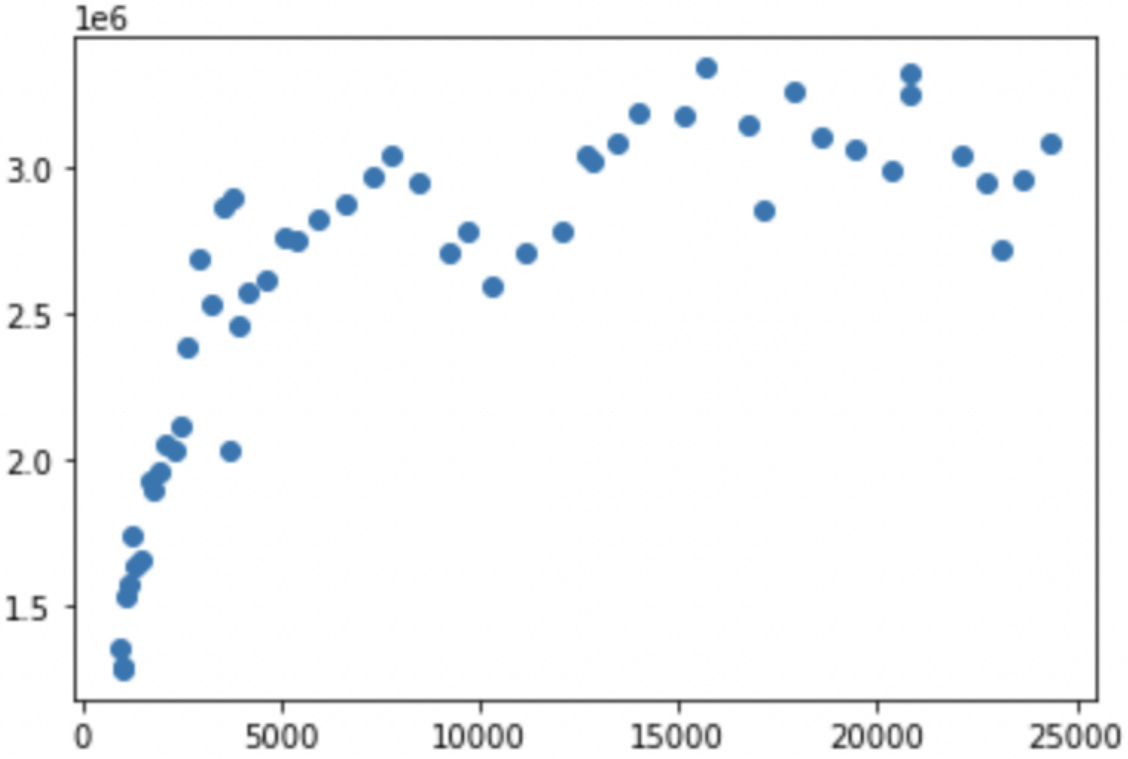

Exhibit 1: South Korea

Exhibit 2: United Kingdom

The graphs placed above are the graphs that have been retrieved from countries regarded as developed countries. While the graphs show a decreasing slope after the countries reach a certain point of GDP per capita, the plots do not come back down. This suggests that the countries have not yet been developed to a degree that the EKC indicates, or that the EKC is false. To check whether or not the EKC holds for the countries regarded as developed, more time should pass. Since most developed countries are making an effort to use more sustainable energy resources and implement policies that would protect the environment, the degree of environmental degradation in these countries could decrease more in the future.

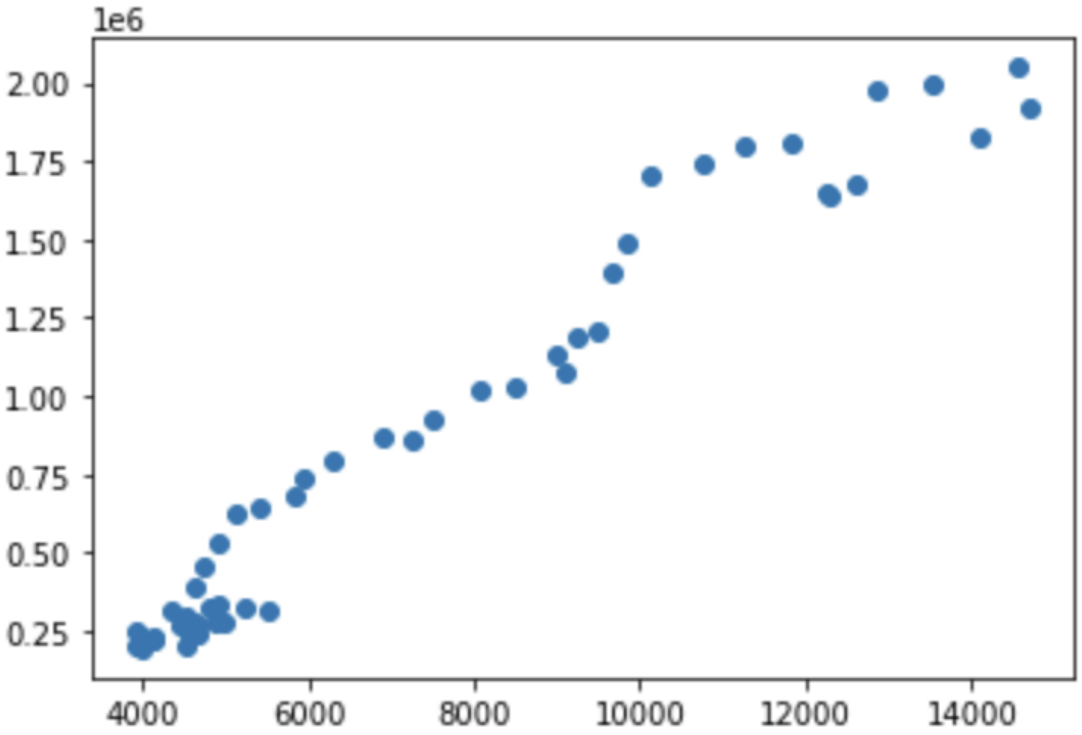

Exhibit 3: Chile

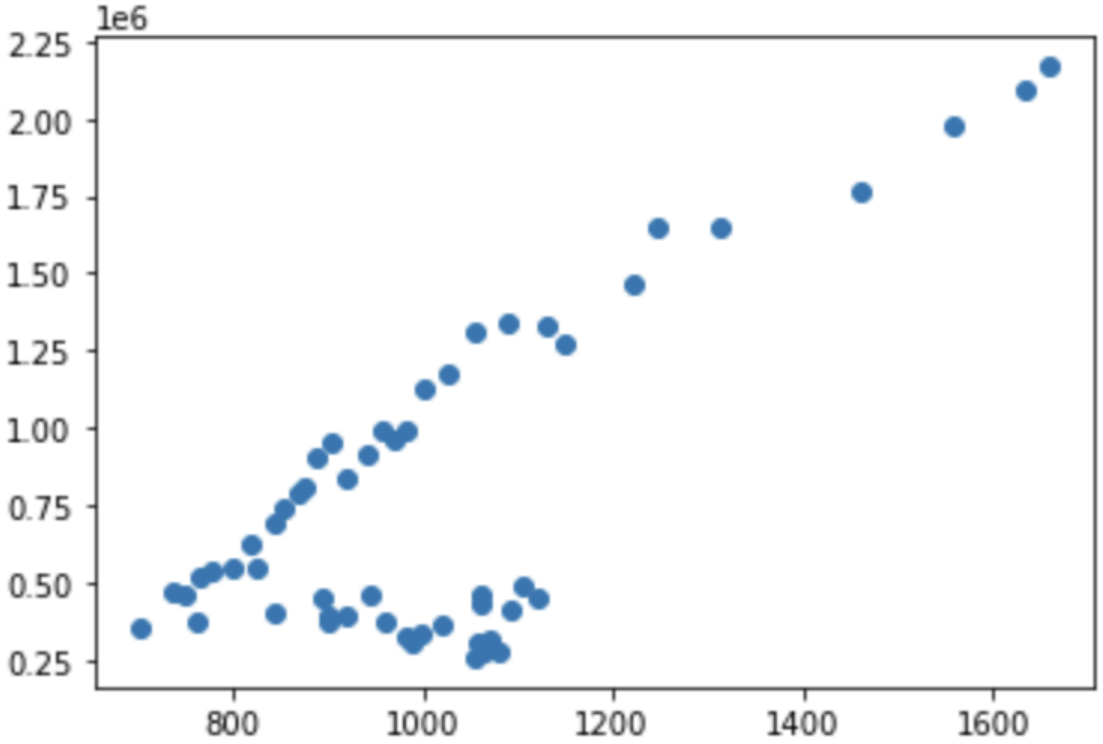

Exhibit 4: Ghana

The two graphs above are achieved from countries that are regarded as developing countries. The countries seem to have a constantly increasing slope in the graphs. This indicates that a part of the EKC is still true and shows when countries start to develop the environmental degradation increases. However, again, this cannot conclude whether or not the EKC is true. This only represents the beginning phase of the EKC, where countries are starting to develop. It would be impossible to determine whether or not the slope would change in the future.

There are two main reasons why the graphs would have shaped this way. One is that as countries develop more, the industry that they rely on for economical development changes. This leads to less National Footprint needed for development which could be inferred by looking at the change of National Footprint. Another reason is that countries that are still starting to develop put industrial and economic development as a priority rather than sustaining the environment, but they also focus on environmental conservation for their economic successes once developed enough. From the graphs achieved from countries regarded as developing countries and developed countries, this research failed to conclude whether or not the EKC theory is true. It could be the case that the country still has not developed to the degree where environmental degradation decreases or the EKC theory may not be true. In conclusion, this research showed that the EKC is still true to a degree, but more time would be needed in order to check the validity of the EKC theory as a whole.

During this research, some new questions arose. How can a country decrease its environmental degradation after its environment has already become polluted to a high degree? Would that even be possible? This question was based on the fact that, by looking at the graphs that were achieved during this research, the rate of increasing environmental degradation of each country decreased at a certain rate, but the graphs did not show the total environmental degradation rate going down. Afterward, in order to solve this question, there shall be research on how to decrease a country's general rate of environmental

degradation: not just ways to decrease its increasing rate of environmental degradation, but a way to make up for the environment that was already polluted. If this question is solved, the initial question about the validity of the EKC would be proven to a certain stance. Thus, further research shall be done on how to decrease the total environmental degradation.