Impact of Entrepreneurship and Globalization on Environment in Developed Countries: Environmental Kuznets Curve Approach

تأثير ريادة الأعمال والعولمة على البيئة في البلدان المتقدمة: مقاربة منحنى كوزنتس البيئي

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Abstract:

Using the Environmental Kuznets hypothesis (EKC), this paper seeks to investigate the impact of entrepreneurship and globalization on CO2 emissions. Using static panel data methodology, this research provides the evaluation of EKC specifications for nineteen developed countries from 2001 to 2019. The estimation results of the Feasible Generalized Least Squares (FGLS) model and the Panel Corrected Standard Error (PCSE) model generated the same result as the validity of the EKC hypothesis, indicating that environmental pollution is associated with the economic growth in an inverted N-letter shape, taking into account entrepreneurship and globalization. Entrepreneurship increases CO2 emissions in developed countries, whereas globalization has a beneficial impact on the environment.

Key words: Entrepreneurship, Globalization, EKC, FGLS, PCSE.

الملخص:

باستخدام فرضية كوزنتس البيئية (EKC) ، تسعى هذه الورقة إلى التحقيق في تأثير ريادة الأعمال والعولمة على انبعاثات ثاني أكسيد الكربون. باستخدام منهجية بيانات البانل الثابتة ، يوفر هذا البحث تقييمًا لمواصفات EKC لتسعة عشر دولة متقدمة من عام 2001 إلى عام 2019. أعطت نتائج تقدير نموذج المربعات الصغرى المعممة القابلة للتطبيق (FGLS) ونموذج الخطأ المعياري المصحح للبانل (PCSE)نفس النتيجة باعتبار صحة فرضية EKC ، مما يشير إلى أن التلوث البيئي مرتبط بالنمو الاقتصادي في شكل حرف N معكوس ، مع دور ريادة الأعمال والعولمة. تزيد ريادة الأعمال من انبعاثات ثاني أكسيد الكربون في البلدان المتقدمة ، في حين أن العولمة لها تأثير مفيد على البيئة.

الكلمات المفتاحية: ريادة الأعمال ، العولمة ، EKC، FGLS، PCSE

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Introduction :

Despite the fact that entrepreneurship is seen as a critical approach for attaining economic growth, economic success is accompanied with a host of environmental concerns. As a result, environmental issues and economic development have been regarded to be contradictory. Entrepreneurship promotes both economic and non-economic development by creating employment and improving commodities. According to (Schumpeter, 1931), entrepreneurs are the drivers for change, innovation, economic dynamism, and growth.The basic objective of entrepreneurs is to fill an unmet need or to improve the way that need is already being supplied. As a result of attaining this important and promising goal, good social and environmental benefits may not be achieved as a result of the project. On the contrary, entrepreneurial activity has a major (and historically) negative impact on the environment.

Globalization is breaking down the boundaries that have historically separated local business prospects and local enterprises from their worldwide rivals. Local markets are increasingly getting integrated into larger, global marketplaces. Entrepreneurs and small firms will play a more significant role in the global commercial arena as globalisation accelerates.Globalization has a significant impact on our way of life. It resulted in faster access to technology, increased communication, and mass manufacturing of things. Environmental activists stated that globalisation has considerably increased product consumption, which has had an impact on the ecological cycle. Not only does globalisation increase product consumption, but it also leads to greater energy consumption; as a result, globalization puts more strain on environment(Tang, Wang, Yang, & Tang, 2020).

The main purpose of this study is to obtain answers to the following question:

What impact do entrepreneurship and globalization have on the environment in developed countries?

In order to address the issue, the following hypotheses can be relied upon:

- 'Total Early-Stage Entrepreneurial Activity' has a statistically insignificant impact on environmental degradation in the developed countries.
- 'Research and development expenditure' has a negative moderate statistically significant impact on environmental degradation in the developed countries.
- 'Globalization' has a strong positive statistically significant impact on environmental degradation in the developed countries.

The main objective of this study is to investigate the role and impacts of entrepreneurship and globalization on environmental sustainability, by include these elements as dominant economic features in an econometric environmental Kuznets (EKC) model.The study looks at the processes that are driving the entrepreneurial and globalisation renaissance in developed countries in order to boost economic development on the one hand, and its environmental consequences on the other. Despite the fact that entrepreneurship and globalisation are all qualitative notions, they are referred to in this study as variables.In our model, we'll include these two notions as variables to determine if there's a relationship between their incidence and CO_2 emissions.The measures we used to quantify entrepreneurship were total early-stage entrepreneurial activity and development expenditure (R&D). The Globalization Index (GI) is used to assess the economic, social, and political aspects of globalisation. To strengthen our model, we included both per capita energy use and population density, both of which have a major impact on emissions.

The rest of the article is organized as follows: Section 2 addresses theoretical and empirical literature; Section 3 gives the data and methodology used in this article; Section 4 analyzes the regression results and discusses the impact of entrepreneurship and globalization on CO_2 emissions; and Section 5 includes the conclusion with related policy implications.

1. Theoretical and empirical literature:

In literature, the Environmental Kuznets Curve is most typically employed to depict the relationship between economic development and environmental degradation (EKC). We classified the relevant literature into two groups for our investigation. In the first stream, the relationship between environmental challenges and entrepreneurial activity is discussed. In the second stream, it looks at the impact of globalization on environmental changes.

2.1. Nexus between entrepreneurship and environment:

Entrepreneurship was originally described as starting a firm with own funds, and entrepreneurs and entrepreneurial activity have occurred for a long time. Schumpeter, on the other hand, proposed a new concept of entrepreneurship and entrepreneurs as "innovators who employ a process of shattering the status quo of current products and services to set up new products, new services." In this context, entrepreneurship may be described as the development of new entrepreneurial activities such as new ventures, strategy renewal, and innovation that contribute to improved social and economic performance in businesses(Omri, 2018).

Achieving green and sustainable enterprise development is a challenge and requirement of the modern era. Entrepreneurship plays a crucial part in this process. Entrepreneurship assists businesses in adapting to market changes and actively supports businesses in carrying out activities such as technical green innovation and foreign investment, therefore encouraging their environmental governance and innovation practises to enhance environmental quality(Gu & Zheng, 2021).Several researchers have examined the impact of entrepreneurship on economic growth, but few have examined how it impacts the environment.

(Ben Youssef, Boubaker, & Omri, 2017)concluded that the role of innovation and institutional quality for achieving sustainability are important issues tackled by current sustainable development debates, particularly in developing countries. Using a modified environmental Kuznets curve model, their study improved the understanding of the critical roles of innovation, institutional quality, and entrepreneurship in structural change toward a sustainable future for Africa. Their empirical results show that formal and informal entrepreneurship are conducive to reduced environmental quality and sustainability in 17 African countries however informal entrepreneurship contributes more than formal entrepreneurship to this environmental degradation. The relationship between entrepreneurship and sustainable development turns strongly positive in the presence of high levels of innovation and institutional quality. This study contributes to this emerging research strand by clarifying the conditions that allow African countries to move toward more sustainable economies. Their results highlight the important roles played by innovation and institutions for achieving sustainability in Africa.

(Nakamura & Managi, 2020)used worldwide data to investigate the relationship between entrepreneurial activity and environmental burden (focused on CO_2).Their main contribution is the inclusion of the entrepreneurial component in the relationship not just between entrepreneurship and the environment, but also between economic development, entrepreneurship, and the environment with economic value, through the calculation of marginal cost.The results show a U-shaped relationship between entrepreneurship and the marginal cost of CO_2 emissions in economic development. While an advanced country such as Japan has a median level of marginal cost of CO_2, countries such as China, which have low levels of CO_2 abatement, have higher rates of entrepreneurial activity.Further encouragement of environmental and social entrepreneurship through technology innovation would enable countries near the turning point achieve higher sustainable growth, which is critical for future sustainable development.

(Gu & Zheng, 2021)interpreted the environmental Kuznets model from an entrepreneurial standpoint. As a result, the panel regression model is used in this article to test the relationship between entrepreneurship, economic development, and environmental pollution using micro data, and a moderated mediation model is built to analyse the relationship between entrepreneurship and the three environmental effects.Furthermore, from the standpoint of enterprise heterogeneity, the environmental Kuznets curve and entrepreneurial impacts under varied locations, industrial features, and property rights are studied in this article. According to the findings, China's listed polluting firms exhibit an N-type environmental Kuznets curve. Entrepreneurship directly causes environmental degradation, but it also has a negative impact on the environment through environmental technical impacts, scale effects, and structural consequences.Simultaneously, environmental regulation reverses the good impact of the moderated effect on pollution and so relieves environmental pressure.

2.2. Nexus between entrepreneurship and globalization:

Globalization has a wide range of effects on the environment. Trade and foreign direct investment have an influence on the global location, scale, composition, and environmental impact of both production and consuming activities. Environmental policymaking may alter in a global economy, owing to concerns about international competitiveness. The emissions produced by international transportation have a direct impact on the environment as a result of commerce and travel. Globalization also has an influence on technological dissemination, lifestyle, and the spread of invasive species and illness, all of which have an impact on the environment(Copeland, Shapiro, & Taylor, 2021).Different researchers have examined the relationships between globalisation and the environment by studying time series and panel data with various econometric methods.

(Akadiri, Lasisi, Uzuner, & Akadiri, 2019)attempted to examine the impact of globalization on the Environmental Kuznets curve (EKC) hypothesis for the case of tourist destination states. The study examined the existence of an inverted U- shaped hypothesis, and interactions between globalization, tourism, and real income to show how they contributed to the CO2 emission level, for 15 selected tourism destination states during the period of 1995 to 2014. The results of the study supported the EKC hypothesis for selected states. They indicated that the international tourism growth and CO2 emissions, through the channels of energy consumption, globalization, and real income, are in a long-term equilibrium relationship. Moreover, international tourism and the squared real income have an inverse significant effect on CO2 emission levels. However, energy consumption, globalization, and real income have positive and significant effects on CO2 emission levels in the long term.

(Phong, 2019)conducted a study to evaluate the impacts of globalization, financial development, incorporating energy consumption, urbanization, and GDP per capita, on CO2 emissions with the presence of the Environmental Kuznets Curve (EKC) model for selected Asian countries. This study utilized approximates heterogeneity panel data over the period between 1971and 2014. The results demonstrated thatfinancial development, energy consumption, and urbanization pushed CO2 emissions to increase. furthermore, globalization as an aggregate measure significantly boosts CO2 emissions; its effect resulted from the economic globalization facet.Finally, the EKC hypothesis is highly supported in selected Asiancountries.

(Xiaoman, Majeed, Vasbieva, Yameogo, & Hussain, 2021)examined the impacts of natural resource abundance and economic globalization on environmental quality from 1980 to 2018, taking into account trade openness, urbanization, and economic growth.They employed second-generation panel cointegration methods, as well as continuously updated fully modified (Cup-FM) and continuously updated bias-corrected (Cup-BC) methods.The results suggest that natural resource availability enhances environmental quality greatly. Similarly, economic globalisation reduces emissions in the MENA region.Trade openness, urbanisation, and economic growth, on the other hand, significantly degrade environmental quality. Natural resources and economic globalisation promote trade openness, as seen by the unidirectional relationship.

2.3. The environmental Kuznets curve (EKC):

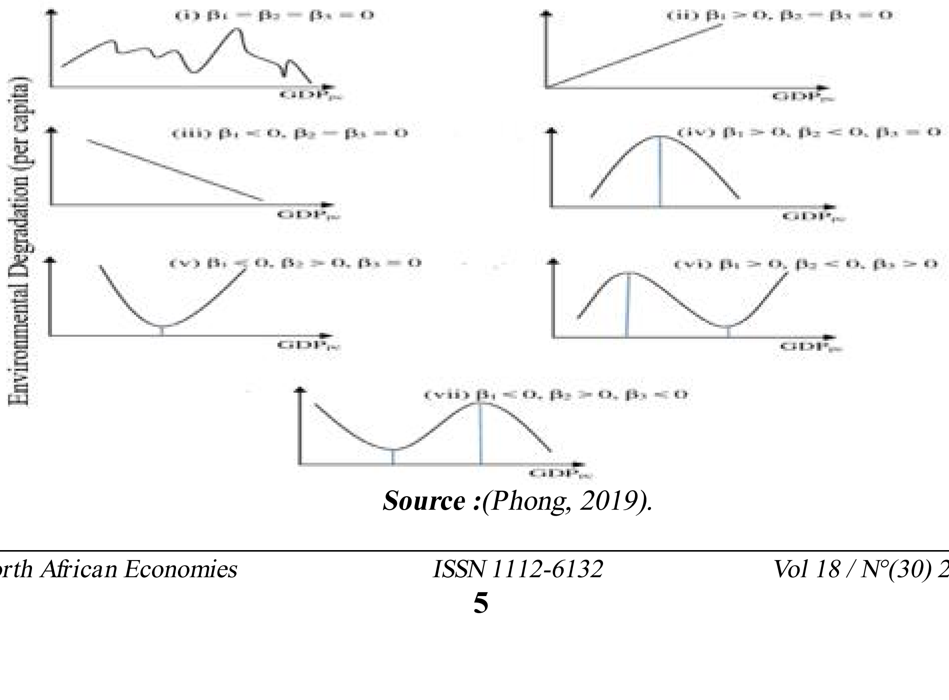
Economic growth has traditionally been seen as a "synonym" with environmental degradation. Researchers have found that economic growth can also correlate with environmental conservation. Sustainable development can be viewed as an approach aimed at calming the relationship between economic development and ecosystem(s) (Almeida, Cruz , Barata, & García-Sánchez, 2017). The impact of economic growth on ecosystems has been extensively studied through statistical models, using different variables and methods. But the conclusions are still like a complex black box. In fact, several findings have shown that an economic system can put ecosystem(s) under stress and, as a consequence, harm its sustainability (Machado, Schaeffer, & Worrell, 2001).

Researchers are interested in analyzing the impact of economic growth on environmental degradation using various measures. While policy makers are interested in understanding how to promote sustainable growth, free from any environmental degradation. Therefore, a popular hypothesis widely used in the field of environmental economics literature for quantitative modelling of economic growth - environmental degradation is known as the environmental Kuznets curve, which is referred to as EKC (Azam & Khan, 2016). The theoretical relationship between environmental degradation and economic growth is usually described as follows (Grossman & Krueger , 1991):

$$\text{EDcp}_{i,t} = \beta_0 + \beta_1 GDPpc_{i,t} + \beta_2 GDPpc2_{i,t} + \beta_3 GDPpc3_{i,t} + \beta_4 Z_{i,t} + \varepsilon_{i,t} \ldots\ldots (01)$$

where EDcp stands for per capita environmental degradation, GDPpc stands for per capita income, and Z includes all other variables that may affect environmental quality. The parameter β_0 measures the average environmental stress when income has no effect, β_1 to β_4 indicates the direction and significance of the exogenous variables, and εit is the error term. Depending on the sign of different parameters related to individual income (β_1 to β_3), EKC will take different forms. In the field of environmental economics, the EKC hypothesis is used to consider the relationship between economic growth and the environment. When per capita income is plotted along the horizontal axis and the per capita environmental degradation index is plotted on the vertical axis for a particular country, we generally get a relationship that takes the following forms(Uchiyama, 2016):

Figure 1. The Environmental Kuznets Curve (EKC)



Source :*(Phong, 2019).*

In the existing literature, three different empirical specifications were used to analyze the EKC hypothesis (Grossman & Krueger, 1995): log-linear, quadratic, or cubic form. These forms can be generalized by usingother factors such as time, regional characteristics, and technical factors like external variables.

Unlike the previous studies, there is only employed energy consumption as a control variable in a model that expresses the relationship between CO2 emissions and real income under the EKC hypothesis framework (Akadiri, Lasisi, Uzuner, & Akadiri, 2019). Where the existence of an inverted U-shaped framework between CO2 emissions and real income was confirmed. The current study, attempts to introduce globalization alongside energy consumption and real income as a determinant of CO2 emission level. Thus, globalization in addition to real income and energy consumption is assumed to contribute to CO2 emission levels.

For quadratic curves and cubic curves, different combinations of coefficient symbols have different curve forms.

Table 3. Curve shape of the relationship between environment and income

Model	Value of βi	Forms of the curve
Model 1	β1 = β2 = β3 = 0	no
Model 2 (linear)	β1 > 0, β2 = β3 = 0	Linear monotonically increasing
Model 3 (linear)	β1 < 0, β2 = β3 = 0	linear monotonically decreasing
Model 4 (quadratic)	β1 < 0, β2 > 0, β3 = 0	U-shaped relationship
Model 5 (quadratic)	β1> 0, β2 < 0, β3 = 0	inverted U-shaped relationship
Model 6 (cubic)	β1 > 0, β2 < 0, β3 > 0	N-type relationship
Model 7 (cubic)	β1 < 0, β2 > 0, β3 < 0	inverted N-type relationship

***Source**: (Fan & Zheng, 2013)*

As shown in Table3., there are seven models for the curve, and the meanings vary from model to model, broadly speaking, linear monotonically increasing means that the environment quality deteriorates as income increases, linear monotonically decreasing means that the environmental quality improves with income increases. The U-shaped relationship means that when income levels are in the lower stages, the environment quality improves as income rises, and when the income level is at a high stage; the environment quality deteriorates as incomes rise., Moreover, inverted U-shaped relationship means that when income levels are in the lower stages, the environment quality deteriorates as incomes rise and when income levels are in the high stages, the environment quality improves as income rises. Besides, the N-type relationship is a kind of curve that explain when the income levels rise gradually, the environment quality deteriorates before further improvement, and finally, it falls into deterioration. In contrast, the inverted N-type relationship is totally opposite that as income levels raise gradually, the environment quality first improves before deterioration and at last improves.

3. Data and Methodology :

3.1.Data:

To analyse the existence of the Environmental Kuznets Curve Hypothesis of the countries was investigated,the present study uses annual data from 2001 to 2019 for 19 developed countries (see appendix 1). The countries were chosen according to the availability of data for the variables that will be considered in the analysis. For each country, we have considered a set of indicators measuring CO2 emissions (CO2cp), GDP per capita (GDP pc), Energy consumption per capita (ECpc), Total Early-Stage Entrepreneurial Activity (TEA), Research and development expenditure

(RDE), Globalization Index (GI)and Population density (POPd).Table 2 describes the dependentand independent variables of the study, including their definition and sources.

Table 2. Description of the variables considered in the analysis.

Variable	Definition	Source
Dependent Variable		
Per capita CO2 emissions (CO2cp)	Carbon dioxide emissions are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during the consumption of solid, liquid, and gas fuels and gas flaring.	International Energy Agency (IEA)
Independent variables		
GDP per capita (GDPpc)	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or depletion and degradation of natural resources. Data are in constant 2010 U.S. dollars.	World Bank national accounts data, and OECD National Accounts data files.
Energy consumption per capita (ECpc)	Energy use refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport.	https://ourworldindata.org/energy-production-consumption
Total Early-Stage Entrepreneurial Activity (TEA)	Percentage of 18-64 population who are either a nascent entrepreneur or owner-manager of a new business	Global Entrepreneurship Monitor - GEM
Research and development expenditure (RDE)	"Research and development expenditure (% of GDP)","Gross domestic expenditures on research and development (R&D), expressed as a percent of GDP. They include both capital and current expenditures in the four main sectors: Business enterprise, Government, Higher education and Private non-profit. R&D covers basic research, applied research, and experimental development."	UNESCO Institute for Statistics
Globalization Index (GI)	The KOF Globalization Index measures the economic, social, and political dimensions of globalization. Globalization in the economic, social, and political fields has been on the rise since the 1970s, receiving a particular boost after the end of the Cold War.	KOF Swiss Economic Institute
Population density (POPd)	Population density is midyear population divided by land area in square kilometers. The population is based on the de facto definition of population, which counts all residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin.	Food and Agriculture Organization (FAO) and World Bank population estimates

Source: *Researchers' elaboration.*

The dependent variable in our study is Per capita CO2 emissions (CO2cp), which represents one of the most important indicators of environmental degradation. Data of this indicator was obtained from International Energy Agency (IEA). Our key explanatory variables are:

- GDP per capita (GDP pc) is measured by the World Bank national accounts data, and the OECD National Accounts data files.
- Energy consumption per capita (ECpc) data provided by our world in data website.
- Entrepreneurial activity at the country level comes from Global Entrepreneurship Monitor - GEM, measured by Total Early-Stage Entrepreneurial Activity (TEA).
- Research and development expenditure (RDE) datacollected from theUNESCO Institute for Statistics (UIS).
- Globalization Index (GI), measured byKOF Swiss Economic Institute.
- Population density (POPd) data was collected from the Food and Agriculture Organization (FAO) and the World Bank population estimates.

The sources of data used in the present study are the most major sources of data, they offer data on many different Global Indexes, they are considered as official sources of data worldwide since a number of them are official websites for international and governmental institutions.

The first data source is The World Bank Data, which provides data of different indexes for 189 countries members.

The second source of the data used in the current study is International Energy Agency (IEA). it is at the heart of global dialogue on energy, providing authoritative analysis, data, policy recommendations, and real-world solutions to help countries to provide secure and sustainable energy. It consists of 30 countries from all around the world.

The Swiss Economic Institute (KOF) is the third source; it was established on May 16, 1938. The Institute carried out its first surveys among companies in 1955. It still provides economic surveys, data, and analysis until today.

Another source of data was used is the Global Entrepreneurship Monitor (GEM); which is a research program that focuses on a major driver of economic growth: entrepreneurship. The GEM research program, initiated in 1998, provides the required fundamental knowledge by assembling relevant harmonized data on an annual basis(Reynolds et al, 2005).

Also, we used data from the UNESCO Institute for Statistics (UIS);which is the official and trusted source of internationally-comparable data on education, science, culture and communication.

3.2.Estimation Strategy:

We estimated an empirical model consisting of a relationship between CO2 emissions (CO2cp) and the following explanatory variables: income (GDP), globalization (GI), energy consumption (ECpc), Total Early-Stage Entrepreneurial Activity (TEA), Globalization Index (GI),and Research and development expenditure (RDE). The model is given by:

$$CO2cp_{it} = \alpha_{it} + \beta_1 GDPpc_{it} + \beta_2 GDPpc_{it}^2 + \beta_3 GDPpc_{it}^3 + \beta_4 ECpc_{it} + \beta_5 TEA_{it} + \beta_6 RDE_{it} + \beta_7 GI_{it} + \beta_8 POPd_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots. (02)$$

All the series are transformed into natural logarithmic form following Lean and Smyth (2010). The log-linear specification presents consistent and efficient empirical results compared to simple linear modeling (Shahbaz et al., 2015b). The log-linear specification is modeled as follows:

$$LCO2cp_{it} = \alpha_{it} + \beta_1 LGDPpc_{it} + \beta_2 LGDPpc_{it}^2 + \beta_3 LGDPpc_{it}^3 + \beta_4 LECpc_{it} + \beta_5 LTEA_{it} + \beta_6 LRDE_{it} + \beta_7 LGI_{it} + \beta_8 LPOPd_{it} + \varepsilon_{it} \quad \ldots\ldots\ldots\ldots (03)$$

In the present study, the presence of the Environmental Kuznets Curve (EKC) hypothesis is empirically tested using a panel data set, covering 19 countries over a nineteen-years between 2001 and 2019. The selected empirical strategy is subject to theoretical considerations, dataset structure, and the potential econometric issues that need to be carried out in this investigation. The use of panel data is the first remedy to address some of the above-listed issues in the presence of the

Environmental Kuznets Curve (EKC) in the selected developed countries. This study follows the previous research practice, which suggests that static estimators, namely fixed effects (FE) and random effects (RE) are more commonly used in panel data analysis. The suitability of the two alternative estimators is assessed on a theoretical basis, the relationship to be investigated, and the type of the data (heterogeneity; unobserved effects), and on the diagnostics tests.Random effects (RE) estimator is preferred in situations, where the unobserved country effects are assumed to be uncorrelated with the included regressors (Gujarati, 2004). On the other hand, the fixed effects (FE) estimator accounts for such correlation between the unobserved heterogeneity and explanatory variables in the model, within each cross-sectional observation, e.g., between countries. The FE rather than the RE is more frequently applied in the entrepreneurship-economic performance literature. Favoring the use of (FE), (Wooldridge J. M., 2013).

The study relies on the Hausman test to confront the decision of which is the most appropriate estimator for this investigation (Hausman, 1978). The null hypothesis states that there are no systematic differences between the two estimators, i.e., that the (RE) model is valid. A rejection of the null hypothesis suggests that the fixed effects (FE) are being preferred over the random effects (RE) (Baltagi, 2021).

The use of panel data methods to address unobserved heterogeneity can bring substantial gains in robustness but is not without costs. The fixed-effects identification strategy cannot be applied in all contexts. Sometimes a variable of interest is measured at only one point in time. Even where variables are measured at more frequent intervals, some are highly persistent, in which case the within-country variation is unlikely to be informative.

Given the potentially unattractive trade-off between robustness and efficiency, (Barro & Sala-i-Martin, 1997), (Temple, 1999), and (Wacziarg, 2002) all argue that the use of fixed effects in empirical growth models has to be approached with care. The price of eliminating the misleading component of the between variation – namely, the variation due to unobserved heterogeneity – is that all the between variation is lost.

There are alternative ways to reveal this point, but consider the random effects GLS estimator of the slope parameters, which will be more efficient than the within-country estimator for small T,when the random-effects assumptions are appropriate. This GLS estimator can be written as a matrix-weighted average within-country estimator and the between-country estimator, which is based on averaging the data over time and then estimating a simple cross-section regression by OLS (Durlauf, Johnson, & Temple, 2005).

To address some of the above empirical issues to ensure econometric validityand statistical inference, (Hoechle D. , 2007) suggests using standard errors adjusted for unbalanced panel data (Driscoll & Kraay, 1998). (Hoechle D. , 2007)argues that "*Driscoll-Kraay standard errors are well-calibrated when theregression residuals are cross-sectionally dependent*". According to (Driscoll & Kraay, 1998), Driscoll-Kraay standard errors are robust to most of the forms ofcross-sectional "spatial" and dependence. The second concern in the empiricalanalysis is the presence of time-invariant or slowly-moving (rarely-changing)regressors.

4. Results and discussion :

4.1.Descriptive statistics:

Table 4. displays descriptive statistics (mean and standard deviation) of the variables that were included in the analysis. The descriptive statistics provide a summary of the sample and observations in the panel data.

Table 4. Description of the variables considered in the analysis.

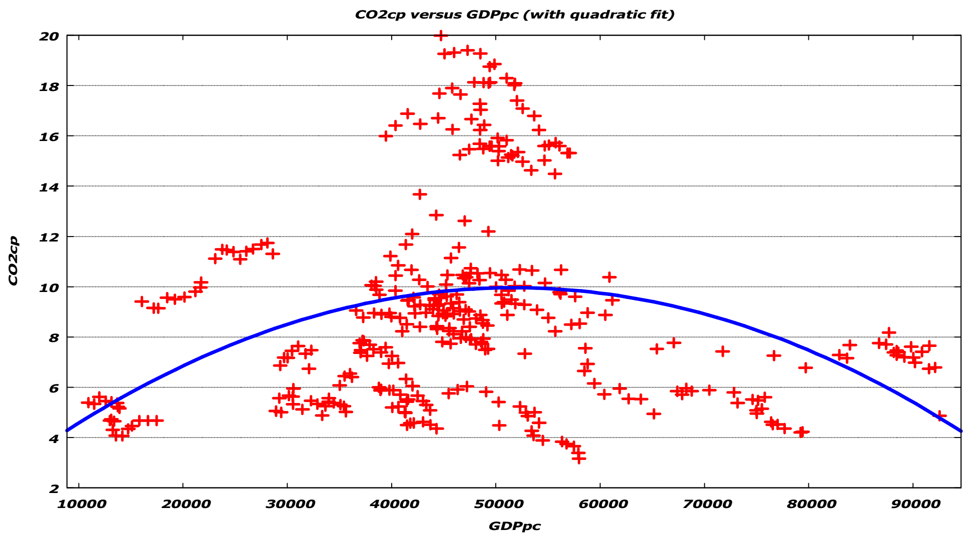
Variable		Mean	Std. dev.	Min	Max	Observations
CO2cp	overall	9.041745	3.916869	3.16	19.99	N = 361
	between		3.854362	4.636842	17.11263	n = 19
	within		1.108408	6.118061	12.52543	T = 19
GDPpc	overall	47025.76	16573.76	10916.81	92556.32	N = 361
	between		16603.64	13771.33	88628.76	n = 19
	within		3576.671	36922.88	70930.7	T = 19
ECpc	overall	57223.79	22798.48	24560.78	115926.9	N = 361
	between		22980.28	27737.64	109856.3	n = 19
	within		4252.346	44274.44	68961.1	T = 19
GI	overall	84.52105	4.735786	68.2	91.79999	N = 361
	between		4.502215	74.44211	89.57895	n = 19
	within		1.780793	77.98947	89.47896	T = 19
TEA	overall	7.20777	3.123317	1.48	18.75	N = 361
	between		2.584052	3.741579	11.89895	n = 19
	within		1.847065	1.676191	14.19303	T = 19
RDE	overall	2.244876	.8075588	.86123	4.763	N = 361
	between		.7786264	1.163438	3.368106	n = 19
	within		.2760529	1.15058	3.63977	T = 19
POPd	overall	169.3681	157.8523	2.526978	531.8688	N = 361
	between		161.8165	2.880765	510.6216	n = 19
	within		6.480447	148.4112	190.6153	T = 19

***Source**: Authors' calculation usingStata/BE 17.*

The dependent variable mean, CO2 emissions (CO2cp), in the developed countries under study is 9.041745, it can be observed that the mean belongs to the range between 3.16 as the minimum value and 19.99 as the maximum value of the CO2 emissions (CO2cp) worldwide.

Figure 1. shows the quadratic curve fitting diagram for environmental pollution and the per capita GDP in the developed countries.

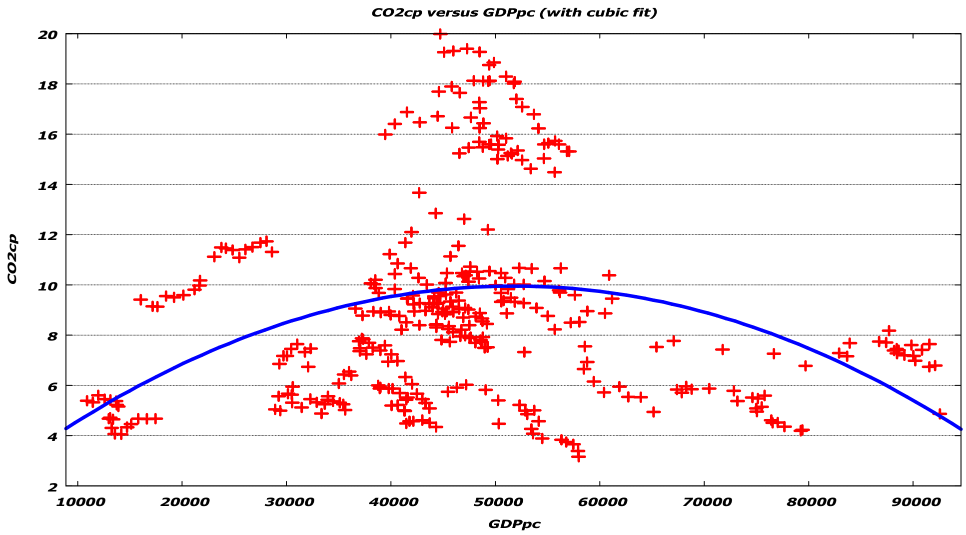
Figure 2. Quadratic curve



***Source**: Authors' drawing usinggretl.*

Figure 1.1 shows the cubic curve fitting diagram for environmental pollution and the per capita GDP in the developed countries.

Figure 3. Cubic curve



Source: Authors' drawing usinggretl.

It can be seen from Figure 1. and Figure 2. that both the quadratic and the cubic curves conform well-inverted U-shaped.

4.2.Estimation results and discussion :

Table7. shows the results of fixed effects estimation:

Table 7. Fixed effects model estimation.

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Fixed-effects (within) regression               Number of obs     =        361
Group variable: country                         Number of groups  =         19

R-squared:                                      Obs per group:
     Within  = 0.8419                                         min =         19
     Between = 0.2538                                         avg =       19.0
     Overall = 0.2540                                         max =         19

                                                F(8,334)          =     222.27
corr(u_i, Xb) = -0.9449                         Prob > F          =     0.0000
```

LCO2cp	Coefficient	Std. err.	t	P>|t|	[95% conf.	interval]
LGDPpc	-21.51178	19.27946	-1.12	0.265	-59.43625	16.41268
LGDPpc_2	1.897989	1.872945	1.01	0.312	-1.786266	5.582244
LGDPpc_3	-.0561385	.0604745	-0.93	0.354	-.1750973	.0628204
LECpc	1.361578	.0547365	24.88	0.000	1.253906	1.46925
LGI	.6177024	.2286084	2.70	0.007	.1680087	1.067396
LTEA	-.0201283	.0125204	-1.61	0.109	-.044757	.0045005
LRDE	.0229527	.0341744	0.67	0.502	-.0442716	.090177
LPOPd	-.5916421	.1160112	-5.10	0.000	-.8198469	-.3634374
_cons	68.79943	66.47656	1.03	0.301	-61.96609	199.5649
sigma_u	1.1078307					
sigma_e	.05574183					
rho	.99747467	(fraction of variance due to u_i)				

```
F test that all u_i=0: F(18, 334) = 292.42                   Prob > F = 0.0000
```

***Source**: Authors' calculation usingStata/BE 17.*

It is evident from the outputs of the previous table that the comparison between the pooled model and the fixed effects model based on the restricted Fisher statistic (F) test, which indicates the rejection of the null hypothesis and acceptance of the alternative hypothesis, meaning that the fixed effects model is the best. The next step is to estimate the random effects model:

Table 8. Random effects of model estimation.

```
Random-effects GLS regression                   Number of obs     =        361
Group variable: country                         Number of groups  =         19

R-squared:                                      Obs per group:
     Within  = 0.8280                                         min =         19
     Between = 0.3861                                         avg =       19.0
     Overall = 0.4154                                         max =         19

                                                Wald chi2(8)      =    1510.16
corr(u_i, X) = 0 (assumed)                      Prob > chi2       =     0.0000
```

LCO2cp	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
LGDPpc	-24.80696	20.08149	-1.24	0.217	-64.16595	14.55204
LGDPpc_2	2.383474	1.950813	1.22	0.222	-1.44005	6.206997
LGDPpc_3	-.0772282	.0629948	-1.23	0.220	-.2006958	.0462394
LECpc	1.379162	.0534708	25.79	0.000	1.274361	1.483962
LGI	.2525723	.234677	1.08	0.282	-.2073862	.7125309
LTEA	-.0177881	.0133532	-1.33	0.183	-.0439598	.0083836
LRDE	-.0331283	.0349052	-0.95	0.343	-.1015413	.0352847
LPOPd	.0054891	.0377343	0.15	0.884	-.0684687	.0794468
_cons	73.185	69.13502	1.06	0.290	-62.31714	208.6871
sigma_u	.23797815					
sigma_e	.05574183					
rho	.94798942	(fraction of variance due to u_i)				

***Source**: Authors' calculation usingStata/BE 17.*

After obtaining the estimates of the random-effects model, it is required to perform a Hausman test for the comparison between the fixed effects model and the random-effects model.

Table 9. Hausman test .

	Coefficients (b) fe	Coefficients (B) re	(b-B) Difference	sqrt(diag(V_b-V_B)) Std. err.
LGDPpc	-21.51178	-24.80696	3.295172	5.340327
LGDPpc_2	1.897989	2.383474	-.485485	.5189739
LGDPpc_3	-.0561385	-.0772282	.0210897	.0167338
LECpc	1.361578	1.379162	-.0175835	.0249259
LGI	.6177024	.2525723	.36513	.07508
LTEA	-.0201283	-.0177881	-.0023402	.0019481
LRDE	.0229527	-.0331283	.056081	.0117608
LPOPd	-.5916421	.0054891	-.5971312	.1192075

```
                         b = Consistent under H0 and Ha; obtained from xtreg.
          B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

    chi2(7) = (b-B)'[(V_b-V_B)^(-1)](b-B)
            =  55.48
Prob > chi2 = 0.0000
```

***Source**: Authors' calculation usingStata/BE 17.*

The output of the previous table shows the rejection of the null hypothesis and acceptance of the alternative hypothesis; therefore, the fixed effects model is the best. The next step is to run the diagnostic tests for the fixed-effects model.

Pesaran CD (cross-sectional dependence) test was used to test whether the residuals are correlated across entities. Cross-sectional dependence can lead to bias in test results (also called contemporaneous correlation) (Pesaran, 2004).

Table 10. Pesaran cross-sectional dependence test.

```
Pesaran's test of cross sectional independence =    -0.034, Pr = 0.9727

Average absolute value of the off-diagonal elements =     0.403
```

***Source**: Authors' calculation usingStata/BE 17.*

The result of the Pesaran test indicates the acceptanceof the null hypothesis and therejection of the alternative hypothesis, which indicates that the model dosen'tsuffer from the problem of non-cross-sectional dependence.

The Modified Wald statistic was used to assess the groupwise heteroskedasticity in the residuals of a fixed-effect regression model. The modified Wald statistic is workable when the assumption of normality is violated, at least in asymptotic terms(Greene, 2020).

Table 11. shows the Modified Wald test for GroupWise heteroskedasticity.

```
Modified Wald test for groupwise heteroskedasticity
in fixed effect regression model

H0: sigma(i)^2 = sigma^2 for all i

chi2 (19)  =     1839.49
Prob>chi2 =       0.0000
```

***Source**: Authors' calculation usingStata/BE 17.*

The null is homoskedasticity (or constant variance). According to the results of the modified Wald test above, we reject the null hypothesis and accept conclude heteroskedasticity.

Many tests for serial error correlation in panel data models have been proposed in the literature. The HR-test was used to test the first-order serial correlation in fixed effect panel data models without gaps (Born & Breitung, 2016), (Wursten, 2018).

Table 12. shows the HR-Born & Breitung test.

Heteroskedasticity-robust Born and Breitung (2016) HR-test as postestimation
Panelvar: country
Timevar: year

Variable	HR-stat	p-value	N	maxT	balance?
Post Estimation	0.37	0.708	19	19	balanced

Notes: Under H0, HR ~ N(0,1)
H0: No first-order serial correlation.
Ha: Some first order serial correlation.

***Source**: Authors' calculation usingStata/BE 17.*

The null hypothesis is no serial correlation. Therefore, we accept the null hypothesis and reject the alternative hypothesis, which concludes the residuals devoid of the first-order autocorrelation.

Diagnostic tests of the specified model suggest the presence of heteroscedasticity and the absence of serial correlation and cross-sectional dependency. The fixed effects estimator was either inconsistent, biased, or inefficient in the presence of heteroscedasticity. To illustrate this, heteroscedasticity would make the estimates inefficient and their standard errors biased. FGLS (Feasible Generalized Least Squares) is normally designed to produce an optimal unbiasedestimator of β for the situation with heterogeneous variance. It can also deal with the problems of heteroscedasticity and serial correlation. Information on FGLS can be found in (Greene, 2020), and (Tsionas, 2019).

Table 14. Feasible Generalized Least Squares model estimation.

```
Cross-sectional time-series FGLS regression

Coefficients:  generalized least squares
Panels:        heteroskedastic
Correlation:   no autocorrelation

Estimated covariances      =        19          Number of obs     =        361
Estimated autocorrelations =         0          Number of groups  =         19
Estimated coefficients     =         9          Time periods      =         19
                                                Wald chi2(8)      =    3660.86
                                                Prob > chi2       =     0.0000
```

LCO2cp	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
LGDPpc	-300.8271	17.28205	-17.41	0.000	-334.6993	-266.9549
LGDPpc_2	29.2656	1.650559	17.73	0.000	26.03056	32.50063
LGDPpc_3	-.9466278	.0524491	-18.05	0.000	-1.049426	-.8438294
LECpc	.648841	.0209709	30.94	0.000	.6077388	.6899432
LGI	-2.607666	.1489301	-17.51	0.000	-2.899563	-2.315768
LTEA	.1587486	.0176525	8.99	0.000	.1241503	.1933469
LRDE	-.0875387	.0201022	-4.35	0.000	-.1269383	-.0481391
LPOPd	.0134622	.0057306	2.35	0.019	.0022304	.024694
_cons	1034.349	60.34826	17.14	0.000	916.0686	1152.629

***Source**: Authors' calculation usingStata/BE 17.*

The Panel Corrected Standard Error (PCSE) model was also employed. PCSE is an alternative to the Feasible Generalized Least Squares (FGLS) for fitting panel data models when the errors are not independent and identically distributed; rather, the errors are either heteroscedastic across panels or heteroscedastic and contemporaneously correlated across panels, with or without autocorrelation.For further details on PCSEsee(Beck & Katz, 1995), (Hoechle D. , 2007)and (Baltagi B. , 2021).

Table 14. Panel Corrected Standard Error model estimation.

```
Linear regression, heteroskedastic panels corrected standard errors

Group variable:   country                        Number of obs     =        361
Time variable:    year                           Number of groups  =         19
Panels:           heteroskedastic (balanced)     Obs per group:
Autocorrelation:  no autocorrelation                           min =         19
                                                               avg =         19
                                                               max =         19
Estimated covariances      =        19           R-squared         =     0.7180
Estimated autocorrelations =         0           Wald chi2(8)      =    2154.31
Estimated coefficients     =         9           Prob > chi2       =     0.0000
```

LCO2cp	Coefficient	Het-corrected std. err.	z	P>|z|	[95% conf.	interval]
LGDPpc	-263.3659	20.20835	-13.03	0.000	-302.9735	-223.7583
LGDPpc_2	25.70436	1.929303	13.32	0.000	21.92299	29.48572
LGDPpc_3	-.8340113	.0612682	-13.61	0.000	-.9540947	-.7139279
LECpc	.6566881	.0313299	20.96	0.000	.5952827	.7180935
LGI	-2.91903	.2215463	-13.18	0.000	-3.353252	-2.484807
LTEA	.2285709	.0303684	7.53	0.000	.16905	.2880918
LRDE	-.141674	.0365738	-3.87	0.000	-.2133574	-.0699906
LPOPd	.0265453	.0103951	2.55	0.011	.0061713	.0469193
_cons	904.4069	70.60376	12.81	0.000	766.0261	1042.788

***Source**: Authors' calculation using Stata/BE 17.*

The FGLS and PCSE models used to handle the heteroscedasticity problem provide identical findings and differ from the fixed-effect regression model. The number of statistically significant variables re-rised to eight, in both models.

For every one percent increase in energy consumption (LECcp), CO2 emissions increase by around 0.65%. This is not dissimilar to (Pao & Tsai, 2010)and (Haseeb, Xia, Danish, Baloch, & Abbas, 2018)for BRICS countries; (Jaunky, 2011)for 36 high-income countries; (Dogan & Seker, 2016)for the European Union countries; and (Dogan & Turkekul, 2016)for the USA. The aforementioned findings recommend that the governments of those countries necessitate some energy policies for sustainable development such as: promoting effective and efficient energy use, upgrading obsolete technology towards modernity and efficiency, researching and developing renewable energy and green energy sources, and reducing the impacts of energy consumption on the environment.

Entrepreneurial activity increases CO2 emissions in developed countries to the extent where a 1% rise in Total Early-Stage Entrepreneurial Activity (TEA) results increase in LCO2 by0.23 percent as per PCSE model, and by 0.16 percent as per FGLS model. Although this increase is relatively weak, it argued that entrepreneurship raises environmental degradation, which in turn shrinks sustainable development in developed countries. Research focusing on the effects of entrepreneurship on the EKC relationship is limited, making it difficult to draw parallels.(Omri, 2018)concluded that the contribution of entrepreneurship to environmental degradation is lower in the case of high-income countries compared to the other country samples.By calculating marginal cost, (Nakamura & Managi, 2020)explicated the relationship between entrepreneurial activities and environmental load by including the entrepreneurship factor in the relationship not only between entrepreneurship and environment but also between economic development, entrepreneurship, and the environment with economic value.They demonstrated that entrepreneurial activities thrive when a country's CO2 marginal cost is low, and they slacken when the CO2 marginal cost is high. However, the results show that once a certain tipping point is reached, entrepreneurial activity rises to the point where the marginal cost of CO2 emissions rises as well.Likewise, (Kövendi, Nagy, Salah Uddin, & Hoon Kang, 2021)used quantile regression on panel data from developed countries from 2006 to 2016, to evaluate the impact of entrepreneurship, technology, and innovation on the environment. They revealed that entrepreneurship boosts CO2 emissions in developed countries.(Mekhzoumi & Gharbi , 2021), on the contrary, found an inverse relationship between Total Early-Stage Entrepreneurial and revenue per person employed in industrialized countries, resulting in a beneficial influence on the environment. They have explained, that in addition to its lack of optimal utilization of the available possibilities, available resources, and opportunities, with the possibility that the pillars of entrepreneurial activity and entrepreneurial ambition of technical readiness, the innovation of new technologies, new goods, and services, in addition to competitiveness and the ability to spread internationally, may not materialize, which leads to these projects defaulting or bankruptcy and incurring financial losses. As a result, the most important empirical researches advocated for increased encouragement of environmental and social entrepreneurship through technical innovation, which aids in achieving more long-term growth, which is critical for future sustainable development. They argued that a qualified education system and the universities, particularly business schools, may employ entrepreneurship education to promote sustainability from an entrepreneurial perspective. Correspondingly, academics and policymakers should collaborate to develop research, publications, and other initiatives aimed at promoting sustainable entrepreneurship, which has been identified as one of the best solutions to improve environmental quality by both the ecological modernization and Schumpeterian theories.

Our results suggest that a boost in R&D in developed countries has an advantageous impact on the environment. The research and development decelerate CO2 emissions in developed countries reached at when 1% increase in the research and development expenditure (LRDE) causes fall in LCO2 around 0.09% as per FGLS model, and around 0.14% as per PCSE model.What can be deduced is that our results fully support the findings of (Ahmad, Khan, Rahman, Khattak, & Khan, 2019)who found that innovation supports a reduction in CO2 emissions in developed countries. A negative correlation between R&D and CO2 emissions has been found for developed countries, but in order to reduce CO2 emissions more effectively, R&D must be focused on sustainable solutions and development. The topic then becomes how to shift R&D expenditures to research sustainable solutions instead of conventional ones. Business owners and prospective entrepreneurs might benefit from updating their teaching techniques, according to (Rashid, 2019). This could be used as a tool to assist alter basic beliefs about how firm and innovation should be done, as well as the definition of a successful business. The dissemination of sustainable development knowledge, according to (Rahmana & Bawono, 2021), will also lead to an increase in the number of businesses adopting a sustainable strategy. As a result, the training should begin with ideas such since the triple bottom line, as the strategy of incorporating environmental and social value into economic value generation may affect how firms function and what sort of R&D they invest in. As a comprehensive recommendation, a transition to greener R&D activities is anticipated to have a rippling effect on the future of sustainability of innovation and entrepreneurship.

Our empirical results suggest that increased globalization in developed countries has a huge positive impact on the environment. Globalization reduces CO2 emissions in developed countries to the point that a 1% increase in the Globalization Index (LGI) leads in a 2.9 percent drop in LCO2 as per the PCSE model and a 2.6 percent decrease as per the FGLS model. Our findings entirely support many empirical results. (Yang, et al., 2021)used panel data from the Organization for Economic Cooperation and Development (OECD) covering 1971-2016 to argue that economic globalization, like trade globalization, minimize long-term CO2 emissions.(Shahbaz, Mahalik, Shahzad , & Hammoudeh, 2019) empirically evaluated the dynamic relationship between globalization and CO2 emissions for 87 countries (high, middle, and low income). They reached that more globalization will reduce carbon emissions in the future. In other words, it demonstrates that globalization primarily benefits both high- and middle-income nations through increasing environmental quality via lowering carbon emissions.(Lenz & Fajdetić, 2021)Ahmed and Ali used dynamic panel analysis using the Arellano and Bond estimator for 26 EU countries from 2000 to 2018. Their findings revealed that increasing the KOF Globalization Index, which encompasses economic, social, and political elements, minimizes negative environmental effects.Using the Environment Kuznets Curve (EKC) hypothesis, (Sahu & Kumar, 2020)investigated the impact of globalization on CO2 emissions in India from 1971 to 2014. The results reveal that overall globalization, social globalization, and political globalization all have a significant negative impact on CO2 emissions, whereas economic globalization has a positive but not significant impact.In contrast, some studies have shown the opposite results to our findings.Globalization is positively related to CO2 emissions for selected South Asian economies during 1985 - 2018, according to the empirical findings of(Jun, et al., 2021).Also,(Leitão & Shahbaz, 2013) discovered that globalization has a positive impact on co2 emission by using a dynamic panel data (GMM-system estimator) of chosen 18 countries during 1990 - 2010.According to the findings of (Muhammad & Khan, 2021) study, social globalization has a critical influence in reducing CO2 emissions in both developed and developing countries. Furthermore, economic globalization in developed countries increases CO2 emissions. Although economic globalization reduces CO2 emissions in developing countries, political globalization increases CO2 emissions.

Migration effects may indicate the potential spillovers of the density population (LPOPd). Improving environmental quality in relation to economic development fundamentally refers to fixing pollutions rather than passing them on to future generations or people in other regions. In actuality, the answer to the pollution problem may be represented by enhanced polluters' capacity to separate themselves from high ambient pollution created by their consumption and polluting activities in affluent neighborhoods. Additionally, distancing behavior has two components: removing polluted sources and avoiding locations with high pollution. As a result, migration may be a significant contributor to the population economic impacts on neighbor emission. In addition, various groups in different communities have differing abilities to migrate away from polluted places, hence migratory impacts likely to aggravate environmental inequality and be a main factor behind the EKC(Dinda, 2004).

Finally, evidence of the EKC has been proven in developed economies. GDP per capita, in particular, reduces CO_2 emissions (as indicated by the negative coefficient of LGDPpc), but the square of GDP per capita increases CO_2 emissions (as denoted by the positive coefficient of LGDP2).Similarly, the cubic of GDP per capita reduces CO_2 emissions (as represented by the negative coefficient of LGDP3), implying that CO_2 emissions move in the inverted N-shaped pattern predicted by the EKC hypothesis. This conclusion was confirmed by (Minlah & Zhang, 2021) , (Özokcu & Özdemir, 2017), (Peng, Wu, & Zhao, 2014), and (Kang, Zhao, & Yang, 2016). This, nevertheless, contradicts the findings of (Zhang & Zhao, 2014), (Rashdan, Faisal, Tursoy , & Pervaiz , 2021), (Gyamfi, Adedoyin, Bein, & Bekun, 2021), and (Balin & Akan, 2015), where estimates from various econometric approaches provide the predicted N-shaped EKC.

5. Conclusion :

The relationship between entrepreneurship and economic growth has been studied using growth theories, notably neoclassical, endogenous, and Schumpeterian growth theories. While the nexus between entrepreneurship and innovation on the one hand, and sustainability on the other, has gotten little attention. Entrepreneurship has a significant impact on economic growth, according to comprehensive reviews of scientific literature. The worldwide industrialization process, particularly in developed countries, has resulted in fast economic development. CO_2 emissions are on the rise as a result of increasing energy use and rapid economic growth. Climate change is produced by CO_2 emissions increasing, which threatens human life and raises the question of sustainability. The relationship between CO_2 emissions and economic growth has been examined in a number of research over the past few decades. Economic Growth and CO_2 Emission Model (EKC) is one of the paradigms that focuses on the relationship between economic growth and CO_2 emission. The main contribution of this research is the combination of the role of entrepreneurship and globalization in the challenge of sustainability through the application of the EKC environmental Kuznets curve approach.

In this paper, we looked at the impact of GDP per capita, entrepreneurship, globalisation, and other control factors on CO_2 emissions in 19 developed countries covering 2001-2019.The measurement and definitional challenges highlighted, as well as a study of literature, drove the selection of economic growth, entrepreneurship, globalization, R&D, energy consumption, population density, and CO_2 emissions. The findings of the static approach estimators indicated that the coefficient of the entrepreneurship measure 'Total Early-Stage Entrepreneurial' has a significantly negative impact in explaining variation in environmental degradation assessed by CO_2 emission in developed countries. Moreover, the "Globalization Index" coefficient has a significant negative impact on explaining variation in the dependent variable.

The results back up the EKC hypothesis by demonstrating EKC evidence in developed countries. The increase in GDP per capita, in particular, decreases CO_2 emissions. This is seen by the negative coefficient of LGDPpc. However, the square of GDP per capita increases CO_2 emissions, as indicated by the positive LGDP2 coefficient. Concurrently, the negative LGDP3 coefficient suggests that increasing GDP per capita lowers CO_2 emissions. This implies that CO_2 emissions follow the inverted N-shaped pattern predicted by the EKC hypothesis.

The present findings of this study aided us in developing some important policy implications to promote sustainability and environmental quality through two major necessary approaches: entrepreneurship and globalization. Despite the fact that there is an inverse relationship between R&D and carbon emissions, the effectiveness is still modest (from 0.09 to 0.14 percent). In addition to the positive relationship between entrepreneurship and carbon emissions, developed countries should step up their efforts to promote and encourage sustainability while also lowering environmental deterioration. They need to concentrate more resources and logistics to this endeavour in order to reduce CO2 emissions from energy use, the majority of which comes from fossil fuels. The use of cleaner and more efficient fossil fuels, such as natural gas and higher-grade coal, is vital for these countries to meet their energy security objectives. A policy that promotes the use of renewable energy in all countries is another feasible approach for lowering emissions.Increased R&D spending on renewable energy sources, as well as market mechanisms that incentivize firms to increase their use of renewable energy, are two more strategies to minimise energy-related pollution. Because renewable energy is comprised of multiple unique energy sources, R&D funds must be divided intelligently among them.

Regardless of the fact that we discovered a significant and positive relationship between globalisation and CO2 emissions, environmental taxes are an essential policy tool that may benefit the environment and the climate. Expanding the Globalization Index, which considers economic, social, and political dimensions, will, moreover, considerably reduce the negative environmental repercussions. Although our findings underscore the importance of globalization, policymakers in developed countries required to support and promote ecologically and climate-friendly policies and international agreements. They also confirm the selected green strategy, which places developed countries in the forefront of a climate-neutral growth drive. Technologies barriers that impede the spread of advanced technology should be abolished. To overcome the problems of economic globalisation (specifically, the Pollution Haven Hypothesis), developed countries should support the use and transfer of technology, particularly those linked to CO2 reduction, across the world.

Within this context, we argue that in order to address environmental concerns in developed countries, entrepreneurial efforts are essential. Furthermore, the significant advantages will only be realised by utilising the R&D and innovation capabilities of entrepreneurs who will develop innovative business solutions to handle environmental challenges. Coercive and more voluntary procedures are often employed to encourage these firms (small and large) to comply with the major aims of sustainable development. Governments employ the former through laws and legislation, but the latter is voluntary pledges made by corporations themselves through corporate social responsibility. We further urge that governments in developed countries consider expanding producer responsibility. However, this should be done with caution since it may have a domino effect on local economies by diminishing the competitiveness of indigenous firms.

The lack of lengthy data, particularly for entrepreneurship and globalization, is an essential limitation of this study. This research solely looks at the globalization index as a whole. Future study on this issue might be more valuable to academics if the three dimensions of globalization are used (economic, social, and political). Another limitation of this article is that it solely considers developed countries; hence, certain results may not be applicable to other countries. As a result, in the future, we would use comparative approach to explore the effects of entrepreneurship and globalization on CO2 emissions in a larger sample that includes both developed and developing countries.

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7. Appendices

Appendix 1:Descriptive statistics - mean by(country) for developed countries 2001-2019

	CO2cp	GDPpc	ECpc	GI	TEA	RDE	POPd
Australia	16.986	51880.27	69315.693	80.611	11.408	2.037	2.881
Belgium	9.177	44012.315	67886.165	89.579	4.974	2.18	359.517
Canada	15.844	47216.47	109856.26	83.089	11.765	1.824	3.745
Denmark	7.864	59587.68	39567.491	88.311	5.384	2.78	131.614
Finland	10.186	46160.704	65123.562	86.279	5.924	3.228	17.631
France	5.196	41136.061	46631.53	85.968	5.005	2.162	118.275
Germany	9.305	42535.588	46915.097	87.184	4.986	2.728	235.026
Hungary	4.857	13771.335	27737.638	84.074	7.432	1.163	110.646
Ireland	8.881	55798.472	40808.918	83.958	8.611	1.296	64.789
Italy	6.496	36017.659	33360.092	81.189	4.339	1.215	201.007
Japan	9.072	45359.972	44476.97	74.442	3.742	3.226	349.662
Korea	10.553	22716.057	59647.293	75.632	10.871	3.368	510.622
Netherlands	9.669	50852.407	62889.146	89.168	7.461	1.87	493.329
Norway	7.248	88628.757	104189.62	85.316	7.37	1.719	13.437
Spain	6.148	30841.444	36659.488	83.316	5.871	1.198	90.576
Sweden	4.637	52778.525	65359.504	89.205	5.644	3.365	23.091
Switzerland	5.192	74007.839	43301.687	89.411	7.118	2.959	198.871
USA	17.113	49701.872	84613.242	80.489	11.899	2.69	33.664
United Kingdom	7.368	40486.028	38912.697	88.679	7.146	1.643	259.611

***Source**: Authors' calculation using Stata/BE 17.*

8. Citations:

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