

An Empirical Analysis Of Economic Growth, Green Entrepreneurship, And Sustainable Development: Evidence From 30 SDG Achievers



Shraddha Rana^{1*}, Prof. Twinkle Prusty²

^{1*}Research Scholar, Faculty of Commerce, Banaras Hindu University, Email Id: shraddharana@bhu.ac.in, Contact: +91 8887251217

²Professor, Faculty of Commerce, Banaras Hindu University, Email Id: twinkle.prusty@gmail.com, Contact: +91 88742 00866

Abstract

In the time of increasing environmental challenges globally, the need of sustainable and innovative solutions is created. In this context, to focus on developing environmentally friendly products, services, and processes, Green Entrepreneurship plays a vital role. However, these eco-conscious enterprises often require substantial financial investments, thereby making the role of financial institutions important in providing necessary financial assistance. Although growing recognition of green entrepreneurship's importance in policy and academic discussions, there is still very limited empirical evidence that shows how economic growth influences green entrepreneurship. These entrepreneurial activities contribute to sustainable development. To address this, the current study examines data of 690 observations over 23 years (2000 to 2022), studying 30 leading sustainable development goal achieving countries. The analysis has been done using Panel data econometric techniques, including fixed effects, Generalised least squares models, and random effects to understand the relationship among variables. The evidence suggests that economic growth measured using GDP has a statistically significant impact on green entrepreneurship. Furthermore, Green entrepreneurship has a positive and significant effect on sustainable development outcomes. Based on the findings, the result suggests that plans and policies promoting economic growth, research and development investments, encouraging trade openness, and improving human capital play a significant role in stimulating green entrepreneurial initiatives and supporting sustainable development.

Keywords: *Economic Growth, Sustainability, Green Entrepreneurship, Sustainable Development*

1 Introduction

The intensified environmental deterioration in recent years has raised significant concerns about the future sustainability of ecological systems. This concern is further multiplied by rapid population growth, placing additional pressure on available natural resources and Environmental adequacy. Parallely, the world is witnessing an increased socioeconomic development. This expansion is the outcome of continuous contamination of natural resources and hence lays down the foundation of sustainable development (Sohail & Din, 2024). The present scenario of development brings into light the contribution of the whole world towards a careful and sustainability-oriented approach (Li et al., 2022). The need for collective action arises, and various international institutions have framed a necessary policy framework where the United Nations Sustainable Development Goals (SDGs) serve as a primary mechanism. In order to guide these sustainability objectives (Sharif et al., 2023). Certain terms, such as green entrepreneurship, ecopreneurship, and enviropreneurship, are quite different yet comprehensively emphasise ecological sustainability via innovation-led business models (Melay & Kraus, 2012). This requires a systematic transformation, which is quite possible

only when entrepreneurial actors reach a significant position utilising their capabilities. Their proactive indulgence will promote the sustainable development outcomes (Meng et al., 2022). When their entrepreneurial capabilities are exploited positively, each individual will be able to contribute to environmental betterment, mitigating ecological challenges (Sreenivasan & Suresh, 2023). Green entrepreneurship proves to be a significant resort for issues like diminishing natural resources. It helps in the global transition towards sustainability (Sohail & Din, 2024).

The current study brings into light the relationship between three major constructs: economic growth (EG), green entrepreneurship (GE), and the Sustainable Development Goals (SDGs) across a diverse array of international economies. The analysis is conducted relying on cross-country data on social entrepreneurship, conducted by Global Entrepreneurship Monitor (GEM), which presents a global relevance of green entrepreneurship in achieving SDGs. This initiative contributes valuable insights into the broader impacts of green entrepreneurship, enriching our understanding of its role in aiding sustainable development worldwide (Johnson & Schaltegger, 2020). Following an extensive review of the literature, it is evident that

numerous studies have explored the impact of GE on the growth of the nation's economy. However, a noticeable gap exists within the existing body of research regarding the reciprocal relationship—specifically, the influence of economic growth on green entrepreneurship among the top achievers of SDGs globally. Recent numbers show that top SDG achievers perform flourishingly with Finland leading the way with a growth rate of 2.5% (Our World in Data team, 2023), supporting 140 green entrepreneurship organizations (Green Entrepreneurship in India, 2023), and scoring 86.35 in putting sustainable development efforts (SUSTAINABLE DEVELOPMENT REPORT 2024 Includes the SDG Index and Dashboards, n.d.). This paper addresses the research gap running analyses over the performance of 30 countries elucidating two key research inquiries: first, the extent to which EG influences the emergence and success of GE; and second, the consequential impact of GE on the attainment of SDGs.

This paper provides a deep insight to the readers gleaned from the top 30 achievers of SDGs and provides valuable perspectives on the interconnectedness of EG, GE, and SD. To examine their relationship, the paper employed econometric methods like; Fixed Effect (FE), Random Effect Estimation (RE), and Generalised Least Squares (GLS). Additionally, Descriptive Statistics, Correlation, and Regression Analysis were conducted to provide an overview, assess the relationship between, and examine the impact of key variables respectively.

The findings highlighted that increasing GDP, fostering innovation (RD spending), and enhancing trade openness and human capital can significantly drive sustainable entrepreneurial practices. In addition to this, it emphasized that higher inflation could hinder sustainable development.

The study provide valuable insights for policymakers, focusing on the need to foster economic growth through investing in ecopreneurship driving sustainable development, businesses can leverage this information to align their strategies, ensuring long-term profitability and benefiting society at large through large job creation. To ensure the conceptual clarity of this study, it is organised into subsequent sections. The second section critically examines the Existing literature about the interrelationship between EG, GE, and SD. Forming a theoretical framework for hypothesis development of this study, the existing evidence builds the foundation for the third section, which outlines the data, variables, and econometric framework employed to empirically test the formulated hypothesis. Followed by the presentation and interpretation of the results, the fourth section offers a contextualisation of the findings through a comprehensive discussion while exploring the study's limitations. Additionally, this section

highlights the practical policy implications and identifies the potential avenues for future research in this field.

2 Theoretical framework and hypotheses formation

2.1 Global Leaders in Sustainable Development:

Finland's leading position at the global sustainable development rankings, securing the position out of 166 nations, with the country's score of 86.80, indicates a high level of achievement across environmental, economic, and social dimensions (SUSTAINABLE DEVELOPMENT REPORT 2024 Includes the SDG Index and Dashboards, n.d.). Across several key indicators, Finland excels notably in the areas such as poverty alleviation, access to quality education, and transition to affordable and clean energy. These areas appear to be primary and central to its overall standing position. Following it closely, Sweden ranks just after Finland in overall performance, showcasing its meticulous efforts and consistent progress in poverty reduction, and achieving plausible and significant performance in gender equality (Measuring Performance in Achieving SDG Targets, 2020). Additionally, Sweden demonstrates moderate progress in transitioning towards cleaner energy alternatives. The top 30 achievers identified from a pool of 166 nations have demonstrated relatively strong performance across multiple SDG's. This cohort is largely dominated by European countries, however, a limited number of non-European economies have also represented. Countries such as Denmark France, Austria, Poland, Croatia, Czechia, Norway, Switzerland, Portugal, Ireland, Poland, Slovenia, Belgium, Japan, Hungary, Netherlands, Slovak Republic, Moldova, Greece, Canada, Italy, and Iceland stand out for their exemplary achievements in poverty alienation. Countries such as Denmark, Germany, Austria, France, Norway, the United Kingdom, Spain, Portugal, Belgium, Netherlands, and Italy have showcased exceptional strides in advancing the goal of gender equality. (Sachs Jeffrey D. et al., n.d.).

Significantly, Denmark, Germany, Austria, France, Norway, Latvia, Spain, Slovakia, Iceland, and Chile have made substantial strides in transitioning to green energy, successfully attaining the goal of affordable and clean energy. The study commences with a critical review of the extensive literature examining the nexus between EG, GE, and Sd dynamics over time. The review identifies the inconsistencies in existing discourse and synthesises the empirical literary contributions, building upon the ideas from previous studies. The present study develops a structured conceptual framework that crafts the directional linkage among variables. The framework posits economic growth as a key driver of green entrepreneurship, which ultimately contributes to sustainable development. To validate the structured approach, the study employs an

empirical model, facilitating a deeper understanding of underlying mechanisms.

2.2 Economic Growth and Green Entrepreneurship:

Prior studies indicate a positive association between green entrepreneurship and economic growth, with significantly observing 3 central dimensions: economic, social, and environmental development. The study examines the interconnection and cumulative impact between GDP and sustainable development, highlighting its influence in the broader sustainability nexus (Holzmann & Gregori, 2023a). (Gecheng Yuan, 2021) Offering the potential to expedite the transformation significantly compared to reliance solely on alternative factors, GE emerges as a crucial catalyst in driving the transition towards a sustainable bioeconomy (Kuckertz et al., 2020). The proposed framework aims to address the need for nuanced understanding of SE (Watson et al., 2023) and its critical contribution in fostering inclusive socio-economic progress. The GE enhances the viability of sustainable entrepreneurial ventures (Liu et al., 2022), facilitating improved performance, access to diverse funding channels, scalability, and credibility (Holzmann & Gregori, 2023b). Typically, studies have examined the influence of entrepreneurship and institutions in isolation, neglecting the synergistic effects that an ecosystem approach could offer in fostering sustainable growth dynamics (Acs et al., 2018).

(Jay Barney, 1991) proposes the Resource-Based Theory arguing that industries with distinct and valuable resources win over the competition with forward advantage. With economic growth, firms gain vivid resources and direct them toward green entrepreneurial ventures. Governments and particular institutions too promote sustainable innovation by allocating financial grants (Cohen & Winn, 2007a).

Endogenous growth theory, proposed by (Paul M Romer, 1989) and (Robert E. Lucas, 1988) emphasises that human capital, technological innovations, and knowledge spillovers drive economic growth, resulting in increased R&D investments, and subsequently creating fertile grounds for green entrepreneurship. The potential entrepreneurs leverage these advancements to bring eco-friendly products and services that enhance sustainability (Ács & Szerb, 2009).

Many studies have been done to find the impact of GE on EC, but the reciprocal impact has been studied here to understand the above-said theories. This interpretation recognises that socio-entrepreneurial initiatives arise primarily to address societal challenges and generate broadened developmental outcomes, rather than being strict Economic gains solely (Wiguna & Manzilati, 2014).

Hypothesis 1. There is a significant positive impact of Economic Growth on Green Entrepreneurship.

2.3 Green Entrepreneurship and Sustainable Development:

Rather than existing as a standalone concept, Green entrepreneurship bridges sustainability goals and entrepreneurial action by utilising environmental considerations within opportunity-driven ventures (Mendes et al., 2022; Schaltegger & Wagner, 2011). From an ecosystem perspective, entrepreneurial habitats do not function in isolation, but they are largely dependent on coordinated inputs and efforts among key institutional units and social actors where higher education institutions, governments, industries, and citizens influence the outcomes. This synergy among units creates a supportive environment and enhances innovation capacity. As a result, this framework supports Entrepreneurial efforts aligning the global sustainability agendas, such as SDG's. Sustainable entrepreneurship thereby refers to entrepreneurial activities as a form of venture creation that integrates Innovation with environmental responsibility and generates social value. It emphasises the proactive problem solving and transformative impact, rather than traditional administrative-centric approaches (Schaltegger & Wagner, 2011). Rising awareness of Environmental issues has led to a reorientation of research priorities toward assessing the impact of entrepreneurial initiatives on achieving long-term ecological balance and sustainability (Sreenivasan & Suresh, 2023). Given the evident positive correlation between various forms of entrepreneurship and sustainable development (Huang et al., 2023), it becomes imperative to discern which stakeholders wield the greatest influence on advancing sustainability objectives (Méndez-Picazo et al., 2021). This symbiotic relationship suggests that social entrepreneurs act as catalysts within society for economic structural change. Through their interventions, they shape economic systems, promote inclusivity, strengthen economic resilience, and facilitate the conditions that are important for long-term development (Sreenivasan & Suresh, 2023).

The Triple Bottom Line (TBL) Theory propounded by Elkington (1997) address that business not only be measured by profit but also by its impact on people (social) and environment. GE goes parallel to TBL by promoting Sustainable business practices (Hall et al., 2010).

(Cohen & Winn, 2007b) emphasized in Sustainable Entrepreneurship Theory that market imperfections create entrepreneurial opportunities for green entrepreneurs, thereby addressing sustainability gage by introducing environment-friendly redressal (Dean & McMullen, 2007).

Even the Circular Economy Theory highlights how resource inefficiency and environment degradation

could be minimized by adopting circular economy principles in the role of green entrepreneurship and hence promoting sustainable development (Geissdoerfer et al., 2017)

The literature clearly states that there exists a relationship between Enviropreneurship and SD. We've constructed a conceptual model of the study, drawing from theoretical perspectives and a review of existing literature, outlined in Figure 1.

Hypothesis 2. There is a significant positive impact of Green Entrepreneurship on Sustainable Development.

3 Data and methodology

3.1 Data Collection

This research delves into the interconnection among EG, GE, and SD across a sample of 30 countries. These

Table 1 outlines the description of the variables involved. For investigating H1, green entrepreneurship is the dependent variable (Cohen et al., 2008) (Sohail & Din, 2024), measured by factors such as nuclear energy production, renewables and other energy emissions (quad BTU) sourced from the Energy Information Administration (EIA). Economic growth (Levine, 1997), represented by GDP per capita, serves as the primary independent variable (Wentao Gu, 2022). Control variables include foreign direct investment (FDI), trade openness, inflationary pressure (consumer prices), human capital (school

enrollment) (Johnson & Schaltegger, 2020), (Carree & Thurik, 2010), and research and development expenditure (Wentao Gu, 2022). To standardize our data, we have opted to logarithmically transform the variables for green entrepreneurship and GDP. Data for these variables are obtained from the World Development Indicators (WDI) database. For investigating H2, sustainable development is the dependent variable, measured by the sustainable development goals index score from the SDG report. Green entrepreneurship remains the main independent variable (Bonfanti et al., 2024), with economic growth (GDP) also included as a control variable alongside those from the H1 investigation.

enrollment) (Johnson & Schaltegger, 2020), (Carree & Thurik, 2010), and research and development expenditure (Wentao Gu, 2022). To standardize our data, we have opted to logarithmically transform the variables for green entrepreneurship and GDP. Data for these variables are obtained from the World Development Indicators (WDI) database. For investigating H2, sustainable development is the dependent variable, measured by the sustainable development goals index score from the SDG report. Green entrepreneurship remains the main independent variable (Bonfanti et al., 2024), with economic growth (GDP) also included as a control variable alongside those from the H1 investigation.

Table 1: Variables Description

Abbreviation	Variables	Measures	Description	Sources
GE	Green Entrepreneurship	Nuclear, renewables, and other energy production (quad Btu)	Green entrepreneurship, quantified by nuclear, renewables, and other energy production (quad Btu), reflects the generation of energy from sustainable sources such as nuclear power, renewable energy sources, and other environmentally friendly alternatives, serving as a metric for eco-conscious entrepreneurial activities.	EIA
EG	Economic Growth	GDP (US\$)	The GDP itself includes all of the gross value added by all producers who are residents of the economy, deducts any product taxes, and adds back any subsidies that aren't included in the product values.	WDI
SD	Sustainable Development	Sustainable Development Goals Index score	The SDG index score is a composite assessment crafted by the United Nations, consolidating scores from all goals, indicators, and targets spanning social, economic, and environmental dimensions. It serves as a holistic measure to evaluate the sustainability performance of countries.	SDG report 2023
FDI	Foreign Direct Investment	Foreign direct investment, net	The term "foreign direct investment" describes the net inflow of capital	WDI

		inflows (% of GDP)	intended to obtain a significant, long-term managerial interest (usually 10% or more of voting stock) in a business operating in an economy that is distinct from the investor's own.	
RD	Research and Development	Research and development expenditure (% of GDP)	The four main sectors that makeup research and development expenditure are business enterprise, government, higher education, and private non-profit. These sectors include both capital and current investment. Basic research, applied research, and experimental development are all included in this R&D.	WDI
IP	Inflationary Pressure	Inflation, consumer prices (annual %)	The consumer price index measures inflation as the annual percentage change in the costs that the average consumer must pay to buy a pre-selected range of products and services. These costs can stay the same or change at regular intervals, like once a year.	WDI
TO	Trade Openness	Trade (% of GDP)	Trade represents the aggregate value of goods and services both exported and imported, presented as a proportion of the Gross Domestic Product (GDP).	WDI
HC	Human Capital	School enrollment, secondary (% gross)	The gross enrollment ratio signifies the proportion of total enrollment, irrespective of age, relative to the population within the specified age group corresponding to the education level depicted.	WDI

3.2 Methodology

The objective of this study is to investigate the nexus between economic growth, green entrepreneurship, and sustainable development goals in the global domain of international economies. Following the above theoretical concepts, the following primary model has been developed:

$$GE_{it} = \beta_0 + \beta_1 EG_{it} + \beta_2 FDI_{it} + \beta_3 RD_{it} + \beta_4 IP_{it} + \beta_5 TO_{it} + \beta_6 HC_{it} + \gamma_t + \varepsilon_{it} \quad (1)$$

Where, green entrepreneurship (GE) is dependent on economic growth (EG), foreign direct investment (FDI), research and development (RD), inflationary pressure (IP), trade openness (TO), human capital (HC), γ_t represents the year fixed effects (dummy variables for each year), and randomly distributed error term (ε_{it}).

$$SD_{it} = \beta_0 + \beta_1 GE_{it} + \beta_2 EG_{it} + \beta_3 FDI_{it} + \beta_4 RD_{it} + \beta_5 IP_{it} + \beta_6 TO_{it} + \beta_7 HC_{it} + \gamma_t + \varepsilon_{it} \quad (2)$$

The second equation delved into how green entrepreneurship affects sustainable development, with sustainable development (SD) being the dependent variable and green entrepreneurship (GE) as the independent variable. We employed

three distinct estimation methods to investigate the aforementioned pair of equations. The analysis of the relationship between a country's economic growth and clean entrepreneurship necessitates an examination of various country characteristics. These include Foreign Direct Investment (FDI), which can catalyze entrepreneurial activity (control variables), Environmental Pressures, indicative of the environmental challenges and opportunities within a nation, Trade Openness, reflecting the degree of integration into global markets, Human Capital, encompassing the skills and knowledge of the workforce, and Research and Development (R&D) capabilities, which drive innovation and technological advancements. By considering these multifaceted factors, a comprehensive understanding of the interplay between economic growth, clean entrepreneurship, and sustainable development can be attained.

4 Result and discussion

4.1 Descriptive Statistics

by the values of the mean and standard deviation. An overview of the average levels observed across the sampled countries can be obtained by looking at the mean values of variables like GE, EG, SD, TO, HC, RD,

Table 2 shows the main variables that are used in the analysis, particularly descriptive statistics. The average level and variations of each factor are shown

IP, and FDI. Furthermore, the standard deviation indicates the extent to which variables deviate from their respective means. The averages of green entrepreneurship, economic growth, and sustainable development are -1.817, 26.301, and

77.874, respectively. Likewise, the standard deviations for green entrepreneurship, economic growth, and sustainable development are 1.939, 1.63, and 3.43, respectively. Detailed descriptive statistics can be found in

Table 2.

Table 2: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
SDG	690	77.874	3.43	68.514	86.761
GE	690	.595	.991	0	4.803
EG	690	7.906e+11	1.176e+12	1.288e+09	6.272e+12
FDI	690	4.942	10.315	-40.086	106.573
RD	690	1.733	.915	.232	3.874
IP	690	2.716	3.128	-4.478	31.299
TO	690	96.624	41.106	19.56	252.495
HC	690	109.206	14.873	81.468	164.08

4.2 Correlation analysis:

In

Table 3, the correlation analysis reveals a positive and significant relationship between economic growth and green entrepreneurship, suggesting that as the economy expands, green entrepreneurship tends to improve. Furthermore, sustainable development exhibits a positive and significant correlation with both economic growth and green entrepreneurship. This implies that as the economy grows, entrepreneurship increases, ultimately contributing to higher levels of sustainable development across the sampled countries. The

Table 3: Correlation Matrix

correlation analysis results indicate that none of the correlation coefficients exceed 0.70, suggesting the absence of multicollinearity. However, following Gujarati (2004) recommendation, this rule of thumb alone is not sufficient to determine multicollinearity. Therefore, we also examine the Variance Inflation Factor (VIF) and VIF/1. If the VIF exceeds 10, it suggests high collinearity, but in our case, none of the VIF values even exceed 4. Additionally, the results of VIF/1 are close to 1, indicating a low level of collinearity. Overall, the model demonstrates the absence of multicollinearity.

Table 3: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) GE	1.000							
(2) GDP	0.682***	1.000						
(3) SDG	0.112***	0.104***	1.000					
(4) FDI	-	-	-0.095**	1.000				
(5) RD	0.115***	0.125***			1.000			
(6) IP	0.348***	0.400***	0.686***	-	0.100***	1.000		
(7) TO	-0.196***	-	-	0.056	-	0.281***	1.000	
(8) HC	-0.384***	-	0.093**	0.288***	-0.092**	0.178***	1.000	
Variance Inflation Factor (VIF)	-0.022	0.455***	0.384***	0.076**	0.380***	-	0.143***	1.000
VIF/1		-0.077**				0.182***		
	1.92	2.27		1.11	1.57	1.14	1.42	1.30
	0.52	0.44		0.90	0.64	0.88	0.70	0.77

***p < 0.01; **p < 0.05; *p < 0.10

4.3 Discussion of regression results for H1 and H2

This research utilized three different econometric methods: fixed effect estimation (FE), random effect

estimation (RE), and generalized least square regressions (GLS). The results of these analyses are presented in

Table 4 and Table 5. Heteroskedasticity was assessed using the Breusch-Pagan/Cook-Weisberg test,

autocorrelation was examined using the Wooldridge test, and non-normality based on skewness and kurtosis. We observed issues related to non-normality, autocorrelation, and heteroscedasticity.

Table 4 investigates how economic growth influences green entrepreneurship. The findings reveal that the Hausman and Breusch-Pagan LM tests confirm that the random effect model is more appropriate for analysis. The findings indicate that green entrepreneurship has a significant and positive relationship with economic growth. The previous literature shows the consistency of the above findings, standing by the side of the significant relationship between EG and GE (Acs et al., 2018b) (Wentao Gu, 2022). Specifically, a 1% increase in the GDP of sampled countries results in a qualitative growth of green entrepreneurship by 0.684%, 0.813%, and 0.772% in the fixed effect (FE), random effect (RE), and generalized least squares (GLS) models, respectively. Furthermore, research and development (RD) expenditure exhibits a positive and significant effect on green entrepreneurship across all models, suggesting that a 1% increase in RD spending leads to a GE increase of 0.264% (FE), 0.311% (RE), and 0.19% (GLS). Additionally, trade openness (TO) also demonstrates a positive and significant impact on GE, indicating that a 1% increase in TO results in a GE increase of 0.01% (FE) and 0.009% (RE). Similarly, human capital has a substantial and positive influence on GE, implying that a 1% increase in secondary school enrolment leads to a GE increase of 0.008% (FE & RE). This suggests that higher levels of human capital contribute to increased green entrepreneurship. Furthermore, Table 5 presents the results of three models: FE, RE, and GLS, examining the impact of GE on the SD of sampled countries. As per these regression results, the Hausman and Breusch-Pagan LM test confirmed that the FE estimation model is suitable for the analysis. The findings of the study show that GE has a significant and positive effect on SD (Bonfanti et al., 2024), implying that an increase

To address these challenges, we also opted for GLS regression, which proved to be the most appropriate method (Moalla & Dammak, 2023) in this context.

of merely 1% in green entrepreneurship leads to increased sustainable development in our sampled countries by 0.448% (FE), 0.405% (RE), and 0.282% (GLS). Similarly, research and development have a significant positive impact on SD, suggesting that a 1% increase in research and development expenditure leads to increased sustainable development by 0.83% (FE), 0.833% (RE), and 0.953% (GLS). Additionally, economic growth (EG) also has a positive impact on SD, indicating that a 1% increase in GDP results in increased sustainable development of sampled countries by 1.058% (FE) and 0.579% (RE). This implies that our sampled countries are more inclined toward energy production through renewable resources rather than non-renewable resources, which may also contribute to their status as top achievers in sustainable development goals worldwide. Likewise, foreign direct investment (FDI) (Leiva et al., 2014) also demonstrates a positive and significant impact on sustainable development (SD), suggesting that a 1% increase in FDI leads to a 0.005% (FE) increase in sustainable development. This suggests that the sampled countries may allocate FDI towards factors that contribute to achieving sustainable development goals. Furthermore, inflationary pressure has a negative and significant impact on sustainable development, indicating that a 1% increase in inflation results in a decrease of -0.045% (FE) and -0.047% (RE) in sustainable development. The findings above affirm that the relationships postulated in the hypotheses align with previous research in existing literature, demonstrating coherence and consistency. The statistical metrics including R-squared, F-statistics, Wald chi-square, and p-values indicate the validity of our models (Tables 4 & 5). Moreover, the consistency of results across all models

Table 4 and Table 5 suggests the robustness of our findings, providing a reliable basis for interpretation.

Table 4: Regression results (Dependent Variable=Green Entrepreneurship)

Variable	FE		RE		GLS	
	Coefficients	t-stats	Coefficients	t-stats	Coefficients	t-stats
EG	.684***	7.06	.813***	10.91	.772***	22.54
FDI	.001	0.75	.001	0.66	0	0.47
RD	.264***	3.87	.311***	4.83	.19***	4.52
IP	.002	0.19	.002	0.21	.003	0.76
TO	.01***	7.37	.009***	6.83	.001	0.80
HC	.008***	3.29	.008***	3.09	.001	0.48
Constant	-22.465***	-8.60	-25.811***	-12.75	-22.533***	-23.07
Year effect	Yes		Yes		Yes	
R-squared	0.389		0.386		NA	
No. of obs.	690		690		690	

F-stats/ Wald Chi-square	14.376	468.076	734.146
P-value	0.000	0.000	0.000
Husman test	Chi-square = 14.84		NA
Brusch Pagan LM test	Chi-square = 5111.83***		NA

***p < 0.01; **p < 0.05; *p < 0.10

Table 5: Regression results (Dependent Variable=SDG)

Variable	FE		RE		GLS	
	Coefficients	t-stats	Coefficients	t-stats	Coefficients	t-stats
GE	.448***	5.86	.405***	5.34	.282***	3.33
EG	1.058***	5.47	.579***	3.59	-.046	-0.40
FDI	.005*	1.65	.005	1.62	-.001	-0.38
RD	.83***	6.26	.833***	6.50	.953***	7.71
IP	-.045***	-2.84	-.047***	-2.97	-.007	-0.78
TO	-.003	-0.89	-.002	-0.69	.001	0.25
HC	-.003	-0.55	.001	0.17	.003	0.78
Constant	52.657***	9.92	64.943***	14.44	79.885***	24.59
Year effect	Yes		Yes		Yes	
R-squared	0.881		0.879		NA	
No. of obs.	690		690		690	
F-stats/ Wald Chi-square	160.665		4493.079		877.841	
P-value	0.000		0.000		0.000	
Husman test	Chi-square =42.59**				NA	
Brusch Pagan LM test	Chi-square =4979.26***				NA	

***p < 0.01; **p < 0.05; *p < 0.10

5 Conclusion and implications

The study seeks to explain the research question: whether economic growth contributes significantly to green entrepreneurship, and examines the participation of green entrepreneurial activities worldwide towards the contribution to sustainable development. The research findings indicate that there exists a critical role of economic growth in fostering green entrepreneurial activities and consequently green entrepreneurship in advancing sustainable development. It suggests that the increased number of environmental entrepreneurial activities has a substantial contribution to the sustainability outcomes, as studied in the sample countries.

The research methodology adopted for this study involves a panel data approach, including non-normality, heteroscedasticity, and autocorrelation. The study involves multiple estimation techniques, which include generalised least squares, random effects, and fixed effects. In order to confirm the robustness and reliability of the result. The findings suggest that Economic growth actually plays a catalytic role towards green entrepreneurship, which implies that as GDP increases, entrepreneurial activities associated with the environment also increase.

Furthermore, the study explains the control variables like R&D expenditure, trade openness, and human capital, which positively influence the green entrepreneurial activities, depicting that there exists a liaison that proposes the multi-dimensional drivers towards sustainability. It implies that green

entrepreneurship is not only income-driven but also supported by innovative research capabilities, global exposure, and an efficient workforce. Considering policymakers, it is suggested that they must be encouraged to adopt a comprehensive development strategy so as to foster sustainable development. It is essential to find an integrated framework that promotes green entrepreneurship and helps in achieving broader sustainable development goals.

6 REFERENCES

- 1) Baltagi, B. H., & Baltagi, B. H. (2008). *Econometric analysis of panel data* (Vol. 4, pp. 135-145). Chichester: Wiley.
- 2) Bobinaite, V., & Tarvydas, D. (2014). Financing instruments and channels for the increasing production and consumption of renewable energy: Lithuanian case. *Renewable and Sustainable Energy Reviews*, 38, 259-276.
- 3) Caglar, A. E., & Yavuz, E. (2023). The role of environmental protection expenditures and renewable energy consumption in the context of ecological challenges: Insights from the European Union with the novel panel econometric approach. *Journal of Environmental Management*, 331, 117317.
- 4) Alsagr, N. (2023). How environmental policy stringency affect renewable energy investment? Implications for green investment horizons. *Utilities Policy*, 83, 101613.
- 5) Cuerva, M. C., Triguero-Cano, Á., & Córcoles, D. (2014). Drivers of green and non-green innovation: empirical evidence in Low-Tech

- SMEs. *Journal of cleaner production*, 68, 104-113.
- 6) Dutta, N., & Meierrieks, D. (2021). Financial development and entrepreneurship. *International Review of Economics & Finance*, 73, 114-126.
 - 7) Gast, J., Gundolf, K., & Cesinger, B. (2017). Doing business in a green way: A systematic review of the ecological sustainability entrepreneurship literature and future research directions. *Journal of cleaner production*, 147, 44-56.
 - 8) Ma, B., Sharif, A., Bashir, M., & Bashir, M. F. (2023). The dynamic influence of energy consumption, fiscal policy and green innovation on environmental degradation in BRICST economies. *Energy Policy*, 183, 113823.
 - 9) Kartal, M. T., Pata, U. K., Destek, M. A., & Caglar, A. E. (2023). Environmental effect of clean energy research and development investments: Evidence from Japan by using load capacity factor. *Journal of Cleaner Production*, 416, 137972.
 - 10) Acs, Z. J., Estrin, S., Mickiewicz, T., & Szerb, L. (2018a). Entrepreneurship, institutional economics, and economic growth: an ecosystem perspective. *Small Business Economics*, 51(2), 501-514. <https://doi.org/10.1007/s11187-018-0013-9>
 - 11) Avelar, S., Borges-Tiago, T., Almeida, A., & Tiago, F. (2024). Confluence of sustainable entrepreneurship, innovation, and digitalization in SMEs. *Journal of Business Research*, 170. <https://doi.org/10.1016/j.jbusres.2023.114346>
 - 12) Bonfanti, A., De Crescenzo, V., Simeoni, F., & Loza Adau, C. R. (2024). Convergences and divergences in sustainable entrepreneurship and social entrepreneurship research: A systematic review and research agenda. *Journal of Business Research*, 170. <https://doi.org/10.1016/j.jbusres.2023.114336>
 - 13) Carree, M. A., & Thurik, A. R. (2010). The Impact of Entrepreneurship on Economic Growth. In *Handbook of Entrepreneurship Research* (pp. 557-594). Springer New York. https://doi.org/10.1007/978-1-4419-1191-9_20
 - 14) Cohen, B., Smith, B., & Mitchell, R. (2008). Toward a sustainable conceptualization of dependent variables in entrepreneurship research. *Business Strategy and the Environment*, 17(2), 107-119. <https://doi.org/10.1002/bse.505>
 - 15) Cohen, B., & Winn, M. I. (2007a). Market imperfections, opportunity and sustainable entrepreneurship. *Journal of Business Venturing*, 22(1), 29-49. <https://doi.org/10.1016/j.jbusvent.2004.12.001>
 - 16) Dean, T. J., & McMullen, J. S. (2007). Toward a theory of sustainable entrepreneurship: Reducing environmental degradation through entrepreneurial action. *Journal of Business Venturing*, 22(1), 50-76. <https://doi.org/10.1016/j.jbusvent.2005.09.003>
 - 17) Del-Aguila-Arcentales, S., Alvarez-Risco, A., Jaramillo-Arévalo, M., De-La-cruz-diaz, M., & Anderson-Seminario, M. de las M. (2022). Influence of Social, Environmental and Economic Sustainable Development Goals (SDGs) over Continuation of Entrepreneurship and Competitiveness. *Journal of Open Innovation: Technology, Market, and Complexity*, 8(2). <https://doi.org/10.3390/joitmc8020073>
 - 18) Geissdoerfer, M., Savaget, P., Bocken, N. M. P., & Hultink, E. J. (2017). The Circular Economy – A new sustainability paradigm? In *Journal of Cleaner Production* (Vol. 143, pp. 757-768). Elsevier Ltd. <https://doi.org/10.1016/j.jclepro.2016.12.048>
 - 19) Gujarati, D. N. (2004). Gujarati Basic Econometrics www.forumakademi.org (3). The McGraw-Hill Companies.
 - 20) Holzmann, P., & Gregori, P. (2023a). The promise of digital technologies for sustainable entrepreneurship: A systematic literature review and research agenda. In *International Journal of Information Management* (Vol. 68). Elsevier Ltd. <https://doi.org/10.1016/j.ijinfomgt.2022.102593>
 - 21) Huang, Y., Li, P., Bu, Y., & Zhao, G. (2023). What entrepreneurial ecosystem elements promote sustainable entrepreneurship? *Journal of Cleaner Production*, 422. <https://doi.org/10.1016/j.jclepro.2023.138459>
 - 22) Jay Barney. (1991). Firm Resources and Sustained Competitive Advantage. *Journal of Management*, 17(1), 99-120.
 - 23) Joana Carolina, C. V., Gabriela, R. G., & Ismael, M. C. (2024). Effect of the economic, social and technological factors on sustainable entrepreneurship over time. *Journal of Business Research*, 173. <https://doi.org/10.1016/j.jbusres.2023.114457>
 - 24) Johnson, M. P., & Schaltegger, S. (2020). Entrepreneurship for Sustainable Development: A Review and Multilevel Causal Mechanism Framework. *Entrepreneurship: Theory and Practice*, 44(6), 1141-1173. <https://doi.org/10.1177/1042258719885368>
 - 25) Kuckertz, A., Berger, E. S. C., & Brändle, L. (2020). Entrepreneurship and the sustainable bioeconomy transformation. *Environmental*

- Innovation and Societal Transitions*, 37, 332–344.
<https://doi.org/10.1016/j.eist.2020.10.003>
- 26) Leiva, J. C., Alegre, J., & Monge, R. (2014). Entrepreneurs emerging from multinational corporations of foreign direct investment: An exploratory study in Costa Rica. *Estudios Gerenciales*, 30(131), 124–133.
<https://doi.org/10.1016/j.estger.2013.12.004>
 - 27) Levine, R. (1997). Financial Development and Economic Growth: Views and Agenda. In *Journal of Economic Literature* (Vol. 35, Issue 2).
 - 28) Liu, D., Zhang, Y., Hafeez, M., & Ullah, S. (2022). Financial inclusion and its influence on economic-environmental performance: demand and supply perspectives. *Environmental Science and Pollution Research*, 29(38), 58212–58221.
<https://doi.org/10.1007/s11356-022-18856-1>
 - 29) Mansouri, S., & Momtaz, P. P. (2022). Financing sustainable entrepreneurship: ESG measurement, valuation, and performance. *Journal of Business Venturing*, 37(6).
<https://doi.org/10.1016/j.jbusvent.2022.106258>
 - 30) Melay, I., & Kraus, S. (2012). ABSTRACTS 1. GREEN ENTREPRENEURSHIP: DEFINITIONS OF RELATED CONCEPTS. 12(2).
 - 31) Mendes, A. C. S., Ferreira, F. A. F., Kannan, D., Ferreira, N. C. M. Q. F., & Correia, R. J. C. (2022). A BWM approach to determinants of sustainable entrepreneurship in small and medium-sized enterprises. *Journal of Cleaner Production*, 371.
<https://doi.org/10.1016/j.jclepro.2022.133300>
 - 32) Méndez-Picazo, M. T., Galindo-Martín, M. A., & Castaño-Martínez, M. S. (2021). Effects of sociocultural and economic factors on social entrepreneurship and sustainable development. *Journal of Innovation and Knowledge*, 6(2), 69–77.
<https://doi.org/10.1016/j.jik.2020.06.001>
 - 33) Moalla, M., & Dammak, S. (2023). Do media coverage and audit quality of US companies affect their Environmental, Social and Governance transparency? *Journal of Financial Reporting and Accounting*.
<https://doi.org/10.1108/JFRA-09-2022-0353>
 - 34) Neumann, T. (2022a). Impact of green entrepreneurship on sustainable development: An ex-post empirical analysis. *Journal of Cleaner Production*, 377.
<https://doi.org/10.1016/j.jclepro.2022.134317>
 - 35) Paul M Romer. (1989). ENDOGENOUS TECHNOLOGICAL CHANGE. *National Bureau of Economic Research*.
 - 36) Pereira, D., Leitão, J., Oliveira, T., & Peirone, D. (2023). Proposing a holistic research framework for university strategic alliances in sustainable entrepreneurship. In *Heliyon* (Vol. 9, Issue 5). Elsevier Ltd.
<https://doi.org/10.1016/j.heliyon.2023.e16087>
 - 37) Robert E. Lucas, Jr. (1988). ON THE MECHANICS OF ECONOMIC DEVELOPMENT. *Journal of Monetary Economics*, 3–42.
 - 38) Sachs Jeffrey D., Lafortune Guillaume, Fuller Grayson, & Drumm Eamon. (n.d.). *SUSTAINABLE DEVELOPMENT REPORT 2023 Implementing the SDG Stimulus Includes the SDG Index and Dashboards*.
<https://doi.org/10.25546/102924>
 - 39) Schaltegger, S., & Wagner, M. (2011). Sustainable entrepreneurship and sustainability innovation: Categories and interactions. *Business Strategy and the Environment*, 20(4), 222–237.
<https://doi.org/10.1002/bse.682>
 - 40) Sharif, A., Mehmood, U., & Tiwari, S. (2023). A step towards sustainable development: role of green energy and environmental innovation. *Environment, Development and Sustainability*.
<https://doi.org/10.1007/s10668-023-03111-5>
 - 41) Sohail, M. T., & Din, N. M. (2024). How does formal credit promote green entrepreneurship? New insights from renewable energy producers in high-, middle-, and low-income countries. *Environmental Science and Pollution Research International*, 31(2), 2869–2882.
<https://doi.org/10.1007/s11356-023-31342-6>
 - 42) Sreenivasan, A., & Suresh, M. (2023). Exploring the contribution of sustainable entrepreneurship toward sustainable development goals: A bibliometric analysis. *Green Technologies and Sustainability*, 1(3), 100038.
<https://doi.org/10.1016/j.grets.2023.100038>
 - 43) Thelken, H. N., & de Jong, G. (2020). The impact of values and future orientation on intention formation within sustainable entrepreneurship. *Journal of Cleaner Production*, 266.
<https://doi.org/10.1016/j.jclepro.2020.122052>
 - 44) Our World in Data team (2023) - "SDG Tracker: Measuring progress towards the Sustainable Development Goals" Published online at OurWorldinData.org. Retrieved from: 'https://ourworldindata.org/sdgs' [Online Resource]
 - 45) *Green Entrepreneurship in India*. (2023). www.ikeafoundation.org

- 46) *SUSTAINABLE DEVELOPMENT REPORT 2024 Includes the SDG Index and Dashboards*. (n.d.). <https://doi.org/10.25546/108572>
- 47) *Measuring performance in achieving SDG targets*. (2020). https://greengrowthindex.gggi.org/?utm_source=chatgpt.com
- 48) Our World in Data team (2023) - "SDG Tracker: Measuring progress towards the Sustainable Development Goals" Published online at OurWorldinData.org. Retrieved from: 'https://ourworldindata.org/sdgs' [Online Resource]
- 49) Li, W., Sun, Y., & Gao, Y. (2022). Relationship between green entrepreneurship orientation, integration of opportunity and resource capacities and sustainable competitive advantage. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.1068734>
- 50) Meng, S., Gao, X., & Duan, L. (2022). Facing the COVID-19 Pandemic and Developing a Sustainable Entrepreneurial Ecosystem: The Theory and Practice of Innovation and Entrepreneurship Policies in China. *International Journal of Environmental Research and Public Health*, 19(14). <https://doi.org/10.3390/ijerph19148797>