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ORIGINAL RESEARCH PAPER

Effect of Income Distribution on Environmental Pollution Growth

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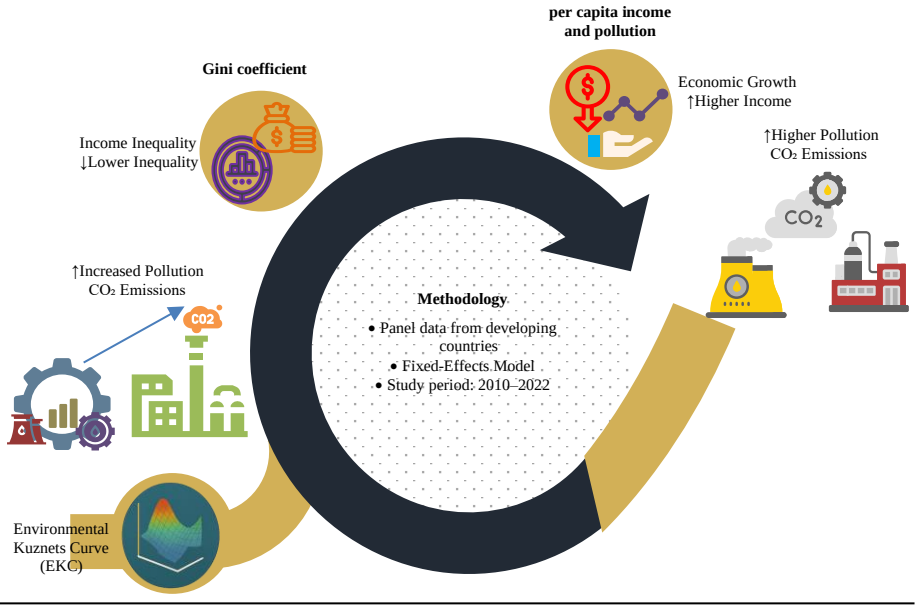
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A B S T R A C T

This research investigates the relationship between income distribution (measured by the Gini coefficient) and environmental pollution, specifically CO2 emissions, in a panel of developing countries (2010-2022). The study acknowledges that economic growth, often leading to increased resource consumption and pollution, necessitates sustainable development planning. It reviews existing theories like the Environmental Kuznets Curve (EKC), which posits that pollution initially rises with income before falling due to structural and technological shifts. Employing panel data analysis, the researchers utilized fixed-effects models after rejecting the pooled and random-effects specifications via Chow and Hausman tests. The key finding is a statistically significant negative relationship between the Gini coefficient and environmental pollutants, meaning that reduced income inequality is associated with increased pollution. Conversely, a positive and significant relationship exists between per capita income and pollution, indicating that as these developing nations increase production and income, pollution levels rise. The conclusion suggests that for these developing economies, efforts to increase per capita income and reduce inequality (lower Gini) currently result in greater environmental degradation, likely due to production methods heavily reliant on polluting, energy-intensive industries. Policymakers are advised to focus on strategies that decouple income growth from pollution, such as moving beyond raw material processing toward higher-value, cleaner industries.



1. Introduction

Natural resources and natural resources are the suppliers of many production inputs and production process, in addition to desirable outputs, has undesirable outputs (environmental pollutants). Therefore, if changes in production techniques and procedures are not performed, then losses from undesirable outputs will be more favorable than that of the desired products. This is more important in the macro dimension. Different countries want balanced economic growth and sustainable development, which requires an appropriate planning plan for achieving high economic growth by reducing environmental impacts

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[1]. If the production is done without regard to the negative effects of the environment, it will certainly have irreversible consequences. Therefore, in order to know and know more about this phenomenon as well as the correct planning for balanced and rational growth this research is done. Therefore, in order to control environmental degradation, it is important to understand its aggravating factors. Among these factors, the present study seeks to explain the effect of gini coefficient on environmental pollution. Although humans have long been aware of the importance of the environment in their lives, the last decade of the 20th century can be considered as the peak time of environmental issues. Although the effect of human on the environmental resources of his life is life as long as his life, destruction and destruction of it after the industrial revolution intensified, enabling the development of science and the of man to subdue nature and cause gradual but continuous destruction of the environment. As the number of humans increases, the amount of pollution imposed on the ground, water, space and air will increase [2]. Moreover, consumption of natural and land resources increases and growth rate is increased, given the fact that the population of the world is increasing, the volume of population has a direct relationship with the consumption of natural resources. In addition, the kuznets curve has been developed for the initial years of economic growth, but it can be improved over time and after reaching a certain level of environmental quality. In other words, in the high growth stages, the amount of environmental degradation decreases. The problem of environmental degradation due to actions and human activities is one of the important global issues facing many countries. This is not only important from the environmental aspect of life and its impact on the systems (systems) of natural resources, but also economically important. So that performance and economic activity may affect even the long - term prosperity of humans. So, in sustainable development process, attention to the environment is undeniable. sustainable development can be defined as maximizing the economic and social development with at least deleterious effects of environmental biology. At present global warming, air pollution, greenhouse gas emissions, loss of ecosystem and thin layer of ozone layer are the most important consequences of excessive use of nature in the direction of human productive activities and consumption of goods and services. these are more evident than before and this is due to the combination of factors such as economic growth, population and industrial activities of human societies. In other words, the economic growth and growth of urbanization, which brings the need for energy to increase energy, will lead to an increase in environmental issues. ever since economic growth was considered as a desirable goal, environmental degradation was the focus of attention of nature lovers. because economic growth and development cannot happen without significant effects on the environment. It is also believed that the needs of the growing population are the leading cause of environmental degradation; the most important reason for such a hypothesis is to limit the capacity of the environment [3].

The effects of urbanization on energy consumption and carbon dioxide emissions are considered by considering three theories 1. Changing the environment to urban space, 2. Urban density and 3.urban density theory. Cities have played a worthwhile role in the growth and prosperity of human civilization. One of the most important demographic phenomenon in the pursuit of economic development and industrialization of countries is rapid growth of cities and urban population. In recent decades, the consequences of urbanization, especially its effects on the environment and accelerating resource depletion and non - renewable resources and also its effect on consumption patterns in general and energy consumption patterns and pollutants in particular, have been among the economists. As the urban population increased from 52/1 billion in 1975 to 29 billion in 2007, the world experienced rapid urbanism (the united nations development programme, 2011). Such an unprecedented growth requires additional urban infrastructure. Due to the effect of urbanization on energy consumption and emission of carbon dioxide in developing countries, this factor is considered as an important factor for the development of energy consumption and carbon dioxide emission in developing countries [4].

States that the use of energy has increased the productivity of production factors, but the use of energy through its polluting effects has increased the viability of the environment, as the bulk of greenhouse gases emitted in the world is the carbon dioxide gas released by fossil fuels. On the other hand, the energy sector has the most important contribution to environmental conditions. Thus, the energy policy and the environment are closely linked. Historically, the increase in energy consumption caused more emissions to the environment. The sustainable environment for the future clearly depends on the success of the world's efforts to reduce energy costs to produce products. Improvement of production devices to reduce or eliminate emissions is an attempt in this direction. Although more urbanization is discussed in the form of economic modernization, it is an indicator of population that has increased urban density, has changed the behavior of human behavior, thus affecting household energy consumption pattern. However, the scope in which the effects of urbanization on energy consumption at the national level and CO_2 emissions are thoroughly investigated are clearly not explained in a single theory. In contrast, some of the possible effects of urbanization on the environment are discussed in detail in three interrelated theories: urban density theory, urban development theory, urban density theory [5].

ecological rehabilitation theory (ecological) was developed in the early 1980 in a small group of western countries, notably germany, the netherlands and england. Social scientists like martin of germany, arthur p.j. a mole of holland and joseph murphy of the uk have a substantial contribution to this theory. The purpose of the theory of ecological modernization is to analyze how the industrial societies cope with environmental crises. The general purpose of the studies done in line with the traditional theory of environmental renewal, focuses on environmental adjustments (existing and planned) due to social activities, socio institutional arrangements as well as political discourse to protect the livelihood base of communities, so the theory of ecological modernization focuses not only on economic modernization but also on social - institutional transformations. In this theory urbanism is a process of social transformation. Researchers argue that environmental problems may be increased from low development stages to mid-development stages. However, further renovations can minimize such problems. The lower stages of development are often encountered with environmental problems associated with poverty (shortage of clean water and sanitation) [6]. However, as income levels increase, these problems gradually subside. The increase in wealth in the cities is accompanied with an increase in production activities, which lead to industrial pollution, such as air pollution. Such problems in the rich cities decrease due to improvements in environmental regulations, technological progress and structural changes in the economy. Consumption patterns and lifestyles in affluent cities are more likely to use more resources compared to the lower - income cities, so rich cities are more likely to encounter environmental issues related to consumption. In other words, in cities that are becoming rich, demand for urban infrastructure, transportation and consumption of personal resources increases [7]. As a result, issues related to consumption, such as energy consumption and CO_2 emissions, are important. Urban density theory discusses the benefits of urban congestion caused by urban congestion, arguing that high urban density reduces the use of scales for public utilities public transportation, schools, and water supply, reducing energy consumption and reducing CO_2 emissions resulting from energy consumption burton. However, some critics believe that the losses arising from the increase in urban density are likely to be more likely due to the density of quality, overcrowding and air pollution in contrast, it is possible to increase energy use and greenhouse gas emissions. In principle, without support from the appropriate urban infrastructure, high urban density can be considered as a viable environmental problem. In contrast, the other group that critics consider the green curve of the kuznets curve believe that this u-shape diagram is ultimately transformed to an n-shaped curve. (The following diagram) is neutral as it seeks to increase economic growth, any improvements made in the environment of the environment. Simon smith, in his famous paper as economic growth and income inequality in 1995, raised the question of how income inequality changes during the process of economic growth in a country. recently ,environments have attempted to explain the interaction between improving the quality or destruction of the environment and national income (gdp) based on the kuznets hypothesis. The result of their efforts to discover the relationship of u shape has led to the discovery of the inverse relationship between the quality of the environment and national income. Applied the term "environmental kuznets curve" for the first time because of this curve [8].

in the early stages of economic growth, awareness and awareness of environmental problems is low and these issues are important for the people. In these stages, compatible technologies with the environment and so- called bio- environment are not available. Thus, in the first stages of economic growth, environmental damage along with revenue growth will increase and this increase will continue to a level of income. After passing this level, the quality of the environment is increased as per capita income [9]. This link can be represented by an inverted u-curve. This relationship is expressed as the ekc curve obtained from the view of kuznets curve. according to ekc, there is a long-term relationship between economic growth and environmental impacts. along with the speed of development which occurs by increasing and intensification of oil and agriculture resources and other resources, the rate of extraction of resources exceeds the rate of production and pollution is increased in terms of quantity and toxicity [10]. At the higher levels of structural changes toward services and industries that focus more on information and with increasing awareness and environmental information, implementation of environmental laws, better technology and higher environmental costs that lead to decrease in the level and gradual decrease of environmental degradation will be discussed. In the first step, we assume that the changing of income from the point of return from the perspective of the change will start to improve and improve the environment. Therefore, ekc can be described as a natural process of economic growth and development that starts from a clean and clean economy and finally leads to a clean service economy advocates of the kuznets hypothesis believe that at high levels of development, economic structure is moving toward new industries and services [11]. The combination of inputs and pollutants of pollutants can be modified. Also, knowledge about the environment of the environment is high and the rules of environment are more useful and effective in order to maintain and promote the environment. Thus, the effect of economic growth on the environment is divided into three parts: scale effect , structural effect and technological effect. In the assumption of kuznets curve, there is no clear indication of time; that is, by considering other countries" conditions separately in their growth process, they experience positions of income and destruction, which are similar on the same ekc. given the assumption that all countries follow a ekc, therefore, in each section of time, it should be seen that the poor countries are forming the initial stages of the ekc or started to decrease, or start to decrease, and other rich countries have developed a decrease and decrease in the EKC [12].

Emissions by simon smith in 1955 raised the question of how income inequality changes during the economic growth process of a country. And in recent years, researchers have sought to find out whether there is a reverse relationship

between economic growth and gross production and the environment. In relation to the effects of economic growth on the environment, different theories have been proposed to the existence of a negative relationship between economic growth and the quality of the environment. Therefore, the use of energy sources and produce more pollutants, the more degraded environment has a significant effect on carbon dioxide emissions. Therefore, in this study a model is estimated to determine the effect of both variables on carbon dioxide level [13].

Economic growth as the most important component of development, without improving the human and environmental conditions as two basic parts of the process of achieving sustainable development will not be achieved. Therefore, the energy consumption and energy consumption and the impact on the environment are very important. Tables 1 indicate that the transport sector with the production of 47.4% percent of the total emissions NO_x, 97.1% CO, 50.4% N_2O, 79.7% CH_4 and 78.3% suspended particles have contribution in emission of different gases among the energy consumers of iran. It should be noted that the of power plant and transport are SO_2 and domestic and domestic, commercial , and public utilities and the rate of emissions CO_2 in this year it is dedicated to yourself. Power and transportation sectors have a significant contribution in the production of sulfur dioxide (78.6%) and nitrogen oxides (81.6%). it should be noted that the values in the tables are mentioned and the share that is presented is due to the lack of access to information in the refinery units and not considering these values. the process of greenhouse gas emissions in selected countries of the study will be discussed in the period 2010-2022.

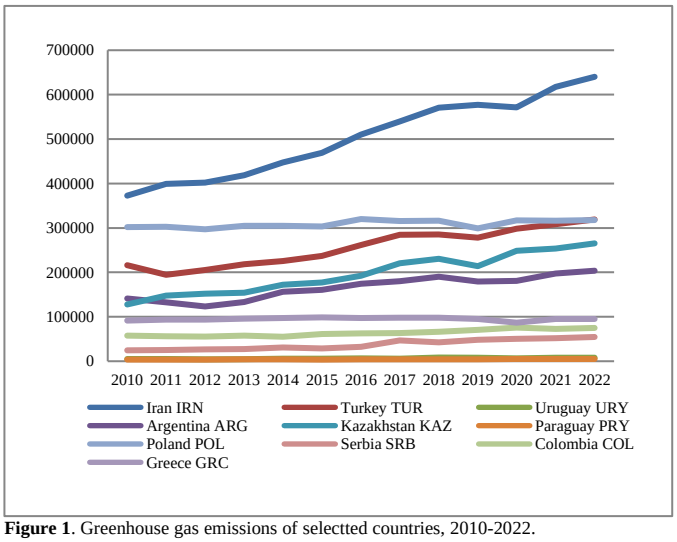


Figure 1. Greenhouse gas emissions of selectted countries, 2010-2022.

2. Method

Of cross sectional data may be associated with problems of uncertainty and estimation of model estimation. the problem of estimating the models by the combination of methods such as fixed effect model, random effect model, seemingly unrelated regression model and integrated data model will not exist. in cross-sectional and time series data, if cross sectional effects and temporal effect are not meaningful, all data can be combined and estimated by ordinary least square regression .panel data analysis is one of the new and applied issues in econometrics, because panel data provides a very rich environment of information for the development of estimation techniques and theoretical results. and researchers are able to use time series data to investigate problems that are not possible to study in only cross sectional or time series environments. panel data method is a method for integration of cross sectional data and time series .the combination of time series and cross sectional data can not only provide useful information to estimate econometric models, but also on the results obtained can be taken into account for the policy makers. in the fixed effect model, the regression slope at each section is constant and the constant term is different from the cross section to another. although the temporal effect is not meaningful, there is a meaningful difference between the cross section and the cross section coefficients cannot change with time. one of the methods to show the cross sectional effect is using virtual variables. the general form of the model is as follows:

$$Y_{it} = \alpha_1 + \alpha_2 DUM_2 + \alpha_3 DUM_3 + \sum \beta_i X_{it} + e_{it}$$

In this regard, X_{it} show independent variables, DUM dummy variable to show cross - sectional effect, Y_{it} vector of dependent variables and e_{it} terms of equation error. in fixed effect models which have a constant slope, it is assumed that the variance of errors in section and also between sections is uniform and there is no correlation between error components. before estimating the model, chow's test is used to determine the fixed effects model against the integration of the data and also the test is performed to determine the use of fixed effects model against random effects. the test is based on the existence or absence of relation between the estimated regression error and the independent variables of the model. in the model used by boris and hernik (1998) and a long term relationship between co2 released (biotic environment factor) and its effective factors (including gini index as income distribution index) and its transformation into a linear form are shown.

$$polt = \beta 0 + \beta 1\,(Yt) + \beta 2\,(GINI_t) + Ut$$

In this model, pol the release gas (co2 emissions), Y_t per capita income per capita, $GINI_t$ gini index, U_t error correction term.

The population of this study includes selected countries (developing countries, turkey, uruguay, argentina, kazakhstan, paraguay, poland, serbia, colombia and greece). the required data , gini index, per capita income and co2 emissions during the period 2010-2022 and using the data from the world bank. in this research, according to the data type and statistical analysis methods, the hybrid methods are used to estimate model parameters and test hypotheses. the method of synthetic data which is also known as cross - sectional data - time series is done in different ways and has various models that one of them is used.

3. Results and Discussion

According to the explanations presented in the previous section to prevent false regression, in this section with levine, lin chow to examine the reliability of the variables of per capita income, environmental pollution and gini coefficient in countries, the results are in appendix 1 .using levin, lane and cho (CLL) statistics, all variables of research are stationary and are estimated by false regression to model estimation.

3.1. Chow Test

The null hypothesis H_0 of the Chow test is that the model is of the pooling type, and the alternative hypothesis H1 is that the model is of the panel type. The results of the F-test for the research model, based on the obtained probability, indicate that, according to the significance level, the model is of the panel type. In other words, the model is of the panel data type.

Table 1. The chow test.

Effects Test	Statistic	d.f.	Prob.
Cross-Section F	368.752084	(9,88)	0.0000
Cross-Section Chi-square	402.180100	9	0.0000
Period F	2.109684	(10,88)	0.0317
Period Chi-square	23.638905	10	0.0086
Cross-Section/Period F	176.274748	(19,88)	0.0000
Cross-Section/Period Chi-square	403.158969	19	0.0000

The most common test for determining the type of panel data model is the Hausman test. If, after conducting the F-test, the null hypothesis H_0 is rejected in favor of the alternative hypothesis H_1, the Hausman test can be used to choose between fixed and random effects models. The Hausman test is based on the presence or absence of a correlation between the estimated regression error and the independent variables of the model. If such a correlation exists, the fixed effects model is appropriate; if not, the random effects model should be used. The null hypothesis H_0 indicates no correlation between the independent variables and the estimation error, while the alternative hypothesis H_1 indicates the presence of such a correlation.

Table 2. Presents the results of the Hausman test.

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Period Random	0.813569	2	0.6658

According to the probability that the initial hypothesis is rejected and the model of the synthetic data type is constant in the form of the effects and it can be stated that there is no association between independent variables and estimation error. now, according to the, the model is estimated by fixed effects in the form of panel model and the results of model estimation are given in the following table.

Table 3. Results from estimating regressions of environmental pollutants.

Variable	Impact Rate	Std. Error	T-statistic	Probability
Intercept	384136.1	93054.49	4.128077	0.0001
Income Inequality Index (Gini Coefficient)	-6380.707	1499.453	-4.255356	0.0000
Per Capita Income	7.178980	3.285099	2.185316	0.0310
Weighted Statistics				
Coefficient of Determination (R^2)	0.254860			
Adjusted R-squared	0.240932			
F-statistic (p-value)	0.000000			

As the result of model estimation, it is clear that according to economic theories and theories, the effect of income distribution index (gini coefficient) has negative impact on the emission of environmental pollutants, and it is also statistically significant. also the impact of per capita income on the emission of environmental pollutants is positive and significant. according to the result of estimating the model between income inequality index (gini coefficient) and environmental pollutants, there is a negative (negative) effect and there is a

direct relation between per capita income and environmental pollutants. this means that with increase in production and income in selected countries, environmental pollution will increase as well and because the selected countries of this study are all developing countries, it is expected that the increase in production in these countries will be accompanied by increasing environmental pollutants. in these countries, production and income are done through energy consumption and pollution associated with pollution (such as iran , which, for example , increases production in steel industry or other energy industries), also according to the result of the research model, the gini coefficient decreases (class interval decreased) and also by increasing per capita income in these countries, the production and income are increased. The F-statistic also indicates that the resulting regression is statistically significant overall.

4. Conclusions

The study showed that there is a negative (negative) between income inequality index (gini coefficient) and environmental pollutants, and there is a direct relationship between per capita income and environmental pollutants. this means that with increase in production and income in selected countries, environmental pollution will increase as well and because the selected countries of this study are all developing countries, it is expected that the increase in production in these countries will be accompanied by increasing environmental pollutants. in these countries, production and income are done through energy consumption and pollution associated with pollution (such as iran, which , for example, increases production in steel industry or other energy industries), also according to the result of the research model, the gini coefficient decreases (class interval decreased) as well as the increase in per capita income in these countries will increase in production and income. according to the results of estimation in the study countries by reducing gini index and increase per capita income of environmental pollutants, it is suggested for economic policy makers in these countries that instead of selling raw materials (i.e. production of steel) with the arrival of the world's top to increase per capita income and reduce gini coefficient, it is suggested to reduce income inequality and cause increase in environmental pollution.

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