RELATIONSHIP BETWEEN ECONOMIC GROWTH AND ENVIRONMENTAL DEGRADATION IN PERU, PERIOD 1990-2019

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ABSTRACT

Objective: The objective of this research is to analyze the relationship between economic growth and environmental degradation through a regression model for the Peruvian case, during the period 1990-2019, based on Georgescu Roegen's Bioeconomy; who explains that, in environmental terms, economic growth seems to be more of a problem than a solution.

Method: The quantitative approach was considered, of a non-experimental type, with a descriptive and correlational design; where secondary source information from the World Bank database was used.

Results: According to the results obtained, it is concluded that the variable with the most relationship or that best explains economic growth is energy consumption, followed by CO2 emissions; indicators of environmental degradation explain 24% of economic growth, being a model without problems of heteroscedasticity or autocorrelation; the level of individual significance in all cases is less than 5% and according to the proposed model it is necessary to; if CO2 emissions increase, PBI per capita would increase by 19% and if energy consumption increases, PIB per capita would increase by 20%.

Conclusions: Finally, it was possible to contrast the hypothesis that there is a direct and significant relationship between economic growth and environmental degradation.

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RELACIÓN ENTRE CRECIMIENTO ECONÓMICO E DEGRADAÇÃO AMBIENTAL NO PERU, PERÍODO 1990-2019

RESUMO

**Objetivo:** O objetivo desta pesquisa é analisar a relação entre crescimento econômico e degradação ambiental através de um modelo de regressão para o caso peruano, no período 1990-2019, baseado na Bioeconomia de Georgescu Roegen; quem explica que, em termos ambientais, o crescimento econômico parece ser mais um problema do que uma solução.

**Método:** Considerou-se a abordagem quantitativa, de tipo não experimental, com desenho descritivo e correlacional, em que se utilizou a fonte de informação secundária da base de dados do Banco Mundial.

**Resultados:** De acordo com os resultados obtidos, conclui-se que a variável com maior relação ou que melhor explica o crescimento econômico é o consumo de energia, seguido das emissões de CO2; indicadores de degradação ambiental explicam 24% do crescimento econômico, sendo um modelo sem problemas de heteroscedasticidade ou autocorrelação; o nível de significância individual em todos os casos é inferior a 5% e de acordo com o modelo proposto é necessário; se as emissões de CO2 aumentassem, o PBI per capita aumentaria em 19% e se o consumo de energia aumentasse, o PIB per capita aumentaria em 20%.

**Conclusões:** Por fim, foi possível contrastar a hipótese de que há uma relação direta e significativa entre crescimento econômico e degradação ambiental.

**Palavras-chave:** crescimento econômico, degradação ambiental, emissões de CO2, consumo de energia, PIB per capita.

1 INTRODUCTION

In recent years, the relationship between economic growth and the environment has been studied both empirically and theoretically. On the one hand, economic growth plays an important role in all the countries of the world as a means for them to improve the quality of life of their inhabitants, on the other hand, it is one of the factors that most degrades the environment. Despite the positive economic effects associated with the extraction and exploitation of natural resources, such as the creation of local jobs and the stable flow of income for governments; it also entails a high risk for ecosystems, since the current model of economic growth still excludes the effects generated on environmental quality; while world production increases, environmental degradation, depletion of non-renewable natural resources and pollution do so too (Aguado Quintero...
et al., 2018; Durán, 2013; Hernández Mota, 2010; Hopenhayn, 2003; Jara, 2023; Jaramillo et al., 2020; Jiménez Sotelo, 2018; Khristalev et al., 2023; Pérez-Vega, Regil, et al., 2020; Segura, 2015; Vásquez Sánchez et al., 2003).

For its part, energy is an important element of economic growth as a resource for production. Population growth, technological advances and the development of new industries have caused a progressive increase in energy consumption, raising concerns about its relationship with environmental degradation due to the externalities that are generated (Correa, 2004; Madaan et al., 2023; Ocampo, 2011; Pérez-Vega, Regil, et al., 2020; Roca, 2021).

An externality associated with the higher level of economic activity and increased energy consumption is the generation of carbon dioxide (CO2), which, together with other gases, causes the greenhouse effect. These greenhouse gases are the product of both nature and human activity, and despite the fact that nature itself has the capacity to absorb them without causing significant changes in the environment; During the last few years, population growth and higher levels of economic activity have caused gases to be emitted beyond their absorption capacity, causing considerable changes in environmental conditions and in the health of human beings (Agustinus et al., 2023; Britto, 2020; Flores Yucra, 2017; Ramos Caruajulca, 2018; Sarauz Álvarez, 2017).

From an economic point of view, given that carbon dioxide emissions represent approximately 60% of the greenhouse effect, it is of global interest to establish measures to reduce it; since not doing so, the risks and consequences of climate change would be equivalent to losing a minimum of 5% of world PIB each year. It has also been calculated that the costs of action can be limited to around 1% of global PIB per year. (Angulo Guerrero, 2010; Asencios, 2022; Pinzón & Ramírez, 2021; Saavedra Vargas, 2014; Sosa-Rodríguez, 2015; Zanetti et al., 2017; Zegarra Tello et al., 2021).

It is for the same, Correa (2004) analyzed the validity of the Kuznets Environmental Curve hypothesis for an underdeveloped country like Colombia, which indicates that there is a relationship between environmental quality and economic growth, highlighting that in the short term economic growth generates greater environmental deterioration; but in the long term it begins to be beneficial for the environment, that is, as income increases, so does environmental quality. But based on empirical evidence, this hypothesis is only true in developed countries, or in economies that are richer, which is
why it is not true in the case of Colombia, where economic growth generates more environmental deterioration.

Complementarily, Naula (2019) analyzed the hypothesis of the Kuznets Environmental Curve, but in this case for Ecuador, concluding from its results that the same as in the previous case; the inverted U-shaped curve is not fulfilled, but in this case, when it is represented by an inverse linear relationship, it is affirmed that high levels of income are related to low levels of emissions.

Just like Suárez (2011), determined that, in the case of Latin America and the Caribbean, there is a relationship between the economy and the environment, since according to the results, per capita income has influenced the amount of pollutant emissions; although it is not correct to establish the existence of a generalizable CKA for some countries, since they present differences in notorious characteristics such as the case of the Caribbean and Latin America, therefore the results will depend on each country of study.

Peru is no stranger to these concerns, since the country's economic growth requires increasing the use of energy, resources and services by the population and industries; which means the release of atmospheric pollutants and gases that alter air quality and affect human health. Added to this, it is known that environmental deterioration, especially air pollution, is the main environmental risk for public health, since it has been linked to a variety of health problems that manifest in different diseases and in many cases, can cause death (Daly & Cognuck, 2021; Espinal, 2017; Garros & Borla, 2020; Glave & Kuramoto, 2002; Guevara, 2016).

For example, Jara (2023) searched for the relationship between PIB per capita and the ecological footprint as representatives of economic growth and environmental degradation respectively, reaching the conclusion that there is a direct effect, because in specific terms, if a thousand soles increase in regional PIB per capita, the regional per capita ecological footprint of 0.15 global hectares increases in the long term, which indicates that economic growth causes environmental degradation.

In addition to, Asencios (2022) carried out a national study, analyzing in this case the impact of energy consumption, the development of the financial system and per capita income on CO2 emissions in Peru, finding a positive relationship between energy consumption and CO2 emissions, in addition to the fact that per capita income and the
financial system have no impact on environmental quality. In other words, for this model, only energy consumption can affect the increase in CO2 emissions.

It is in this context that the present work sought to answer the following question: What is the relationship between economic growth and environmental degradation in Peru, period 1990-2019? Therefore, the objective of the research was to analyze the relationship between economic growth and environmental degradation in Peru for the period 1990-2019.

In this sense, studying the relationship between environmental degradation and the country's economic growth is important, since when studying the Kuznets Environmental Curve (CAK); it seeks to demonstrate the behavior of per capita income and this can consequently generate an inequality gap in the distribution of economic income; which translates into explaining the relationship between environmental deterioration and economic growth, where the behavior of the group with lower levels of per capita income induces an increase in environmental damage, on the contrary; that group with the highest income levels contributes towards the reduction of environmental degradation. In other words, as economies show growth, in some cases, interest in the care and protection of the environment and natural resources improves, which demonstrates the existence of a direct relationship between economic growth and the environment; on the contrary, they contribute to the increase of environmental degradation (Abdalla et al., 1992; Alshuwaikhat & Abubakar, 2008; Catalán, 2014; Pérez-Vega, García, et al., 2020; Pérez-Vega, Regil, et al., 2020).

2 THEORETICAL FRAMEWORK
2.1 ECONOMIC GROWTH

The definition of economic growth is interpreted in different ways depending on its quantitative and qualitative characteristics. It is measured and can generally be defined as the increase in a country's products and services compared to the previous year. The variable that measures Economic Growth par excellence is PIB (Gross Domestic Product), expressed in monetary terms (Jiménez, 2011).

In the classical theory of economic growth, an attempt was made to analyze what factors promoted economic growth and economic enrichment. Smith indicates that the wealth of a nation depends essentially on two factors: first, the distribution of labor factors between productive and non-productive activities, second, the degree of efficiency of
productive activities. But, these two factors, in turn, are influenced by others that are relevant in the process: the division of labor (specialization), the tendency to exchange, the size of the market (use of money and international trade); and finally the accumulation of capital, which is an essential factor that ultimately promotes the growth of a country. In addition, Smith also affirms that, in all nations, depending on the economic development they present, investment opportunities will be exhausted along with their growth, reaching a stationary state. Delaying this steady state can only be achieved with the opening of new markets and the appearance of innovations that create new investment possibilities. However, it should also be taken into account that existing laws and institutions in the country may speed up or slow down the achievement of this stagnation, to the extent that they impede exchanges and reduce the scope of investment opportunities. He also referred to the steady state, stating that it would originate from diminishing returns and would only be avoided by increasing capital and implementing technical progress (Berumen, 2006; Correa, 2004; Hopenhayn, 2003).

2.2 ENVIRONMENTAL DEGRADATION

The word 'demotion' means 'to lose qualification' or 'not to reach the initial level'. Therefore, environmental degradation indicates that the environment has lost its status and can no longer be used as before or that its use cannot be easily expanded to the geographic area where it was previously located. Environmental deterioration supposes an assessment of the transformation that has occurred and refers to "a decrease in degree or to a lower range", so its productivity is reduced. The environment encompasses not only the elements of nature; but to a medium that is the product of the complex relationship between the support elements provided by nature (physical support) and the socially built environment (the city, its physical structures and its social, economic and cultural patterns). It should be noted that not all environmental transformation is synonymous with degradation (Altieri & Nicholls, 2018; Tetreault, 2012).

Environmental degradation is the degradation of the environment that results in the depletion of natural resources such as air, water, soil, and land surface, resulting in the destruction of ecosystems and the extinction of fauna. Environmental degradation processes can occur naturally or be caused by human activities. Currently, international organizations recognize environmental degradation as one of the greatest threats that hang over the planet and that threatens the existence of thousands of species, including humans.
Current trends in environmental degradation require monitoring of natural resources to identify areas where deteriorating conditions are severe (Pérez-Vega, Regil, et al., 2020).

The National Water Authority defines pollution as any substance that degrades the natural environmental quality of water, soil, or air; represents a health hazard; or impairs the usefulness of natural resources. In other words, it refers to the weakening of the climate due to the effect of different variables. Unnatural climate change, deforestation, ecological pollution and substances that damage the ozone layer are some of the causes of environmental degradation. Environmental degradation originates from a variety of causes, such as natural phenomena and, above all, human activities, since they are generally associated with anthropogenic pollutants (Altieri & Nicholls, 2018).

2.3 AIR CONTAMINATION

Air pollution is mainly due to the presence in the air of toxic substances caused by human activity in recent years. These gases and chemicals cause endless phenomena and consequences for ecosystems and life on Earth. Air pollution must be taken more into account as it affects us all: animals, crops, cities, forests and aquatic ecosystems. However, in recent years there has been a particular focus on two areas that suffer many adverse effects from air pollution: the environment and human health (Chung, 2008).

The main air pollutants from the five sources of human activity are: Carbon Monoxide, Carbon Dioxide, Nitrogen Dioxide, Nitrogen Oxide, Ground Level Ozone, Particulate Matter, Sulfur Dioxide, hydrocarbons, lead (Encinas, 2011; Millones & Herrera, 2012).

2.4 CARBON DIOXIDE (CO2)

CO2 is an inert gas under normal conditions and is produced mainly as a by-product of the combustion process. This process can be represented as a complete oxidation reaction of the hydrocarbons. When CO2 gas is present in high concentrations in an enclosed space, it is dangerous because it can displace the air that originally filled the space and in extreme cases can cause suffocation. These compounds are commonly called "greenhouse gases" and contribute significantly to global warming (Quiroga et al., 2021).
2.5 THE BIOECONOMY OF GEORGESCU ROEGEN

The relationship between economic growth and the environment is a topic of great debate in modern economics, since, “in the field of environmental economics, two schools of thought are usually recognized. Standard economic thinking on environmental issues is based on neoclassical theory and the first law of thermodynamics. The other school, known as "bioeconomy", was founded by Georgescu-Roegen (1971) and introduced the second law of thermodynamics (the law of entropy) into the economic process (Córdova & Pinto, 2002).

In his analysis, Georgescu-Roegen emphasizes the centrality of the institutional element in the explanation of economic organization and behavior. The shared use of resources, the necessary balance between needs and resources within physical limits, dependence on and respect for biological processes that sustain agricultural production activities; which translates into a specific allocation and distribution of resources that is far removed from an intelligent capitalist economy, since from a social and ecological point of view, needs are better satisfied (Julca, 2022).

From biological and thermodynamic approaches, Georgescu Roegen criticizes the mechanistic vision of economic processes and offers as an alternative a historical analysis of economic processes that focuses on the irreversibility of qualitative change and its ecological consequences; overcoming the blindness that previous analyzes maintain regarding the physical, energetic and material limitations that limit both production and consumption (Córdova & Pinto, 2002; Julca, 2022).

2.6 THE “FOURTH LAW”

Georgescu Roegen's analysis is based on understanding production and consumption activities as one more aspect of human existence, which must be analyzed within the limits imposed by the laws of thermodynamics on the use of natural resources. Starting from the law of entropy, the source of economic scarcity, he proposed the controversial "fourth law", paying special attention to material restrictions, as well as energy limitations surrounding the economic process (Georgescu-Roegen, 2017).

From this perspective, economic growth seems to be a problem rather than a solution. This means that an urgent reorganization of economic and productive activities in industrial societies is required. Above all, when the necessary constant flows of energy
and matter of any economic system show that "the myth of ecological redemption" is unfeasible (Figueroa, 2013).

This urgent review of economic activity must be guided by what Georgescu Roegen called "minimizing regret" for irreversible losses. Furthermore, this realignment could not be achieved through market mechanisms given the limitations of the proper valuation of non-renewable resources and natural resources in general. Rich and poor countries are different, but a social, cultural, political and institutional change is necessary that takes into account the planet as a whole. With standards of redistributive justice and minimal access to the necessary resources for life, it is urgent to reduce the current rate of production and consumption that leads to ecological degradation. Georgescu Roegen's gaze attempted to analytically understand the complexity of economic reality by integrating social, cultural, political and environmental aspects into fundamental axes instead of subordinate axes (Georgescu-Roegen, 2017).

3 METHOD

This research has a quantitative, non-experimental, correlational and descriptive approach. It is correlational because it seeks to explain whether there is a relationship between the behavior of two variables in natural settings, without manipulation in any of them, as it is proposed to define the association between economic growth and environmental degradation in Peru; it is descriptive because it seeks to evaluate the behavior of the variables through historical, statistical and econometric data (Hernández et al., 2017; Mendoza Bellido, 2014).

The data examined comes from a secondary source, at the level of Peru and in annual frequency for the period 1990-2019, the same ones that were obtained from the World Bank database. The level of CO2 Emissions (measured in metric tons per capita) and Electricity Consumption (kWh per capita) were considered to calculate environmental degradation. In the same way, PIB per capita (Millions of soles at constant prices) was considered to calculate economic growth. The analysis variables are detailed below.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Indicator</th>
<th>Unit of measure</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic growth</td>
<td>PIB per capita</td>
<td>soles at constant prices</td>
<td>World Bank</td>
</tr>
<tr>
<td></td>
<td>CO2 emissions</td>
<td>Metric tons per capita</td>
<td>World Bank</td>
</tr>
<tr>
<td>Environmental degradation</td>
<td>Electric power consumption</td>
<td>kWh per capita</td>
<td>World Bank</td>
</tr>
</tbody>
</table>

Source: Own elaboration.
The approach of the econometric model is as follows:

\[
\text{Economic growth}(\text{PIB})_t = \beta_0 + \beta_1 \text{Emissions of CO2}_t + \beta_2 \text{Electric power consumption}_t + u_t
\]

Where:

\[u_t = Error \text{ trm}\]

By applying a logarithm to the model, we obtained.

\[
\ln\text{Economic growth}(\text{PIB})_t = \beta_0 + \beta_1 \ln\text{Emissions of CO2}_t + \beta_2 \ln\text{Electric power consumption}_t + u_t
\]

4 RESULT
4.1 BEHAVIOR OF ECONOMIC GROWTH AND ENVIRONMENTAL DEGRADATION, IN THE PERIOD 1990-2019

The behavior of PIB per capita, CO2 emissions and energy consumption in Peru, period 1990-2019 are detailed in Figure 1, where: The behavior of CO2 emissions shows some fluctuations during the 30 years of study, the figure shows falls in the years 1997, 2000, 2002 and 2016, however, it also shows an upward trend. Likewise, during the study period, average CO2 emissions were 0.214587 Tm per capita, oscillating between -0.108056 Tm. per capita; and 0.602331 tons. per capita, with a standard deviation of 0.245951 Tm. per capita.
In the case of energy consumption, it has undergone many changes during the analysis period (1990-2019) despite its constant growth, it has suffered two falls during the years 1992 and 2015. In addition, it reached 6.731724 kWh per capita on average, ranging from 6.151698 kWh per capita to 7.250688 kWh per capita, with a standard deviation of 0.365536.

The PIB per capita has maintained its evolution in an increasing way, reaching an average of 9.25 per year, having a maximum value of 9.72 and a minimum of 8.807, with a standard deviation of 0.314544.

### Table 2. Descriptive analysis of the model variables.

<table>
<thead>
<tr>
<th>Statistical</th>
<th>PIB per capita</th>
<th>CO2 emissions</th>
<th>Energy consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>9.251553</td>
<td>0.214587</td>
<td>6.731724</td>
</tr>
<tr>
<td>Median</td>
<td>9.157371</td>
<td>0.10957</td>
<td>6.688284</td>
</tr>
<tr>
<td>Maximum value</td>
<td>9.720296</td>
<td>0.602331</td>
<td>7.250688</td>
</tr>
<tr>
<td>Minimum value</td>
<td>8.807272</td>
<td>-0.108056</td>
<td>6.151698</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>0.314544</td>
<td>0.245951</td>
<td>0.365536</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>1.561946</td>
<td>1.524128</td>
<td>1.502869</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>2.81632</td>
<td>3.308093</td>
<td>2.808341</td>
</tr>
<tr>
<td>Probability</td>
<td>0.244593</td>
<td>0.191274</td>
<td>0.245571</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on information from the World Bank
4.2 ANALYSIS OF THE RELATIONSHIP BETWEEN THE BEHAVIOR OF ECONOMIC GROWTH AND ENVIRONMENTAL DEGRADATION IN PERU, 1990-2019

To determine the relationship between economic growth and environmental degradation, there are scatter diagrams, which show us the direct and significant relationship, both between PIB per capita and CO2 emissions; as between PIB per capita and energy consumption.

Figure 2. Scatter diagrams of the variables under analysis

Source: Own elaboration based on information from the World Bank

In this sense, when proposing the direct relationship between economic growth and environmental degradation, so that to contrast it, econometric estimates were made using the Log-Log model, and in the presence of multicollinearity, the model was regressed into differences. The results obtained are presented in Table 3.

Table 3. Estimation of the econometric model

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln CO2 emissions</td>
<td>0.191627</td>
<td>0.0468</td>
</tr>
<tr>
<td>Ln Energy consumption</td>
<td>0.198182</td>
<td>0.0412</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.290246</td>
<td></td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.235649</td>
<td></td>
</tr>
<tr>
<td>Log likelihood</td>
<td>65.24320</td>
<td></td>
</tr>
<tr>
<td>F-statistic</td>
<td>5.316203</td>
<td></td>
</tr>
<tr>
<td>Prob(F-statistic)</td>
<td>0.011599</td>
<td></td>
</tr>
<tr>
<td>Durbin-Watson stat</td>
<td>1.976804</td>
<td></td>
</tr>
</tbody>
</table>

Source: Own elaboration based on information from the World Bank

Based on the estimation, we can affirm that the variable with the greatest relationship or that best explains economic growth is energy consumption, followed by CO2 emissions. An adjusted R square of 23.56% was obtained, demonstrating that the
indicators of environmental degradation explain 23.56% of economic growth. In addition, the Durbin Watson test has a result of 1.97, a value very close to the comparison value of 2. Therefore, substituting the coefficients, we obtained:

\[
D(\text{LnEconomic growth(PIB))}_t = 0.0200626067555 + 0.191626617968D(\text{LnEmissions of CO2}_t) + 0.198181674172D(\text{LnElectric power consumption}_t) + u_t
\]

So, according to the proposed model, it can be concluded that if CO2 emissions increase, PIB per capita would increase by 19%. If energy consumption increases, PIB per capita would increase by 19.8%. The individual significance level in all cases is less than 5%.

5 DISCUSSION

According to the results obtained in the present investigation, where the relationship of CO2 emissions and energy consumption with economic growth is positive, it is consistent with what was determined by Sanchez (2017), in view of the fact that in said investigation, CO2 emissions and PIB per capita for each country analyzed that have high and medium-high incomes show a direct relationship, but these do not fit the Kuznets (1992) environmental curve; on the contrary, CO2 emissions and PIB in low-income and lower-middle-income countries have a trend as established in the Kuznets (1992) environmental curve; which requires that policies must be established to guarantee an adequate exploitation of natural resources that this second group of countries have, using a more modern and efficient technology, seeking to promote a more sustainable extraction of resources and their conservation for future generations.

In addition, the results complement what is established by Catalán (2014), given that said author, when analyzing 144 countries between the periods 1990-2010, applying the panel data model, was able to determine, as in the present investigation, that; the relationship between CO2 emissions and per capita PIB shows a trend towards the N curve, but these are transitory, since, given a higher economic growth, CO2 emissions have a transitory trend; therefore, the role of environmental policy is highlighted, since a good implementation of it can reduce the impact of economic growth on environmental degradation.
In the same way as what was found in the present investigation for the Peruvian case, what was found by Losada et al. (2021) it is equally consistent, since when seeking to analyze the relationship between the economic growth of the countries of Paraguay, Guatemala, Bolivia, Honduras, El Salvador, Nicaragua and Venezuela and environmental degradation in the period 1990-2018 are positive; Complementarily, production in an initial stage generates an increase in CO2 emissions, showing inflection stages, contributing to the environmental trend of what was proposed by Kuznets. It can be indicated that Quinde-rosales et al. (2020) found similar results for Latin America and the Caribbean, highlighting the establishment of an interest in the design of public policies that allow reorienting the emission of CO2 and the development of clean technologies in the countries that have been strongly affected.

Finally, it coincides with what was determined by Asencios (2022), since it highlights the existence of a positive relationship between energy consumption and CO2 emissions, with the observation that PIB per capita was not significant; that is to say that only a variation in energy consumption could affect the level of CO2 emissions. In contrast to the present work, he determined the existence of a direct and significant relationship between these three variables. The variation in results could occur to a large extent because the econometric model has been considered from another perspective.

6 CONCLUSIONS AND SUGGESTIONS

This research analyzed the relationship between economic growth and environmental degradation in Peru, through a LOG-LOG econometric model; where he was able to determine that there is a positive relationship between economic growth represented by PIB per capita and the variables that represent environmental degradation, energy consumption and CO2 emissions; which would indicate that environmental deterioration explains economic growth during the years of study. From the analysis we can also conclude that PIB per capita, CO2 emissions and energy consumption present a behavior of increasing trend during the period 1990-2019.

Regarding the results of the estimates, they indicate that the indicators of environmental degradation explain 24% of economic growth; energy consumption being the one that is most related or that best explains it at 19.8%, followed by CO2 emissions, which explain 19% of economic growth.
Finally, according to the proposed model, we conclude that if CO2 emissions increase, PIB per capita would increase by 19%. If energy consumption increases, PIB per capita would increase by 19.8%.

It is recommended to continue developing work with these characteristics, given that analyzing at the regional level the relationship between economic growth and environmental degradation would be of good contribution to scientific research and for decision makers; considering that it is necessary to have the bases for the design of the environmental policies of Peru and the rest of the countries.
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