

Measurement of The Role of Innovation in Increasing Environmental Performance Index: Empirical Study in Developed and Non-Developed Countries

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Info Articles

Keywords:
Environmental Performance Index, Government Effectiveness, Innovation, Education Index, SEM

Abstract

This study aims to analyze the effect of GDP per capita, government effectiveness, occupation index, population density and innovation on the environmental performance index. The approach used in this study is a type of quantitative approach. Data in this study were collected from 171 countries based on their income consisting of 52 developed countries and 119 non-developed countries. The data in this study were obtained from official websites and documents published by related sources including the Yale Center for Environmental Law and Policy, World Bank, United Nations Development Program (UNDP), and the Global Innovation Index. The analysis tool used is quantitative analysis of Structural Equation Modeling (SEM). The results of the study show that Government Effectiveness has a significant and positive relationship to the Environmental Performance Index. Per capita GDP has a significant effect and has a positive relationship to the Environmental Performance Index. The Education Index has no significant effect and has a positive relationship to the Environmental Performance Index. Population Density has a significant effect and has a negative relationship to the Environmental Performance Index. The innovation variable can mediate the effect of government effectiveness on the environmental performance index. The results of this study provide policy implications through innovation, developed and non-developed countries based on income, can optimize environmental development goals without trade off between economic and environmental factors.

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p-ISSN 2550-0368
e-ISSN 2549-0303

INTRODUCTION

The quality of the world's environment is declining marked by climate change and global warming. This is inseparable from the intervention of humans, beings who are touted as leaders on this earth. All human activities are always in contact with the environment and will directly or indirectly affect it. From the utilization of natural resources to meet their needs to daily activities which then cause pollution. Therefore, various efforts are needed to continue to protect the environment in order to support human survival in every country. In addition, so that the efforts made can be controlled and measured, a parameter is needed, one of the parameters that has been made is the Environmental Performance Index. This index was developed by Yale University and Columbia University.

The Environmental Performance Index in 2018 calculates the environmental performance of 180 countries based on 24 performance indicators on 10 problem categories covering environmental health and ecosystem vitality. The world's environmental performance is still quite far from achieving international targets. The world Environmental Performance Index score in 2018 was only 46.16, this was only slightly above the basic score obtained based on historical data for the last 10 years before 2018, which was 41.68. While the environmental health and ecosystem vitality scores were 31.50 and 55.93 respectively. In general, a high Index Score indicates a long-term commitment to protecting public health, conserving natural resources, and decoupling greenhouse gas emissions from economic activity (Wendling, Emerson, Esty, Levy, & Sherbinin, 2018).

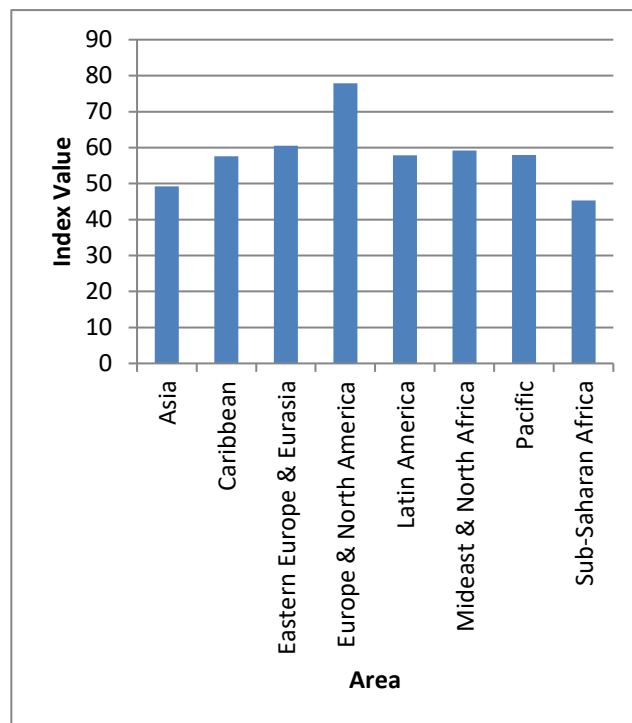


Figure 1. 2018 Environmental Performance Index by Region
Source: epi.yale.edu, 2018

The top Environmental Performance Index rankings in 2018 are dominated by countries in Europe and North America, which are occupied by developed countries. Switzerland has the highest rating on the Environmental Performance Index in 2018 with an assessment score of 87.42 in overall environmental performance. Apart from Switzerland, the ranks of the five countries with an Environmental Performance Index rating in 2018 were France (83.95), Denmark (81.60), Malta (80.9) and Sweden (80.51).

While the lowest ranked Environmental Performance Index is occupied by countries in the Sub-Saharan Africa region. The five countries ranked lowest in the 2018 Environmental Performance Index are Nepal (31.44), India (30.57), Democratic Republic of the Congo (30.41), Bangladesh (29.56), and Burundi (27.43). A low index score is an indication of the need for national sustainability efforts in a number of fields, especially to clean air quality, protect biodiversity and reduce greenhouse gas emissions.

The environmental performance of a country is associated with wealth which is usually represented by GDP per capita. According to Esty & Porter (2005) rich countries have great economic capacity to invest in policies and programs related to environmental aspects, such as pollution control and other indicators to improve the desired environmental performance and quality outcomes.

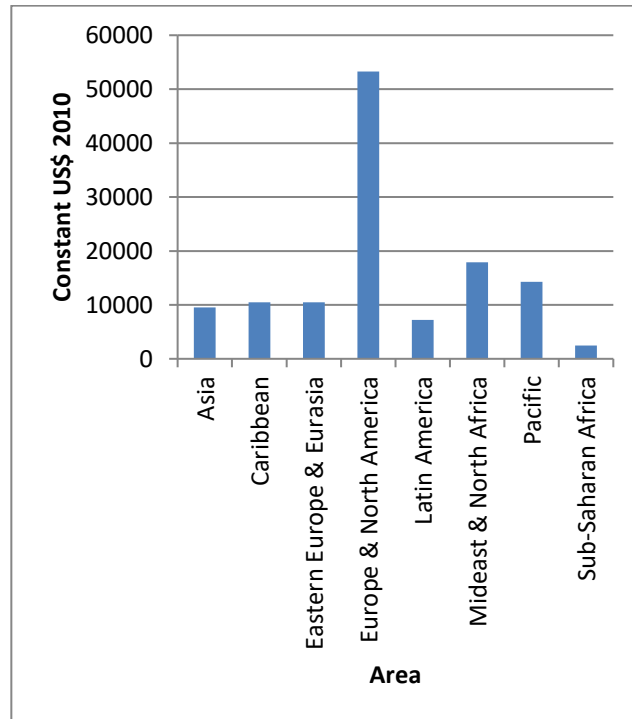


Figure 2. GDP per capita by Region in 2018 (*constant US\$ 2010*)
Source: (data.worldbank.org, 2019)

Figure 2 shows that GDP per capita by region in constant US\$ 2010 in 2018, Europe and North America are far superior to the other 7 regions, this region is also the region with the highest Environmental Performance Index score for that year. Meanwhile, the region with the lowest GDP per capita is Sub-Saharan Africa which is also the region with the lowest Environmental Performance Index score. This is in line with the Environmental Kuznets Curve theory which states that there is a relationship between the level of economic growth and the environmental degradation of a country. According to this theory, when state income is still relatively low, the country's attention will be focused on how to increase state income either through production or investment, which encourages increased income by setting aside environmental quality issues. As a result, income growth will be followed by an increase in pollution levels and then decrease again with ongoing growth (Idris, 2012). In other words, a country with a high GDP per capita is considered to be better able to provide better conditions in various aspects including the environment than a country with a low per capita GDP.

However, research conducted by Álvarez, Rubio, & Ferrero (2018) shows the result that GDP per capita is statistically significant but has a negative relationship with environmental performance. In this study believes that although countries with high GDP per capita can invest money to increase environmental impact, they will also

tend to cause environmental problems due to high consumption. Even though this may not happen, when a country has started to have a good economic situation, the country will gradually improve its environmental performance and minimize environmental problems caused by its economic activities by improving the quality of its human resources and technological development.

One way to improve the quality of human resources in a country is by improving the quality of the education system and facilitating public access to education. The assessment of education in a country has been carried out by the United Nation Development Program which has been published as part of the Human Development Index since 2010, namely the Education Index. This Education Index is measured using two indicators, namely the average length of schooling and the expected length of schooling.

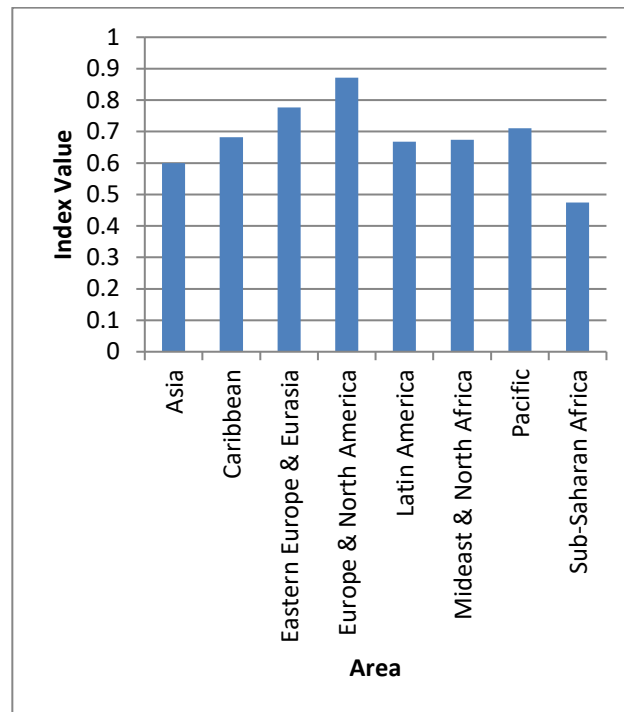


Figure 3. Education Index by Region in 2018

Source: (hdr.undp.org, 2018)

Figure 3 shows that the highest Education Index in 2018 belongs to Europe and North America, while Sub-Saharan Africa is the region that has the lowest Education Index. The country with the highest Education Index is Germany (0.946) which is in Europe and North America and the lowest is Niger (0.247) which is part of the Sub-Saharan Africa region.

It can be said that life in Niger is still quite primitive, poverty in this country is still quite high, and the main livelihood of the majority of the population in Niger is agriculture. This makes parents prefer to send their children to work rather than to school, because they are too poor to afford regular schooling. In addition, the majority of the population in Niger still live a nomadic life, thus making it difficult for children in this country to get access to education (Lahitani, 2016). This should also be the case in most of the countries in Sub-Saharan Africa. It is not surprising that environmental performance in this region is still lagging behind other regions, because the existing human resources are not qualified enough to assist the government in realizing good environmental performance, in fact they still need the government to elevate them to become human resources. higher quality. Education policies that exist in a country are inseparable from the role of the government, as well as environmental performance. The term effective government refers to the right suggestions in achieving goals. Government

effectiveness shows that the government can achieve things that are in line with development planning (Handoyo & Fitriyah, 2019). Therefore, it can be said that government institutions can function and carry out their duties properly, so that problems related to the environment can be overcome and produce good environmental performance as well. This is evidenced by the results of research by Basrija & Handoyo (2019) that government effectiveness has a significant and positive relationship to national environmental performance.

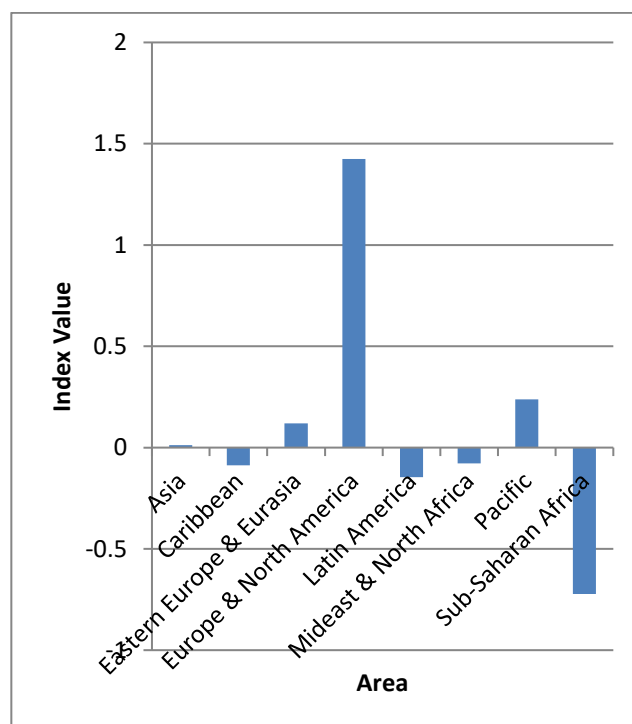


Figure 1. Government Effectiveness by Region in 2018

Source: (data.worldbank.org, 2019)

The World Bank released Worldwide Governance Indicators (WGI) scores to assess government governance in more than 220 countries, where one of the indicators is government effectiveness and five other indicators, namely voice and accountability, political stability, regulatory equality, rule of law, and control of corruption. Graph 4 shows data on government effectiveness scores by region in 2018. Government effectiveness scores range from -2.5 (less effective) to 2.5 (more effective). The data shows that the regions that have a positive score in terms of government effectiveness are Europe and North America followed by the Pacific, Eastern Europe and Eurasia, then Asia. While the remaining regions, namely the Mideast and North Africa, the Caribbean, Latin America, then Sub-Saharan Africa have a government effectiveness score below zero or a negative value.

The country with the highest government effectiveness score in 2018 is Singapore (Asia Region), the government in Singapore really deserves appreciation for its efforts in building the rule of law and a corruption-free government. This is a very good achievement to be able to outperform countries in the European and North American Regions. Looking at it in a broader scope, the Asian region, which is the region with the lowest Environmental Performance Index after the Sub-Saharan Africa Region, in fact has a fairly good assessment of government effectiveness. But unfortunately, the score of government effectiveness which is quite good is still not able to make Asia superior in the Environmental Performance Index assessment of other regions.

Apart from the economic, educational and governmental aspects, the population also has a sizeable contribution to the quality and performance of the environment in a country (Handayani et al., 2022; Pujiati et al., 2022). Sometimes environmental problems that arise are caused by problems that exist within the population itself.

One of the population problems that has a large impact on the environment is the high level of population density. Areas with high population density tend to have poor environmental performance due to the large number of people living with various activities that can directly or indirectly affect the environment (Pujiati et al., 2022).

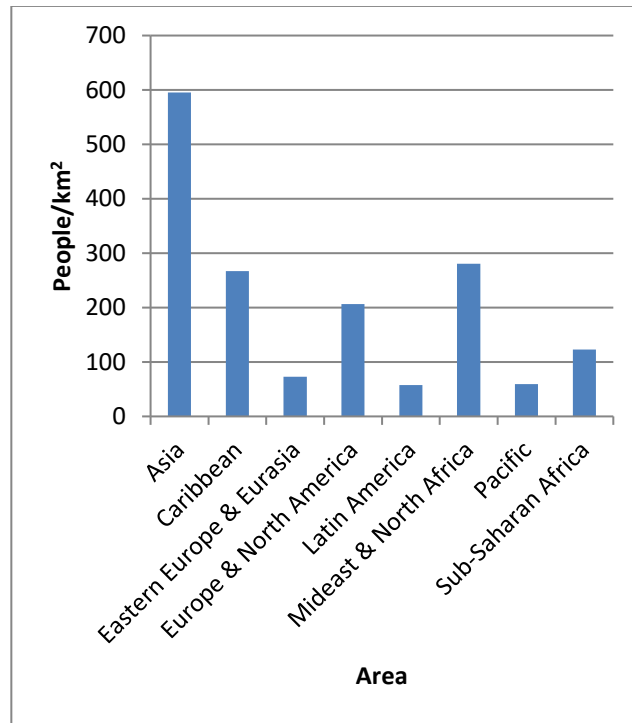


Figure 2. Population Density by Region in 2018

Source: (data.worldbank.org, 2019)

Based on figure 5 it can be seen that Asia is the region with the highest population density. Many of the countries in it have high population densities such as Singapore, Maldives, and Bangladesh. In addition, three of the five countries with the largest population are also in the Asian region, the five countries are China (Asia), India (Asia), the United States (Europe & North America), Indonesia (Asia), and Brazil (Latin America). It is not surprising, then, that in terms of population problems, the Asian region has the lowest Environmental Performance Index score, which is only one level above Sub-Saharan Africa.

In the book "The Population Bomb" 1971 written by Paul Ehrlich describes the population and the environment into three main points, namely: the world has too many people; the state of food is very limited; and because there are too many people in this world, the environment has been damaged and polluted. This is supported by research (Zuhri, 2014) which states that the population density variable positively and significantly influences air emissions in Indonesia. Which air emission is one of the indicators assessed in environmental performance. However, it seems that this is inversely proportional to the situation in Sub Saharan Africa where the region does not have a population density that is too high but the Environmental Performance Index does not get a good score.

This study uses GDP per capita, Education Index, government effectiveness, and population density as independent variables that affect the Environmental Performance Index. Differences in country status (developed and not) are also expected to affect differences in existing environmental performance, therefore this study will also use a control variable for classifying developed and non-developed countries based on their income.

According to Duit (2005) environmental performance is measured not to find out how good the environment can be enjoyed by the state but to investigate how well the state is trying to overcome its

environmental problems. The Environmental Performance Index (EPI) is a parameter developed by the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network at Columbia University in collaboration with the World Economic Forum with support from The Samuel Family Foundation. The Environmental Performance Index ranks how well a country performs in prioritizing environmental issues in two policy areas, namely protecting human health from environmental damage and protecting ecosystems.

The Environmental Performance Index in 2018 has two objectives, ten policy categories and twenty four indicators. The first goal is environmental health which covers three policy categories related to water quality (with indicators; Household solid fuels, Exposure P.M2.5, Excess P.M2.5), water and sanitation (with indicators; drinking water and sanitation), and heavy metals (with indicators; lead). Then the second goal is ecosystem protection which includes seven policy categories related to Biodiversity and Habitat (with indicators; Marine protected areas, Protection of national biomes, Protection of global biomes, Species protection index, Protected area representation index, and Species habitat index), forests (with indicators: Loss of tree cover), Fisheries (with indicators; Status of fish stocks and Marine Trophic Regional Index), Climate and Energy (with indicators; CO2 emission intensity (total), CO2 emission intensity (power), Methane emission intensity, Intensity black carbon emissions, and N2O emission intensity), Air Pollution (with indicators; SO2 and NOx), water sources (with indicators: Wastewater treatment) and agriculture (with indicators: Index of sustainable nitrogen use).

One of the main factors affecting the Environmental Performance Index is GDP per capita. As stated by Duit (2005) that a country's environmental performance is an effort to the extent that a country is able to produce public goods related to the environment. Thus a country that has a higher GDP per capita will also be more able to provide public goods related to the environment.

Research conducted by Álvarez, Galindo, Villardón, & Rosa (2014) entitled "Environmental Performance in Countries Worldwide: Determinant Factors and Multivariate Analysis". The method used in this research is multivariate analysis technique using HJ-biplot. The dependent variable of this study is the Environmental Performance Index, and the independent variables are GDP per capita, adult literacy, government effectiveness, control corruption, and control variables which have a value of 1 if the party in power is right-wing. The results of this study confirm that a higher economic level as represented by the GDP per-capita variable is highly related to the environmental performance of countries. In addition, the variable level of education also has a positive influence on a country's environmental performance. However, in this study the relationship between government effectiveness and environmental performance is negative and not significant. As for the corruption control variable, the results are negative and significant. And for the control variable political ideology does not show a statistically significant relationship with the Environmental Performance Index.

The Education Index is a reflection of the results of development in the education sector (Riani, 2006). This index was published in the context of the Human Development Report (HDR), and is one of the three components of the Human Development Index (IPM). The Education Index has been calculated since 2010 and is measured by calculating the average years of schooling index of the adult population with the expected years of schooling index for children of school entry age.

According to Zuhri (2014) in relation to the environment, the level of education can affect the quality of the environment through each individual. Higher education, especially environmental issues, will also lead to higher awareness of environmental sustainability (Pujiati et al., 2022). If each individual has a high awareness of the environment, then environmental degradation that is happening at this time can be reduced. Another opinion is from Morse (2013) that the better the education level of a population, the better the chances to work, but apart from that education can also bring other benefits to society such as greater awareness of environmental issues and community involvement in them. Likewise, Duit (2005) considers that citizens with higher levels of culture and education can be assumed to be in a better position to initiate and implement their own environmental cooperation schemes.

According to the State Civil Apparatus Commission, the index of government effectiveness is one measure of the ability of the public bureaucracy to carry out its duties and functions. Meanwhile, according to the World Bank as the agency that issued this assessment index, the Government Effectiveness Index measures the quality of public services, the quality of civil services and their level of independence from political pressure, the quality of policy formulation and implementation, and the credibility of the government's commitment to these policies.

The Government Effectiveness Index uses 47 variables (ranging from the quality of the bureaucracy to infrastructure for the distribution of goods and services) from 32 sources (ranging from the African Development Bank to Global Insight Business Conditions and Risk Indicators). These variables are then scaled back and combined through the unobserved components model. The estimate gives the country a score on the aggregate indicator, in units of the standard normal distribution, which ranges from -2.5 (less effective) to 2.5 (more effective).

The term effective government refers to the right advice to achieve goals. Government effectiveness shows that the government can achieve things that are in line with development planning (Handoyo & Fitriyah, 2019). The effectiveness of a country's public administration and government can be a relevant driver in the development of environmental performance. Effectiveness in this regard includes issues such as the quality of the bureaucracy, the competence of public officials, the independence of civil servants from political pressures and the credibility of the government's commitment to policy (Kaufmann, Kraay, & Mastruzzi, 2008). In addition, Duit (2005) also said that if government institutions function properly and correctly, collective problems related to environmental problems can be overcome, and more effective government will be more successful in overcoming environmental problems compared to countries that have weak governance.

The Indonesian Central Bureau of Statistics explains that the definition of population density, or more precisely referred to as Crude Population Density, is a measure that shows the number of inhabitants for each square kilometer of area. Gross population density is a measure of population distribution that is commonly used, because in addition to simple data and calculation methods, this measure has been standardized by area.

Population density occurs due to rapid population growth. According to Mittal & Mittal (2013) Population size is clearly an important factor in measuring environmental impact. The exploitation, overuse, and misuse of physical resources will increase as a result of human population growth. More population means more mouths that need more agricultural production to eat. More land will be planted by clearing forests and reclamation. Advanced agriculture requires the use of more water, more fertilizers and more pesticides. The use of fertilizers and pesticides makes the soil infertile. Deforestation has its own serious impacts and the environment as a whole becomes unbalanced (Sundram et al., 2021; Pujiati et al., 2020). More population means more space requirements for building houses and more availability of consumer goods. It also requires more means of transportation, more consumption of fossil fuels and more air, soil and water pollution. Thus population growth causes air, soil and water pollution.

As the World Bank data team Prydz & Wadhwa (2019) said that to help explain how different groups of countries work, the World Bank groups countries based on various characteristics, such as geography, creditworthiness, fragility, and average income level. In terms of income, the World Bank divides the world economy into four income groups: high, upper-middle, lower-middle, and low. Income classification is based on a measure of national income per person, or GNI per capita, calculated using Atlas conversion factors instead of simple exchange rates. The purpose of using the Atlas conversion factor is to reduce the impact of fluctuations in exchange rates in comparisons of national incomes across countries.

Based on the results of research by Wurie & Pillai (2014) from 98 samples of developing countries, it was found that consumption levels in developing countries have a significant negative effect on environmental health. This means that consumption activities carried out in developing countries (not developed countries) have a negative impact on the environment, for example, the utilization of resources used to meet the needs of the population and production activities of consumer goods which then cause environmental pollution.

Previous studies have explained that the environmental performance index can be influenced by several variables. Gross domestic product has a positive and significant effect on the environmental performance index (Hsu, A., & Zomer), but other studies explain the conflicting findings that gross domestic product has a positive but not significant effect on the environmental performance index (Rogge, 2012). Other studies explain that government effectiveness can have a positive and significant effect on the environmental performance index (Wang et al., 2021). However, other studies explain different findings that government effectiveness has no significant effect on the environmental performance index (Zuo et al., 2017).

Some of the results of previous studies that still produce conflicting findings provide opportunities for further research. This study seeks to analyze the effect of per capita GDP, government effectiveness, occupation index, population density and innovation on the environmental performance index. This study seeks to provide a novelty model by adding the innovation variable as a mediating variable to mediate government effectiveness on the environmental performance index. The framework of thinking in this study is as follows:

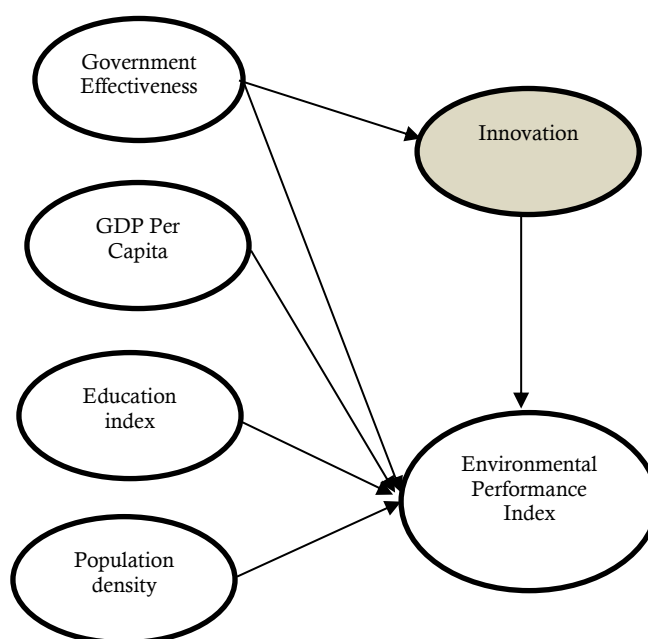


Figure 6. Research Framework

METHODS

The approach used in this study is a type of quantitative approach. The type of data used in this research is secondary data with cross-sectional type. Cross-sectional data is data consisting of one or more variables collected in the same period (Gujarati & Porter, 2010). The data in this study were collected from 171 countries based on their income in 2018 where there were 52 developed countries and the remaining 119 were not developed countries. The data in this study were obtained from official websites and documents published by related sources including the Yale Center for Environmental Law and Policy, World Bank, United Nations Development Program (UNDP), and the Global Innovation Index.

The analysis used in this study is a quantitative analysis of Structural Equation Modeling (SEM). Quantitative analysis in this study consisted of two steps, namely (1) Confirmatory Factor Analysis (CFA) analysis and (2) analysis of the structural model test. The first step is Structural Equation Modeling (SEM) with Confirmatory Factor Analysis (CFA). SEM analysis in this study was chosen because it has several advantages including being able to be used for several equation models at once. In addition, the variables in the SEM model

are very flexible because they can be used as dependent variables or independent variables. In addition, SEM analysis also has the ability to analyze moderating variables and mediating variables.

The structural equation model contained in this study was formulated based on the proposed hypothesis. This study has six main variables, of which of the six variables, four variables are government effectiveness as measured by the quality of public services, the quality of civil services and the degree of independence from political pressure, the quality of formulation, policy implementation, and the credibility of government commitments, GDP per capita as measured with GDP per capita at a constant price of US\$ in the 2010 base year, the education index as measured by calculating the average length of schooling index of the adult population aged 25 years and over with the expected length of schooling index for children at school entry age, and population density as measured by the results of a comparison between the number of inhabitants (people) in a country with the area (km²). These variables are exogenous latent constructs (independent variables), and the next two variables namely innovation are endogenous intervening latent constructs as measured by size, environment, and innovation output, and the environmental performance index is an endogenous latent construct (dependent variable) as measured by calculating and assessing how well the policies that have been carried out by a country related to environmental performance.

$$\text{Environmental Performance Index} = \gamma_1 \text{ government effectiveness} + \gamma_2 \text{ GDP per capita} + \gamma_3 \text{ education index} + \gamma_4 \text{ population density} + \gamma_5 \text{ innovation} + \zeta_1$$

Information:

γ (gamma)	:	Standardized regression coefficient (structural) that explains the effect of exogenous variables on endogenous variables.
ζ (Zeta)	:	Error term associated with endogenous latent variables.

RESULTS AND DISCUSSION

Structural Equation Modeling analysis is an approach that requires a series of regression analysis. In SEM analysis, there are several statistical procedures for testing measurements, functional, predictive and causal hypotheses (Jin et al., 2020). SEM also allows the calculation of measurement error variance for both exogenous and endogenous variables.

The measurement model analysis follows the recommendation of Anderson and Gerbing (1988) with a two-step approach consisting of confirmatory factor analysis (CFA) and structural equation modeling (SEM). This study uses CFA to analyze the measurement model and estimate the reliability and validity of the construct. Then, SEM is used to validate hypotheses related to the relationship between research constructs. This study uses a control variable in the form of a classification of developed and non-developed countries.

Data Normality

Based on the results of data analysis, the values for all indicators for skewness and kurtosis were between ± 2.58 , so that all indicators were univariate normal. The multivariate kurtosis value is 8.567 and the CR is 2.426. This value is still in the range of ± 2.58 , indicating that the data is normal multivariate..

FiT model

The result of the analysis showed that the measurement model achieved good model fit, with $\chi^2 = 146.013$, $\chi^2 / (df = 85) = 1.635$, ($p < 0.001$), good fit index (GFI) = 0.816; comparative fit index (CFI) = 0.824, incremental fit index (IFI) = 0.928, Tucker Lewis index (TLI) = 0.813, normed fit index (NFI) = 0.896, and root mean square

error of approximation (RMSEA) = 0.057. The values of CFI, IFI, and TLI surpassed 0.92 and the values of RMSEA and Standard RMR (0.028) were lower than 0.8 (Hu & Bentler, 1998).

CFA Hypothesis Testing

Based on the CFA evaluation, the psychometric properties of each factor were measured by a reflective scale (Anderson & Gerbing, 1988; Bagozzi & Yi, 1988). Moreover, composite reliability (CR) exceeded 0.70 and the average variance extracted (AVE) was above 0.50, indicating convergent validity (Hair et al, 2014). The results of CFA showed values of CR between 0.823 and 0.917 and values of AVE from 0.687 to 0.824. Table 1 shows the results of the factor loading, CR, and AVE, revealing that the model fulfilled convergent validity.

Table 1. The results of CFA model

Construct	Factor loading	Error Variance	Composite reliability (CR)	Average variance extracted (AVE)
Government Effectiveness				
GE1	0.540	0.674	0.823	0.687
GE2	0.797	0.443		
GDP Per Capita				
GDP1	0.801	0.345	0.917	0.719
GDP2	0.789	0.523		
Education Index				
EI1	0.769	0.347	0.871	0.786
EI2	0.805	0.432		
EI3	0.814	0.337		
Population density				
PD1	0.805	0.551	0.830	0.824
PD2	0.776	0.542		
Innovation				
IN1	0.765	0.631	0.820	0.811
IN 2	0.703	0.642		
Environmental Performance Index				
EPI1	0.828	0.332	0.828	0.814
EPI2	0.807	0.431		
EPI3	0.837	0.445		

Regarding the evidence of discriminant validity, Fornell and Larcker (1981) suggested that the value of the square root of the average of variance extracted (AVE) in each construct should be higher than the relationship coefficients of the particular construct with other constructs. Our findings showed that the square root of AVE was higher than the correlation of each construct, indicating the research model achieved adequate discriminant validity. The test results show that all indicators are in reliable variables, therefore, the variables have been measured by valid instruments and the results are reliable. So that it can be continued in the next test. Table 2 shows the correlation matrix of discriminant validity.

Table 2. Correlation matrix of discriminant validity

Construct	GE	GDP	EI	PD	IN	EPI
GE	0.881					
GDP	0.124	0.896				
EI	0.203	0.777	0.816			
PD	0.215	0.244	0.025	0.819		
IN	0.342	0.543	0.124	0.442	0.823	
EPI	0.234	0.253	0.276	0.432	0.340	0.801

Based on table 2 it can be explained that the discriminant validity results show that the Average Variance Extracted (AVE) value of the average variance extracted for each variable is greater than 0.5 and the correlation value between latent variables and other latent variables is greater in model so that it can be concluded that the discriminant validity in the model is fulfilled.

Assessment of the structural model

Table 3 shows the results of testing the hypothesis proposed in this study. These results were obtained from structural equation modeling (SEM) using the help of Amos software (Ringle, Wende, & Becker 2015; Hair et al. 2017; Brandon-Jones and Kauppi 2018).

Table 3. Displayed any details of the hypotheses results

Hypothesis	Path	β	<i>SD</i>	<i>t</i>	<i>P-Values</i>	Sig
Direct Effect						
H1	GE → EPI	0,137	0,320	2,0843	0,021	**
H2	GDP → EPI	0,232	0,267	2,023	0,022	**
H3	EI → EPI	0,105	0,253	0,502	0,302	ns
H4	PD → EPI	-0,341	0,233	-2,432	0,022	**
H5	IN → EPI	0,302	0,225	2,665	0,014	**
Indirect Effect						
H6	EP → IN → EPI	0,304	0,237	2,234	0,011	**

Note: p-value < 0.05; ns: not-significant.

Based on table 3 it can be explained that the results of testing the first hypothesis (H1) show that the relationship between government effectiveness and the environmental performance index has a p-value of 0.021 < 0.05 (alpha 5%) so it can be concluded that H1 is accepted which means government effectiveness has significant influence on the environmental performance index. The results of testing the second hypothesis (H2) show that GDP per capita has a significant influence on the environmental performance index with a p-value of 0.022 < 0.05 (alpha 5%). The results of testing the third hypothesis (H3) show that the education index has no significant effect on the environmental performance index with a p-value of 0.302 > 0.05 (alpha 5%). The results of testing the fourth hypothesis (H4) show that population density has a significant effect on the environmental performance index with a p-value of 0.022 < 0.05 (alpha 5%). The results of testing the fifth hypothesis (H5) show that innovation has a significant effect on the environmental performance index with a p-value of 0.014 < 0.05 (alpha 5%). The results of testing the sixth

hypothesis (H6) show that government effectiveness has a significant influence on the environmental performance index through innovation with a p-value of $0.011 < 0.05$ (alpha 5%).

The results of the analysis show that Government Effectiveness has a positive and significant effect on the Environmental Performance Index. This is not in line with research conducted by (Álvarez, Galindo, Villardón, & Rosa (2014) and Álvarez, Rubio, & Ferrero (2018) which found that the variables of government effectiveness and environmental performance have an insignificant relationship. The study stated reasons referring to the research of Esty, Levy, Kim, Sherbinin, Srebotnjak, & Mara (2008) which shows that government effectiveness is positively correlated with the performance of per capita greenhouse gas emissions, health, ozone, and water quality which is a representation of the vitality of ecosystems is a part of the Environmental Performance Index whereas in research conducted by Álvarez, Galindo, Villardón, & Rosa (2014) and Álvarez, Rubio, & Ferrero (2018) they also took into account another part of the Environmental Performance Index, namely environmental health. Currently, ecosystem vitality and environmental health are taken into account as a unit in the Index Environmental performance, however, ecosystem vitality is one of the main components of the Environmental Performance Index, which makes sense if government effectiveness has a significant effect on ecosystem vitality, so the same thing happens with the Environmental Performance Index.

Singapore, which has the highest government effectiveness index in 2018, also has the highest Environmental Performance Index score in the Asian Region in the same year. Before independence the government in Singapore was full of chaos and corruption, but after that the ruling party has decided to commit to running a government that is peaceful, clean and free from corruption. Several decades have passed, apart from being committed to creating a clean and corruption-free government, Singapore is also committed to building a constructive government. This effort was proven by the formation of the Public Service Commission (PSC) in 1951 which had a key role in ensuring that civil servants worked cleanly and effectively. This is done with the aim of providing certainty to the public that the civil service has been properly managed. The efforts made by the Singaporean government have proven to have yielded good results with Singapore's achievement in the government effectiveness index which has always excelled for 5 consecutive years from 2014 to 2018. This achievement has of course had a positive impact on Singapore's environmental performance, this is evidenced by the inclusion of Singapore as one part of the Asian Region which is included in the top 50 best Environmental Performance Index along with Japan and Taiwan. This is in accordance with the statement from Duit (2005) that effective government institutions will be more successful in dealing with environmental degradation problems than weak government institutions, if a country's government institutions function properly then problems related to the environment in that country will also be solved.

On the other hand, the Sub-Saharan Africa Region, which has the lowest average government effectiveness index, which is far from being positive, also has the lowest Environmental Performance Index compared to other regions. The Sub-Saharan Africa region which is currently facing economic problems makes individuals think that the easiest way to save themselves from poverty is through political office so that many leaders in power are encouraged to commit acts of corruption. This clearly disrupts the focus of the ruling leaders in running an effective government because their main desire is to enrich themselves and their own group. One example of an ineffective policy implemented by the Sub-Saharan Africa Region is a policy related to the environment. Several policies related to the environment, especially in the Sub-Saharan Africa Region, did not go well because they did not evaluate the results of the challenges that should have been overcome before and after the policies were made (Nakweya, 2019). No matter how good a policy is made, of course it will not produce maximum results if the policy is not carried out by an effective government. This is in accordance with Fiorino's statement (2010) that national environmental performance will be greatly influenced by national commitment to issues, policies, and capacity to resolve environmental problems. And this commitment will be achieved if the role of government in the country is effective.

In addition, Apostoiaie & Maxim's research (2017) states that an effective government consisting of parties with a preference for the environment has succeeded in increasing national environmental performance. For example, what happened in Switzerland, which is a country with the highest

Environmental Performance Index and the 2nd effectiveness index ranking after Singapore has a main party that cares about the environment, this also then continues at the moment of the parliamentary elections in Switzerland where the main political parties in the country are busy. to show how much they care about the environment. This is proof that a country with a good Environmental Performance Index also has an atmosphere of political parties that care about the country's environment.

The results of the analysis that has been carried out show that GDP per capita has a positive and significant effect on the Environmental Performance Index. However, this is not in accordance with research conducted by Álvarez, Rubio, & Ferrero (2018) which shows the results that GDP per capita is statistically significant but has a negative relationship with environmental performance. The research says countries with high GDP per capita tend to have high consumption as well. The high consumption will cause environmental problems in the country. Even though a country with a high per capita GDP also has a high level of consumption, the country will of course also compensate by efforts to maintain environmental sustainability for the survival of its entire population. This is evidenced by the many countries with high GDP per capita occupying the top Environmental Performance Index assessments such as Luxembourg (US\$ 110701.9), Norway (US\$ 92119.5), Switzerland (US\$ 79235), Sweden (US\$ 79235) in the top fifteen countries with the highest Environmental Performance Index scores. Meanwhile, countries with low per capita GDP such as Burundi (US\$ 210.8), Central African Republic (US\$ 379.4), and Sierra Leone (US\$ 472.8) also tend to have low Environmental Performance Index scores.

The theory stated by Duit (2005) states that a country's environmental performance is defined as the extent to which a country is able to produce public goods related to the environment. countries that have a better ability to produce public goods related to the environment compared to countries that have a low GDP per capita. For example, Switzerland, which is a country that has achieved the best Environmental Performance Index in 2018, 97% of the population in Switzerland has been connected to a waste management installation and to date there have been around 900 wastewater management installations in the country. In addition, France which ranked second on its Environmental Performance Index the same year has installed a water turbine farm on the Rhone River that will generate enough power for 400 homes. This is a good step in the utilization of renewable energies in generating electricity. This is in accordance with what was stated by Cracolici, Cuffaro, & Nijkamp (2010) that an increase in GDP per capita is considered a basic prerequisite for increasing the standard of living of a population, one of which is in terms of a healthy and sustainable environment.

In addition, this is also supported by previous research from Álvarez, Galindo, Villardón, & Rosa (2014) which found that a higher economic level represented by the GDP per capita variable is highly related and positively related to the environmental performance of each country. Countries that have a high per capita GDP are more able to invest in programs aimed at preserving the country's environment. For example, countries in the European Area that are members of the European Union with high GDP per capita have initiated efforts to commit to reducing greenhouse gas emissions gradually to achieve their common goal of achieving zero emissions by 2050. To achieve this goal, the European Union must invest in renewable technologies. According to European Commission estimates, Europe's need for funds is around €260 billion in additional investment each year over the next decade. These efforts will of course have a direct impact on the environmental performance of European Union countries.

The results of the previous analysis show that the Education Index has a positive but not significant effect on the Environmental Performance Index. This is inversely proportional to research conducted by Zuhri (2014) which states that the level of education is able to influence the quality of the environment through each individual. Every individual who has a higher level of education, especially education related to the environment, will also have a high awareness of the sustainability of the surrounding environment. This awareness has a positive impact on efforts to minimize ongoing environmental degradation.

As happened in Germany, the country that has the highest Education Index in 2018, with an index of 0.946. Professor Udo Kuckartz, a Professor at Philipps University, Marburg, Germany stated that the German people are very sensitive to the environment and have very good information about existing environmental issues. In general, people in Germany have a very positive attitude towards the environment (Schäfer, 2013). Based on data examination conducted by The National Center for Social Research

(NatCen) on data collected by the European Social Survey regarding public attitudes towards climate change in 16 European countries, Russia and Israel shows that Germany is the country most concerned about climate change. 44% of respondents from Germany are “very” and “very – very” worried about climate change, while the country with the lowest concern about climate change is Poland with only 15% of respondents saying they are “very” and “very – very” worried about climate change. This is in accordance with the opinion expressed by Álvarez, Galindo, Villardón, & Rosa (2014) in his research that a highly trained and educated population will demand more information related to environmental problems and performance.

And the opposite happened in Nigeria, the country that had the lowest Education Index in 2018, which was 0.247. This is not without reason, Nigeria, which is a country with 49.65% of its population being rural residents, is one of the countries that is quite poor. Most of Nigeria's population make a living as farmers. The children there are more often forced to go to work especially when the harvest season comes than to go to school. In addition, access to go to school in Nigeria is also not easy and the distance is quite far. The level of disparity between male and female students is still quite high where female students are much less likely to attend school than male students. These problems make many Nigerians unable to read and write, this causes Nigeria to have the highest illiteracy rate in the world. This is in line with Morse's statement (2013) but from the opposite point of view that the better the education level of a population, the better their chances of getting a job, but apart from that education can also bring other benefits to society such as greater awareness of environmental issues and community involvement in it.

Nigeria's low Education Index certainly affects the country's Environmental Performance Index. Nigeria is one of the countries ranked in the lowest ten places on the Environmental Performance Index in 2018. The low Education Index illustrates that the expected length of schooling and years for Nigerians to attend school are also low, thus their insights are also limited, of course this also includes insights related to environmental issues. With low knowledge about environmental issues they have, they will also be less able to overcome these problems. Government programs related to the environment will also be difficult to implement if the population concerned does not have sufficient capacity in knowledge of handling environmental issues, this will make it difficult to create good environmental performance for a country (Pujiati et al., 2019). This is in line with Duit's (2005) assumption that citizens with higher levels of culture and education can be assumed to be in a better position to initiate and implement their own environmental cooperation schemes.

The results showed that the population density variable has a negative and significant effect on the Environmental Performance Index. This is in accordance with Paul Ehrlich's statement in his book entitled "The Population Bomb" in 1971, he described the population and the environment into three main points; the first that the world has too many people; second, the state of food is very limited; and third, because there are too many people in this world, the environment has been damaged and polluted. A country with a high population density will of course also have more complex activities and needs, the impact of which is environmental damage and pollution because the environment is required to continue to meet the needs of the population in that country to maintain their survival (Nikensari et al. , 2020).

The continent of Asia, which is the most populous continent in the world, has around 59.55% of the world's population, which is around 4.5 billion population in 2018. It includes the two countries with the most populations in the world, namely China and India. China, which has an area of no more than the European continent, is recorded as having a population twice the population of that continent. Nonetheless, the population density in China is not too high, namely 148.3 people/km² of land area, its position is ranked 48th based on country data used in this study. Meanwhile, the ranking of China's Environmental Performance Index in 2018 was in position 120 with an index of 50.74, not too bad but still needs improvement. The lowest problem category rating owned by China is related to air quality, which is equal to 14.39, it can be said that China is a country with the highest level of air pollution. This is caused by several factors namely; high economic activity, increase in the number of motorized vehicles, production from industrial activities, and seasonal weather. Most of these factors are none other than due to the activities of the population. This is in accordance with the statement of Mittal & Mittal (2013) that population size is clearly an important factor in measuring environmental impact. Exploitation, overuse,

and misuse of physical resources will increase as a result of the growth of the human population (Pujiati et al., 2020).

Apart from China, India and Bangladesh also deserve attention because their position in the Environmental Performance Index showed disappointing results. The two countries respectively rank 177th and 179th on the Environmental Performance Index out of 180 countries, both of which are also countries with the lowest Environmental Performance Index ratings in the Asian Region. India, which is the country with the second highest population level after China in 2018, has a population density rate of 454.9 people/km² of land area, while Bangladesh has a population density level almost three times higher than India, which is 1239.6 people/km² of land area in same year. India and Bangladesh are clearly facing the same problem, namely the large number of populations they have. The need for land and very high energy consumption make India and Bangladesh also produce high pollution. This problem then has a negative impact on their environmental performance, especially if the large population that lives cannot compromise to preserve the environment.

However, it is different from what happened in Singapore, the country with the highest population density, which is 7953 people/km², is in fact still able to maintain good environmental performance. This small country which is 100% urban area has a population density of more than 200 times the population density of the US, and 2000 times the population density of Australia. Nonetheless, Singapore is a country that has a high per capita income so that it is able to strive for good environmental performance for the country. Some of the efforts made by Singapore to maintain environmental sustainability are by reducing energy use, designing buildings that are more environmentally friendly using the Green Mark Guidelines, constructing modern and innovative city structures.

Meanwhile, the Sub-Saharan Africa region, although it looks not too dense, geographically, there is a lot of land in Africa that is unfit for habitation, such as for example the Sahara Desert, Kalahari, and Namib. However, it reduces the size of the area that is possible to be inhabited by residents in the region. This is enough to create a bias that the African Region, which is actually quite dense, looks empty. The condition of the population which turns out to be quite dense in the Sub-Saharan Africa Region has an effect on its Environmental Performance Index. We all know that Africa is facing many problems. The problem of population density also cannot be ignored because if the population increases and the area becomes narrower, the problems that arise will also be more complex. The need for food and land is increasing but the available land is not sufficient to produce food and provide shelter. This is in line with Todaro in Zuhri (2014) that environmental degradation is so severe in various places due to the pressure of population growth on existing land, has reduced the level of productivity of agricultural land and food production per capita. This is proven, Africa is currently trapped in the abyss of poverty and has difficulty meeting its needs. This of course also ends with a dilemma for the local government which inevitably sometimes the government must prioritize policies related to the welfare of the people in a limited area and then will first set aside policies related to environmental performance.

The results showed that the control variable for the classification of countries based on income had no significant effect on the Environmental Performance Index, meaning that there was no difference between developed and non-developed countries in terms of the factors that affected the Environmental Performance Index. This is not in line with research results (Wurie & Pillai, 2014) which show findings that consumption levels in developing countries (not developed countries) have a significant negative effect on environmental health. In addition, the opinion of Fiorino (2010) also states that income is associated with the state's commitment to the environment, where countries with higher incomes will also have a greater commitment to the environment. Developed countries have been able to achieve fairly good welfare for their people because they already have a high standard of living and equitable development. Thus their current focus is to maintain and maintain what they already have. One of the main concerns is environmental sustainability for the survival of all its inhabitants. This can be realized by creating good performance towards the environment. Meanwhile, another statement from Ota (2017) states that countries with low income usually do not have enough policies related to the environment. This makes sense because countries that are not developed countries will tend to focus on policies related to development in the

economic and social fields which sometimes tend to ignore the negative impacts that might occur on the environment.

Developed countries, which in this study represent countries that are included in the group of high-income countries according to the World Bank, indeed have a satisfactory Environmental Performance Index. 2018. These countries are Switzerland, France, Denmark, Malta, Sweden, United Kingdom, Luxembourg, Austria, Ireland, Finland, Iceland, Spain, Germany, Norway, Belgium, Italy, New Zealand, Netherlands, Israel, Japan, Australia, Greece, Cyprus, Canada, Portugal, United States, Slovakia, and Lithuania.

The group of non-developed countries in this study represents countries that are included in the upper middle, lower middle and low income countries according to the World Bank. In fact, countries in the upper middle and lower middle income group are still able to compete with developed countries in terms of Environmental Performance Index assessments such as Bulgaria and Costa Rica which occupy the top 30 of the Environmental Performance Index complementing the 28 developed countries previously mentioned. In addition, 59 upper and lower middle income countries also managed to outperform Oman, a country that has the lowest Environmental Performance Index in the group of developed countries, namely with an Environmental Performance Index of 51.32 in the 111th position. Developed countries and non-developed countries can both get an assessment A good Environmental Performance Index depends on how they prioritize the environment in state policies.

CONCLUSION

Based on the description of the research results and discussion that has been presented in the discussion, it can be concluded that Government Effectiveness has a significant effect and has a positive relationship to the Environmental Performance Index in 2018. The results of this study are in accordance with the hypothesis made by the author that there is a significant and positive influence of Government Effectiveness on the environmental performance index in 2018. Countries that have high Government Effectiveness will also have a high Environmental Performance Index, because the government in that country will be more successful in achieving program targets and policies that have been made, including those that related to the environment.

Per capita GDP has a significant effect and has a positive relationship to the Environmental Performance Index in 2018. The results of this study are in accordance with the hypothesis made by the author that there is a significant and positive influence of per capita GDP on the environmental performance index in 2018. Countries with GDP Per capita high capita will also have a high Environmental Performance Index, because the country is more able to invest in programs that aim to overcome problems and preserve the country's environment.

The Education Index has no significant effect and has a positive relationship to the Environmental Performance Index in 2018. The results of this study are in accordance with the hypothesis made by the author that there is an insignificant and positive effect of the Education Index on the environmental performance index in 2018 in 2018. Countries that have a high education index will also have a high environmental performance index, because residents in countries with a high education index have broader insights regarding environmental issues and how to deal with them, they will be more aware of how important environmental preservation efforts are so they will also more able to support government programs related to environmental preservation efforts

Population Density has a significant effect and has a negative relationship to the Environmental Performance Index in 2018. The results of this study are in accordance with the hypothesis made by the authors that there is a significant and negative effect of Population Density on the environmental performance index in 2018. Countries that have Population Density levels high, it will have a low Environmental Performance Index, because the more densely populated the country, the potential for environmental damage will also be high, this is the result of excess resources being used and the pollution produced.

The innovation variable can mediate the effect of government effectiveness on the environmental performance index. The government as a policy making authority has an important role to play in improving environmental performance. Effective governance will be able to have an impact on good environmental quality as well.

Country Classification Based on Income is not significant and has a positive relationship to the Environmental Performance Index in 2018. The results of this study are not in accordance with the hypothesis made by the author that there is a significant and positive effect of Country Classification Based on Income on the environmental performance index in 2018. This can happen because many members of the non-developed country group also have a good Environmental Performance Index.

Suggestions that can be given related to the research that has been done are: 1) In this study the most significant independent variable on the Environmental Performance Index is the innovation variable, therefore countries that still have many problems including environmental problems are advised to increase innovative innovation. to be able to boost environmental performance. 2) The government is the main command that runs the wheels of a country's life, thus it is hoped that the government that has been entrusted with leading a country can carry out its duties with full responsibility so that the country's development targets can be achieved optimally. 3) Efforts to suppress population growth are urgently needed, especially in countries in the Asian Region to avoid even higher population densities that can exceed the capacity of a country itself. 4) It is hoped that the Yale Center for Environmental Law and Policy will be able to publish an Environmental Performance Index with definite benchmarks every year so that research can be carried out in a time series format so that future studies can also observe the development of the Environmental Performance Index in a time series so that better research results.

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