

Elmonshid, Lena Bedawi Elfadli; Sayed, Omer Ahmed

## Article

# The relationship between entrepreneurship and sustainable development in Saudi Arabia: A comprehensive perspective

Economies

## Provided in Cooperation with:

MDPI – Multidisciplinary Digital Publishing Institute, Basel

*Suggested Citation:* Elmonshid, Lena Bedawi Elfadli; Sayed, Omer Ahmed (2024) : The relationship between entrepreneurship and sustainable development in Saudi Arabia: A comprehensive perspective, *Economies*, ISSN 2227-7099, MDPI, Basel, Vol. 12, Iss. 8, pp. 1-23, <https://doi.org/10.3390/economies12080198>

This Version is available at:

<https://hdl.handle.net/10419/329124>

### Standard-Nutzungsbedingungen:

Die Dokumente auf EconStor dürfen zu eigenen wissenschaftlichen Zwecken und zum Privatgebrauch gespeichert und kopiert werden.

Sie dürfen die Dokumente nicht für öffentliche oder kommerzielle Zwecke vervielfältigen, öffentlich ausstellen, öffentlich zugänglich machen, vertreiben oder anderweitig nutzen.

Sofern die Verfasser die Dokumente unter Open-Content-Lizenzen (insbesondere CC-Lizenzen) zur Verfügung gestellt haben sollten, gelten abweichend von diesen Nutzungsbedingungen die in der dort genannten Lizenz gewährten Nutzungsrechte.

### Terms of use:

*Documents in EconStor may be saved and copied for your personal and scholarly purposes.*

*You are not to copy documents for public or commercial purposes, to exhibit the documents publicly, to make them publicly available on the internet, or to distribute or otherwise use the documents in public.*

*If the documents have been made available under an Open Content Licence (especially Creative Commons Licences), you may exercise further usage rights as specified in the indicated licence.*



<https://creativecommons.org/licenses/by/4.0/>

## Article

# The Relationship between Entrepreneurship and Sustainable Development in Saudi Arabia: A Comprehensive Perspective

Lena Bedawi Elfadli Elmonshid \* and Omer Ahmed Sayed 

Department of Finance and Investment, Faculty of Business Administration, University of Tabuk, Tabuk 71491, Saudi Arabia; omer@ut.edu.sa

\* Correspondence: lelmonshid@ut.edu.sa

**Abstract:** This study examines the relationship between entrepreneurship and sustainable development in Saudi Arabia from 2006 to 2022, focusing on the economic, social, and environmental dimensions. Using the autoregressive distributed lag (ARDL) model, the research investigates both short-run and long-run dynamics to understand how entrepreneurial activities influence sustainable development within the framework of Saudi Arabia's Vision 2030 initiative. The findings indicate that entrepreneurship significantly contributes to economic growth through job creation and innovation, thereby aiding in the diversification of the economy away from oil dependency. Socially, entrepreneurial initiatives have a positive impact on gender equality and social inclusion by empowering women and integrating youth into the labor market. Environmentally, entrepreneurship helps reduce carbon emissions and promotes sustainable business practices. Despite these positive outcomes, challenges such as regulatory barriers, limited access to finance, and the need for a supportive entrepreneurial ecosystem remain. Recommendations include enhancing entrepreneurial education, providing financial incentives, and streamlining regulatory processes to better support start-ups and SMEs. This study highlights the necessity of addressing these challenges to fully realize the potential of entrepreneurship for sustainable development in Saudi Arabia. By providing empirical evidence on the significant role of entrepreneurship in driving sustainable development, this research offers actionable insights for policymakers aiming to foster a more resilient and diversified economy in line with Vision 2030.



**Citation:** Elmonshid, Lena Bedawi Elfadli, and Omer Ahmed Sayed. 2024. The Relationship between Entrepreneurship and Sustainable Development in Saudi Arabia: A Comprehensive Perspective.

*Economies* 12: 198. <https://doi.org/10.3390/economies12080198>

Received: 1 July 2024

Revised: 24 July 2024

Accepted: 26 July 2024

Published: 31 July 2024



**Copyright:** © 2024 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** entrepreneurship; sustainable development; economic growth; environmental sustainability; ARDL model

## 1. Introduction

In recent decades, sustainable development has become a cornerstone of global policy agendas, reflecting a commitment to balancing economic growth with social equity and environmental stewardship. This holistic approach recognizes that long-term prosperity depends not only on economic factors but also on social inclusion and environmental sustainability. The role of entrepreneurship has gained prominence as a catalyst for sustainable transformation since nations strive to meet the United Nations' Sustainable Development Goals (SDGs), which are 17 global goals established by the United Nations in 2015 to achieve by 2030. These goals address various aspects of sustainable development, including poverty eradication, quality education, gender equality, clean energy, economic growth, reduced inequalities, and climate action.

The SDGs provide a comprehensive framework for countries to align their policies and strategies. Entrepreneurs drive innovation, create jobs, and introduce new technologies and business models that can address social and environmental challenges while fostering economic dynamism.

The importance of entrepreneurship in achieving sustainable development is underscored by its potential to stimulate economic growth, enhance social outcomes, and reduce

environmental impacts. Numerous studies have highlighted how entrepreneurial ventures contribute to economic development by generating employment, increasing productivity, and fostering innovation (Audretsch and Keilbach 2004; Dhahri and Omri 2018). Additionally, entrepreneurship is seen as a vehicle for social change, improving health, education, and overall quality of life. Green and sustainable entrepreneurship, in particular, has been identified as a key mechanism for reducing carbon footprints and promoting environmental sustainability (Neumann 2022).

Despite the growing recognition of entrepreneurship's role in sustainable development, the specific dynamics of this relationship can vary significantly across different contexts. Saudi Arabia presents a unique case study in this regard. The country is undergoing a profound economic transformation driven by Vision 2030, an ambitious initiative aimed at diversifying the economy away from oil dependence and fostering sustainable development.

Vision 2030 is Saudi Arabia's strategic framework launched in 2016 to diversify its economy and reduce its dependence on oil. The plan focuses on three main pillars: a vibrant society, a thriving economy, and an ambitious nation. It aims to enhance public sector efficiency, foster economic diversification through innovation and entrepreneurship, and improve the quality of life by promoting education, healthcare, and cultural activities. It outlines strategic objectives to increase the contribution of small and medium-sized enterprises (SMEs) to the national economy, enhance innovation, and support sustainable practices.

However, the interplay between entrepreneurship and sustainable development in Saudi Arabia remains underexplored. This study addresses this gap by empirically assessing the connections between entrepreneurial activity and sustainable development across economic, social, and environmental dimensions. By focusing on the period from 2006 to 2022, the research aims to capture the impact of entrepreneurial activities within the broader context of Saudi Arabia's economic reforms.

The research employs the autoregressive distributed lag (ARDL) approach to examine both short-run and long-run relationships between entrepreneurship and various aspects of development. The ARDL model is particularly suited for this analysis due to its flexibility in handling variables of different integration orders, making it an ideal tool for exploring complex, dynamic relationships (Pesaran and Shin 1999).

The study seeks to answer three core questions: How does entrepreneurial activity influence economic development in Saudi Arabia? What is the impact of entrepreneurship on social development indicators such as the human development index (HDI), which encompasses three key dimensions: life expectancy, education, and per capita income? How do entrepreneurial activities affect environmental sustainability, particularly in terms of CO<sub>2</sub> emissions? By addressing these questions, the research aims to provide a comprehensive understanding of the role of entrepreneurship in promoting sustainable development in Saudi Arabia.

The value added by this research lies in its comprehensive approach to examining the multifaceted impact of entrepreneurship on sustainable development in Saudi Arabia. The findings will contribute to the existing literature by offering nuanced insights into the Saudi context and providing empirical evidence to inform policymakers and stakeholders. This research is particularly timely given Saudi Arabia's ongoing efforts to achieve its Vision 2030 goals and transition towards a more diversified and sustainable economy.

This study examines the relationship between entrepreneurship and sustainable development in Saudi Arabia from 2006 to 2022, focusing on economic, social, and environmental dimensions. The conceptual framework is grounded in the works of Audretsch and Keilbach (2004), Dhahri and Omri (2018), and Neumann (2022), who highlight the multifaceted impacts of entrepreneurship. This study aims for the following:

- Quantify the economic impact of entrepreneurship on Saudi Arabia's growth and diversification.
- Assess the social implications, particularly on gender equality and social inclusion.

- Evaluate the environmental outcomes, specifically CO<sub>2</sub> emissions and sustainable practices.

The importance of this research is underscored by the potential for entrepreneurship to drive sustainable development, not only in Saudi Arabia but also as a model for other nations pursuing similar goals.

The research is organized as follows: The next section reviews the relevant literature on entrepreneurship and sustainable development, highlighting key theoretical frameworks and empirical findings. The subsequent section outlines the data sources and variables used in the analysis, followed by a detailed explanation of the ARDL methodology. The Results Section presents the findings from the ARDL models, examining short-run and long-run relationships across the three dimensions of sustainable development. The Discussion Section interprets these findings in the context of the broader literature and Saudi Arabia's policy environment. Finally, the Conclusion summarizes the key insights, discusses policy implications, and suggests avenues for future research.

## 2. Literature Review

The following section provides a comprehensive review of the existing literature on the concept of sustainable development, its main components, and their interactions with entrepreneurial activity. The review is structured to first explore the multifaceted nature of sustainable development, emphasizing the complexity and interdependence of its economic, social, and environmental dimensions. It then delves into the role of entrepreneurship as a catalyst for sustainable development, examining its economic, social, and environmental impacts.

Through a synthesis of key studies, this section highlights how entrepreneurship drives economic growth, enhances social development, and contributes to environmental sustainability. Despite the substantial body of research underscoring these interactions, there remains a significant gap in the empirical examination of these dynamics within the specific context of Saudi Arabia. This study aims to fill this gap by providing a detailed analysis of the impact of entrepreneurial activities on sustainable development in Saudi Arabia from 2006 to 2022.

The literature review sets the foundation for the development of hypotheses, which will be empirically tested using the ARDL approach. These hypotheses are crafted to explore the nuanced relationships between entrepreneurial activity and the three pillars of sustainable development, offering insights that are both timely and relevant given Saudi Arabia's ongoing economic transformation under Vision 2030. This section, therefore, not only consolidates existing knowledge but also paves the way for new contributions to the field of sustainable entrepreneurship.

### 2.1. The Concept of Sustainable Development

Sustainable development is a multifaceted and complex concept that aims to achieve a harmonious balance between economic growth, social inclusion, and environmental protection. The term emphasizes meeting the needs of the present without compromising the ability of future generations to meet their own needs (Dhahri and Omri 2018). This holistic approach requires integrating diverse and sometimes conflicting objectives, making sustainable development an intricate challenge for policymakers and practitioners alike.

The economic dimension of sustainable development focuses on fostering robust economic growth that is inclusive and equitable. Economic growth should create wealth and employment opportunities, enhance productivity, and promote technological innovation. However, this growth must be pursued in ways that do not exacerbate inequality or lead to environmental degradation (Filser et al. 2019). The work of Hartog et al. (2010) underscores the importance of a stable economic environment that supports entrepreneurial activities, which in turn drive economic dynamism and innovation.

Social inclusion is another critical pillar of sustainable development. It involves ensuring that all members of society have access to basic services, opportunities, and

resources, thereby promoting equity and reducing disparities. Social development encompasses improvements in education, healthcare, gender equality, and overall quality of life (Dhahri and Omri 2018). Alwakid et al. (2021) highlight the role of formal institutions in facilitating entrepreneurship, which can lead to social progress by creating jobs and empowering marginalized groups.

Environmental protection is the third essential component of sustainable development. It aims to preserve natural resources, reduce pollution, and mitigate climate change to ensure a healthy and resilient environment for future generations. This requires a shift towards sustainable consumption and production patterns, as well as the development and adoption of green technologies (Neumann 2022). He et al. (2020) provides evidence that entrepreneurial activities can contribute to environmental sustainability through the implementation of eco-friendly practices and innovations.

The interactions between these three pillars are complex and interdependent. Economic activities can lead to social improvements by creating jobs and generating income, but they can also cause environmental harm if not managed sustainably. Similarly, social progress can drive economic growth by fostering a more educated and healthier workforce, yet it may increase consumption and resource use. Environmental sustainability, while crucial, often requires substantial economic investments and can influence social and economic policies (Dhahri et al. 2021).

Apostolopoulos et al. (2018) argues that achieving sustainable development requires innovative and collaborative approaches that can navigate these interdependencies. Effective governance and strong institutional frameworks are essential to balance economic, social, and environmental objectives. This is particularly relevant in the context of developing countries, where the challenges of poverty, inequality, and environmental degradation are more pronounced (Dhahri and Omri 2018; Peprah and Adekoya 2020).

Early-stage business models that prioritize sustainability can have a significant impact on long-term development. Cagarman et al. (2023) introduce the esSROI (sustainable return on investment) model to capture the sustainable impact of early-stage businesses. This model can be applied to assess the sustainability of new ventures in Saudi Arabia, ensuring that entrepreneurial activities contribute positively to economic, social, and environmental outcomes.

In summary, sustainable development is a complex and dynamic concept that necessitates a comprehensive and integrated approach to policy and practice. The interactions between economic growth, social inclusion, and environmental protection highlight the need for innovative solutions and robust institutional frameworks to achieve long-term sustainability. This complexity underscores the importance of entrepreneurship as a catalyst for sustainable development, capable of driving economic, social, and environmental progress in a balanced and synergistic manner.

## 2.2. Entrepreneurship and Sustainable Development

Entrepreneurship is increasingly recognized as a critical driver of sustainable development. It fosters economic dynamism, creates jobs, and introduces innovative solutions to social and environmental challenges. The interaction between entrepreneurship and sustainable development can be examined through its economic, social, and environmental impacts.

Huđek and Bradač Hojnik (2020) provide empirical evidence on the significant role of entrepreneurship in achieving sustainable development goals. Their study shows that entrepreneurial activities contribute to reducing carbon emissions and promoting sustainable business practices. Similarly, Johnson and Schaltegger (2020) highlight case studies where entrepreneurial ventures have successfully integrated sustainability into their business models, leading to positive environmental outcomes.

### 2.3. Economic Impact of Entrepreneurship: Entrepreneurship and Economic Growth

Entrepreneurship contributes significantly to economic growth by generating employment, increasing productivity, and fostering innovation. Studies have shown that entrepreneurial activities are positively correlated with economic growth across various contexts. For instance, [Wennekers and Thurik \(1999\)](#) and [Audretsch and Keilbach \(2004\)](#) highlight the role of entrepreneurship in driving regional and national economic performance. In Saudi Arabia, [Akinwale et al. \(2020\)](#) found that entrepreneurial activities have significantly contributed to economic diversification and growth, particularly in the context of the Vision 2030 initiative aimed at reducing oil dependency.

[Dana et al. \(2024\)](#) reviews the history of women's entrepreneurship research, emphasizing the role of women entrepreneurs in driving economic and social development. [Davari et al. \(2022\)](#) investigate the causal relationships between entrepreneurship, unemployment, and economic growth. Their findings indicate that entrepreneurship reduces unemployment and stimulates economic growth. [Dejardin \(2000\)](#) explores the relationship between entrepreneurship and economic growth, arguing that entrepreneurship is a critical driver of economic performance.

Economic freedom is a critical factor that influences the success of entrepreneurial activities. [Sayed and Abdelrahim \(2024\)](#) provide an empirical analysis of GCC countries, including Saudi Arabia, showing that economic freedom acts as a catalyst for entrepreneurship. Their study finds that reducing regulatory barriers and enhancing economic freedom can significantly boost entrepreneurial activities, leading to economic growth and sustainable development.

[Doran et al. \(2018\)](#) highlight that entrepreneurship stimulates economic growth in both developed and developing countries by creating jobs and fostering innovation. [Ferreira et al. \(2017\)](#) discuss Schumpeterian entrepreneurship, which focuses on innovation, and Kirznerian entrepreneurship, which emphasizes market efficiency.

[Gu et al. \(2020\)](#) show that entrepreneurship drives economic growth in China through innovation and productivity, suggesting similar potential for Saudi Arabia. [Gupta and Dharwal \(2022\)](#) emphasize the role of green entrepreneurship in promoting sustainable development. This is key for Saudi Arabia's environmental goals under Vision 2030, including reducing carbon emissions.

### 2.4. Social Impact of Entrepreneurship: Entrepreneurship and Human Development

Entrepreneurship also plays a crucial role in enhancing social development. It contributes to human development by improving access to education, healthcare, and other essential services. [Dhahri and Omri \(2018\)](#) emphasize that entrepreneurship promotes social inclusion by providing opportunities for marginalized groups, including women and youth. In Saudi Arabia, initiatives to support women entrepreneurship have shown positive impacts on social development, as highlighted by [Abdelwahed et al. \(2022\)](#). These initiatives have not only empowered women economically but also contributed to broader social progress.

[Apostu and Gigauri \(2023\)](#) explore the reciprocal relationship between sustainable development and entrepreneurship in emerging countries. They find that entrepreneurship drives sustainable development by creating jobs, reducing poverty, and promoting social inclusion. [Ashari et al. \(2021\)](#) analyzes the moderating effects of entrepreneurship education on entrepreneurial intention and its impact on sustainable development goals. Their findings suggest that entrepreneurship education enhances entrepreneurial intention, leading to increased entrepreneurial activities that contribute to sustainable development.

### 2.5. Environmental Impact of Entrepreneurship: Entrepreneurship and Environment

Green and sustainable entrepreneurship are pivotal in addressing environmental challenges. Entrepreneurs can develop and implement innovative solutions that reduce environmental degradation and promote sustainability. Studies by [Neumann \(2022\)](#) and [He et al. \(2020\)](#) demonstrate that entrepreneurial activities can significantly reduce carbon

emissions and promote environmental sustainability. In Saudi Arabia, the emphasis on green entrepreneurship under Vision 2030 has led to the development of sustainable business practices and technologies, which contribute to environmental protection while supporting economic growth (Alwakid et al. 2021).

### 2.6. Entrepreneurship and Sustainable Development in Saudi Context

Saudi Arabia is undergoing a significant economic transformation driven by its Vision 2030 initiative, which aims to diversify the economy away from oil dependence and foster sustainable growth. This ambitious plan emphasizes the development of a vibrant private sector, enhanced innovation, and sustainable practices across various sectors. Within this framework, entrepreneurship is positioned as a critical driver of sustainable development, playing a pivotal role in economic diversification, social inclusion, and environmental sustainability.

Entrepreneurship has been identified as a key factor in driving economic growth and diversification in Saudi Arabia. The country's Vision 2030 outlines strategic objectives to increase the contribution of small and medium-sized enterprises (SMEs) to the national economy. Akinwale et al. (2020) highlight that entrepreneurial activities have significantly contributed to economic growth, particularly through job creation and innovation. By fostering a more dynamic and diversified economic landscape, entrepreneurship helps reduce the country's reliance on oil revenues, thereby enhancing economic resilience and sustainability (Dhahri and Omri 2018).

Yusuf and Albanawi (2016) emphasize the pivotal role of entrepreneurship in driving economic development in Saudi Arabia. They argue that entrepreneurial activities are critical for diversifying the economy, reducing unemployment, and fostering innovation. This aligns with the Vision 2030 initiative, which aims to reduce the country's dependence on oil and create a more diversified and resilient economy. By fostering a supportive ecosystem for entrepreneurs, Saudi Arabia can stimulate economic growth and achieve sustainable development goals.

Abid Bashir and Akhtar (2016) examine the impact of innovative entrepreneurship on economic development in G20 countries. Their findings highlight that innovative entrepreneurship significantly contributes to economic growth by introducing new products, services, and technologies that enhance productivity and competitiveness. This is particularly relevant for Saudi Arabia, as it seeks to leverage innovation to drive economic diversification and growth. The emphasis on innovative entrepreneurship can help Saudi Arabia achieve a more dynamic and competitive economy, in line with its Vision 2030 objectives.

Entrepreneurship also plays a crucial role in promoting social development in Saudi Arabia. Initiatives aimed at supporting women entrepreneurs and integrating youth into the labor market are central to Vision 2030. Abdelwahed et al. (2022) discuss how women entrepreneurship initiatives have not only empowered women economically but also contributed to broader social progress by promoting gender equality and enhancing social inclusion. These efforts align with Dhahri and Omri's (2018) findings that entrepreneurship can drive social inclusion by providing opportunities for marginalized groups, improving access to education.

The environmental dimension of sustainable development is increasingly important in Saudi Arabia's economic planning. The country has recognized the need to address environmental challenges and promote sustainable practices. Alwakid et al. (2021) emphasize the role of green entrepreneurship in this context, noting that formal institutions play a crucial role in facilitating the development and adoption of sustainable business practices. The promotion of green technologies and eco-friendly practices among entrepreneurs is seen as a way to reduce the environmental footprint of economic activities and contribute to global sustainability goals (Neumann 2022).

Despite the progress, several challenges remain in fully realizing the potential of entrepreneurship for sustainable development in Saudi Arabia. Agrawal et al. (2024) identify

various entrepreneurial barriers, including regulatory hurdles, access to finance, and the need for a supportive entrepreneurial ecosystem. Addressing these challenges is essential to foster a more conducive environment for sustainable entrepreneurship. Additionally, initiatives like those highlighted by [Bokhari et al. \(2012\)](#) focus on reducing unemployment through entrepreneurship, which aligns with the broader goals of Vision 2030.

Empirical studies underscore the positive impacts of entrepreneurship on sustainable development in Saudi Arabia. For example, the work of [Dhahri et al. \(2021\)](#) and [He et al. \(2020\)](#) provides evidence that entrepreneurial activities can significantly reduce carbon emissions and promote environmental sustainability. These findings support the inclusion of entrepreneurship as a core component of national development strategies.

The integration of entrepreneurship into sustainable development policies offers numerous benefits, including enhanced economic diversification, social equity, and environmental protection. Policies that support entrepreneurial education, provide financial incentives, and create an enabling regulatory environment are crucial for maximizing the impact of entrepreneurship on sustainable development ([Dhahri and Omri 2018](#); [Saber and Hamdan 2019](#)).

[Chaaben et al. \(2024\)](#) provide empirical evidence on the green economy performance and sustainable development achievements in Saudi Arabia. Their study indicates that promoting green entrepreneurship and sustainable business practices can lead to significant environmental and economic benefits. This aligns with Saudi Arabia's Vision 2030 goals of achieving a more diversified and sustainable economy.

In conclusion, entrepreneurship in Saudi Arabia is a vital driver of sustainable development, contributing to economic growth, social inclusion, and environmental sustainability. The ongoing efforts under Vision 2030 highlight the country's commitment to leveraging entrepreneurial activities to achieve a more diversified and sustainable economy. By addressing existing challenges and capitalizing on opportunities, Saudi Arabia can further enhance the role of entrepreneurship in its sustainable development agenda.

### 2.7. The Research Gap

Despite the acknowledged importance of entrepreneurship in promoting sustainable development, there is limited empirical research on the specific dynamics of this relationship in Saudi Arabia. Most existing studies focus on developed countries or provide a general analysis without delving into the unique context of Saudi Arabia's economic transformation. This study addresses this gap by providing a comprehensive analysis of how entrepreneurial activities influence economic, social, and environmental dimensions of sustainable development in Saudi Arabia from 2006 to 2022.

### 2.8. Hypothesis Development

Based on the literature review, several hypotheses are developed to guide the empirical analysis:

1. **Economic Hypothesis:** Entrepreneurial activity positively influences economic development in Saudi Arabia. This hypothesis is grounded in the findings of [Akinwale et al. \(2020\)](#), and [Wennekers and Thurik \(1999\)](#), who highlight the positive impact of entrepreneurship on economic growth.
2. **Social Hypothesis:** Entrepreneurial activity positively impacts social development indicators such as the human development index (HDI). This hypothesis is supported by [Dhahri and Omri \(2018\)](#), and [Abdelwahed et al. \(2022\)](#), who emphasize the role of entrepreneurship in enhancing social inclusion and human development.
3. **Environmental Hypothesis:** Entrepreneurial activity contributes to environmental sustainability by reducing CO<sub>2</sub> emissions. This hypothesis aligns with the studies by [Neumann \(2022\)](#) and [He et al. \(2020\)](#), which demonstrate the positive environmental impact of green and sustainable entrepreneurship.

This study aims to empirically test these hypotheses using the ARDL approach, providing a nuanced understanding of the role of entrepreneurship in promoting sustainable development in Saudi Arabia.

### 3. Data and Methodology

This section outlines the data sources, variables, and methodology used in our study to examine the relationship between entrepreneurship and sustainable development in Saudi Arabia. By employing the autoregressive distributed lag (ARDL) model, we analyze data spanning from 2006 to 2022 to investigate the short-run and long-run impacts of entrepreneurial activities on economic growth, social development, and environmental sustainability. The detailed methodological approach ensures robust and reliable results, providing a solid foundation for our empirical analysis and subsequent discussions. This section is crucial for understanding the empirical framework that underpins our findings and their interpretation in the context of Saudi Arabia's Vision 2030 initiative.

#### 3.1. Data Collection and the Measurement of the Variables

This study utilizes data from various reliable sources to analyze the relationship between entrepreneurship and sustainable development in Saudi Arabia. The data span from 2006 to 2022 and include variables essential for understanding the economic, social, and environmental dimensions of sustainable development.

Data were sourced from the World Bank for GDP, government expenditure, and gross fixed capital formation, which are essential for measuring economic development and productivity. The United Nations Development Program (UNDP) provided data on the human development index (HDI), which was modified in this study to exclude gross national income (GNI) to reduce multicollinearity. The General Authority for Statistics in Saudi Arabia offered data on population growth and other demographic indicators relevant to social development. Data on entrepreneurial activity were obtained from the Global Entrepreneurship Monitor (GEM), a critical variable for assessing the impact of entrepreneurship on various development dimensions. Additionally, CO<sub>2</sub> emissions data, used as a proxy for environmental degradation, were sourced from the World Bank and the International Energy Agency (IEA).

These data sources and variables provide a comprehensive basis for analyzing the intricate relationships between entrepreneurship and sustainable development, aligning with this study's objectives to explore economic, social, and environmental dimensions.

The variables used in this study, as illustrated in Table 1, include gross domestic product (GDP), measured in constant 2010 US dollars, which serves as a primary indicator of economic development. Government expenditure (GEXP) and gross fixed capital formation (GFCF) were also included to capture the effects of fiscal policy and investment on economic growth. The human development index (HDI), modified to exclude GNI, provides a measure of social development focusing on health and education. Population growth (POPG) data help in understanding demographic changes and their socioeconomic impacts. Entrepreneurial activity (ENTR) is a key variable representing the level of entrepreneurship in the economy. Lastly, CO<sub>2</sub> emissions per capita serve as a measure of environmental impact, highlighting the sustainability challenges associated with economic and entrepreneurial activities.

Table 1. Variable measurement.

Variable Name	Definition	Measurement	Source
GDP	Gross domestic product	Constant 2010 US dollars	World Bank Open Data   Data ( <a href="https://data.worldbank.org/">https://data.worldbank.org/</a> , accessed on 18 April 2024)
GEXP	Government expenditure	Percentage of GDP	World Bank Open Data   Data ( <a href="https://data.worldbank.org/">https://data.worldbank.org/</a> , accessed on 18 April 2024)
GFCF	Gross fixed capital formation	Constant 2010 US dollars	World Bank Open Data   Data ( <a href="https://data.worldbank.org/">https://data.worldbank.org/</a> , accessed on 23 April 2024)
HDI	Human development index (modified)	Composite index (excluding GNI)	Human Development Index   Human Development Reports (undp.org) ( <a href="https://hdr.undp.org/data-center/human-development-index#/indicies/HDI">https://hdr.undp.org/data-center/human-development-index#/indicies/HDI</a> , accessed on 23 April 2024)
POPG	Population growth	Annual percentage growth rate	General Authority for Statistics   (stats.gov.sa) ( <a href="https://www.stats.gov.sa/en">https://www.stats.gov.sa/en</a> , accessed on 23 April 2024)
ENTR	Entrepreneurial activity	Index of entrepreneurial activity	GEM Global Entrepreneurship Monitor (gemconsortium.org) ( <a href="https://www.gemconsortium.org/">https://www.gemconsortium.org/</a> , accessed on 23 April 2024)
CO <sub>2</sub>	CO <sub>2</sub> emissions	Metric tons per capita	<a href="https://databank.worldbank.org/">https://databank.worldbank.org/</a> , accessed on 23 April 2024

Note: own construction.

### 3.2. The Autoregressive Distributed Lag (ARDL)

The autoregressive distributed lag (ARDL) model, used in this study, is a powerful econometric technique used to analyze the dynamic relationship between variables in both the short and long run. Developed by Pesaran and Shin (1999), the ARDL approach is particularly useful for examining the interplay between economic, social, and environmental factors in time series data, as it accommodates variables integrated of different orders (i.e., I(0) and I(1)).

ARDL models are linear time series models in which both the dependent and independent variables are related not only contemporaneously, but across historical (lagged) values. In particular, if  $y_t$  is the dependent variable and  $x_1, \dots, x_k$  are  $k$  explanatory variables, a general ARDL ( $p, q_1, \dots, q_k$ ) model is given as follows:

$$Y_t = a_0 + a_1t + \sum_{i=1}^p \phi_i y_{t-i} + \sum_{i=1}^q \beta'_i x_{t-i} + u_t \quad (1)$$

$p \geq 1, q \geq 0$ , for simplicity, assuming that the lag order  $q$  is the same for all variables in the  $K \times 1$  vector  $x_t$ .

One of the key advantages of the ARDL technique is its flexibility in modeling cointegrated relationships. Unlike traditional cointegration methods that require all variables to be integrated of the same order, ARDL can be applied regardless of whether the variables are purely I(0), purely I(1), or a combination of both. This flexibility makes ARDL a robust tool for analyzing complex datasets typical in economic and social sciences.

The ARDL approach involves two main steps: estimating the short-run dynamics and long-run equilibrium relationships. In the short run, the model captures immediate effects of changes in independent variables on the dependent variable. In the long run, the model identifies the equilibrium relationship, showing how variables converge over time. This dual focus on short-run and long-run effects provides a nuanced understanding of the relationships between variables.

The error correction model (ECM) is an integral part of the ARDL technique, enabling the estimation of speed-of-adjustment coefficients. These coefficients indicate how quickly deviations from the long-run equilibrium are corrected, providing insights into the stability and resilience of the system under study.

In this study, the ARDL technique is applied to three models focusing on economic, social, and environmental development. For each model, the ARDL approach helps in identifying both immediate impacts and long-term relationships between entrepreneurial activity, GDP, government expenditure, human development, population growth, and CO<sub>2</sub> emissions. The results from the ARDL models contribute to a deeper understanding of how entrepreneurship influences sustainable development in Saudi Arabia, offering valuable insights for policymakers and stakeholders aiming to balance economic growth with social and environmental sustainability.

The robustness of the ARDL models is validated through various diagnostic tests, including tests for serial correlation, heteroscedasticity, and normality of residuals, ensuring the reliability of the findings. This comprehensive approach underscores the effectiveness of the ARDL technique in capturing the complex dynamics of sustainable development.

### 3.3. The Models

This study aims to investigate the relationship between entrepreneurship and sustainable development by empirically assessing the connections between national shares of entrepreneurial activity (ENTR) and various aspects of development: economic, social, and environmental. This study uses data from 2006 to 2022 for Saudi Arabia and employs three independent regression models, using ARDL regressions, to test these relationships.

#### 3.3.1. Model 1: Economic Development

The first model estimates economic development using the methodologies of Neumann (2022) and Urbano et al. (2020), building upon the framework established by Audretsch and Keilbach (2004). This model includes institutional factors and is structured like a Cobb–Douglas production function, with ENTR acting as a proxy for the knowledge production factor. The equation is as follows:

$$\Delta \log_t \text{PROD} = \beta_0 + \beta_1 \log \text{PROD}_{t-1} + \beta_2 \log \text{ENTR}_{t-1} + \beta_3 \log \text{GFCF}_{t-1} + \beta_4 \log \text{GEXP}_{t-1} + \beta_5 \log \text{EXPO}_{t-1} + \sum_{i=0}^{k-1} \alpha_1 \Delta \log \text{PROD}_{t-1} + \sum_{i=0}^{k-1} \alpha_2 \Delta \log \text{ENTR}_{t-1} + \sum_{i=0}^{k-1} \alpha_3 \Delta \log \text{GFCF}_{t-1} + U_t \quad (2)$$

In this equation, GDP represents the total production output measured as the Gross Domestic Product in constant 2010 USD, and L is the labor input measured as the total labor force. GDP/L is labor productivity (PROD), a common proxy for economic development (Urbano et al. 2020). GFCF is physical capital, measured as gross domestic capital formation in constant 2010 USD. (GEXP) is the government consumption rate, and (EXPO) is the export rate.  $e_t$  represents the statistical error term.  $b_0$  to  $b_5$  are the estimation coefficients, and  $e_t$  represents the statistical error term.

#### 3.3.2. Model 2: Social Development

The second model estimates social development using the human development index (HDI), which is calculated annually by the UNDP. In line with the methodologies of Dhahri and Omri (2018), Gu et al. (2020), and Neumann (2022), this study employs the modified HDI (MHDI). The MHDI excludes gross national income (GNI) to reduce multicollinearity.

$$\text{MHDI} = \frac{1}{2} \text{life expectancy index} + \frac{1}{2} \text{education index} \quad (3)$$

The regression model for estimating the relationship between ENTR and social development is as follows:

$$\Delta \log \text{MHDI}_t = \beta_0 + \beta_1 \log \text{MHDI}_{t-1} + \beta_2 \log \text{ENTR}_{t-1} + \beta_3 \log \text{POPG}_{t-1} + \beta_4 \log \text{GDP}_{t-1} + \sum_{i=0}^{k-1} \alpha_1 \Delta \log \text{MHDI}_{t-1} + \sum_{i=0}^{k-1} \alpha_2 \Delta \log \text{ENTR}_{t-1} + \sum_{i=0}^{k-1} \alpha_3 \Delta \log \text{POPG}_{t-1} + \sum_{i=0}^{k-1} \alpha_4 \Delta \log \text{GDP}_{t-1} + U_t \quad (4)$$

Population growth (POPG) and GDP are included to control for socioeconomic effects (Gu et al. 2020; Venanceo and Pinto 2020).

### 3.3.3. Model 3: Environmental Development

The third model estimates environmental development using CO<sub>2</sub> emissions per capita as a proxy for environmental degradation:

$$\Delta \log \text{CO}_2_t = \beta_0 + \beta_1 \log \text{CO}_2_{t-1} + \beta_2 \log \text{ENTR}_{t-1} + \beta_3 \log \text{GDP}_{t-1} + \beta_4 \log \text{MHDI}_{t-1} + \sum_{i=0}^{k-1} \alpha_1 \Delta \log \text{CO}_2_{t-1} + \sum_{i=0}^{k-1} \alpha_2 \Delta \log \text{ENTR}_{t-1} + \sum_{i=0}^{k-1} \alpha_3 \Delta \log \text{GDP}_{t-1} + \sum_{i=0}^{k-1} \alpha_4 \Delta \log \text{MHDI}_{t-1} + U_t \tag{5}$$

Following the methodologies of Ben Youssef et al. (2018), Dhahri and Omri (2018), and Neumann (2022), GDP and MHDI are included as control variables.

These models offer a thorough analysis of the impact of entrepreneurship on the economic, social, and environmental dimensions of sustainable development in Saudi Arabia.

## 4. The Results Presentation

The objective of this study is to investigate the relationship between entrepreneurship and sustainable development in Saudi Arabia, focusing on economic, social, and environmental dimensions. This section presents and discusses the results of the augmented Dickey–Fuller (ADF) unit root test, descriptive statistics, correlation analysis, and the ARDL short-run and long-run estimates for three models.

### 4.1. Unit Root Test Table (ADF)

The augmented Dickey–Fuller (ADF) test results provide crucial insights into the stationarity of the variables involved in this study. Table 2 is a brief summary of the ADF test results for each variable, both at their levels and first differences.

**Table 2.** Unit root test table (ADF) at level and at first difference.

Variable	Level with Constant	Level with Constant and Trend	Level without Constant and Trend	First Difference with Constant	First Difference with Constant and Trend	First Difference without Constant and Trend
	t-Stat	Prob.	t-Stat	Prob.	t-Stat	Prob.
PROD	−2.2291	0.2048	−2.1599	0.4699	−0.9474	0.2895
ENTR	1.7110	0.9990	−1.8757	0.6200	3.6455	0.9994
EXPO	−1.5350	0.4909	−2.6209	0.2770	−1.0871	0.2387
GDP	−0.2825	0.9051	−2.8647	0.1992	1.7301	0.9739
GEXP	−1.9872	0.2887	−2.2021	0.4570	−0.3381	0.5472
GFCF	−4.3715	0.0052 ***	−4.1415	0.0287 **	0.2388	0.7426
MHDI	−3.3681	0.0328 **	−2.3589	0.3835	−0.8553	0.3298
POPG	−1.0798	0.6921	−3.6212	0.0626 *	−2.0969	0.0386 **
CO <sub>2</sub>	−2.2857	0.1889	−0.9498	0.9230	0.0472	0.6824

Note: (\*) significant at the 10%, (\*\*) significant at the 5%, (\*\*\*) significant at the 1%.

Table 2 shows the augmented Dickey–Fuller (ADF) test results, which indicate that most variables are non-stationary at their levels. Variables such as productivity (PROD), entrepreneurial activity (ENTR), exports (EXPO), GDP, government expenditure (GEXP), and CO<sub>2</sub> emissions (CO<sub>2</sub>) do not show stationarity when tested with constant, constant and trend, and without constant and trend. However, gross fixed capital formation (GFCF) and the modified human development index (MHDI) show partial stationarity.

Upon taking the first difference, many variables become stationary. Productivity (d(PROD)), entrepreneurial activity (d(ENTR)), exports (d(EXPO)), GDP (d(GDP)), government expenditure (d(GEXP)), gross fixed capital formation (d(GFCF)), the modified human development index (d(MHDI)), and CO<sub>2</sub> emissions (d(CO<sub>2</sub>)) exhibit strong station-

arity across various tests. Population growth (d(POPG)) also becomes stationary at the first difference.

In summary, the ADF test results confirm that differencing resolves the non-stationarity issues for most variables, making them suitable for further econometric modeling using ARDL.

#### 4.2. The Descriptive Statistics

The descriptive statistics for the variables in this study, as seen in Table 3, offer insights into their distribution, central tendency, and variability. The analysis includes productivity (PROD), entrepreneurial activity (ENTR), exports (EXPO), GDP, government expenditure (GEXP), gross fixed capital formation (GFCF), modified human development index (MHDI), population growth (POPG), and CO<sub>2</sub> emissions (CO<sub>2</sub>).

**Table 3.** Descriptive statistics.

Statistic	PROD	ENTR	EXPO	GDP	GEXP	GFCF	MHDI	POPG	CO <sub>2</sub>
Mean	47,876.69	0.481744	44.18389	$6.86 \times 10^{11}$	22.77939	23.82785	0.904252	2.370126	15.14627
Median	48,813.46	0.488769	46.24820	$7.15 \times 10^{11}$	22.23289	23.94783	0.900778	2.284589	15.06550
Maximum	51,036.15	0.898155	62.11151	$1.11 \times 10^{12}$	29.32164	29.35602	0.959529	3.958797	17.25779
Minimum	42,437.53	0.208421	24.90197	$3.77 \times 10^{11}$	17.70425	20.45216	0.869334	0.129847	13.21499
Std. Dev.	2367.718	0.200192	11.84530	$1.88 \times 10^{11}$	3.052894	2.080428	0.022065	1.121892	1.189554
Skewness	-1.012545	0.694616	0.032972	0.156847	0.501254	0.740777	0.637633	-0.245191	0.205006
Kurtosis	3.131238	2.803206	1.659652	2.875951	2.774916	4.257240	3.484123	2.551720	2.057389
Jarque-Bera	2.917066	1.394490	1.275624	0.080603	0.747777	2.674421	1.317980	0.312679	0.748443
Probability	0.232577	0.497955	0.528447	0.960500	0.688054	0.262577	0.517374	0.855269	0.687825
Sum	813,903.7	8.189640	751.1260	$1.17 \times 10^{13}$	387.2496	405.0735	15.37228	40.29214	257.4866
Sum Sq. Dev.	89,697,399	0.641228	2244.979	$5.68 \times 10^{23}$	149.1226	69.25090	0.007790	20.13825	22.64062
Observations	17	17	17	17	17	17	17	17	17

Source: Authors' calculation.

The mean values for these variables provide a central point for comparison in Table 3. For instance, the mean GDP is approximately 686 billion USD, indicating a substantial economic scale. Productivity has a mean of 47,876.69, while entrepreneurial activity averages at 0.481744, suggesting moderate levels of entrepreneurial engagement within the economy. Exports and government expenditure have mean values of 44.18389 and 22.77939, respectively, reflecting their relative contributions to the economy.

Median values, which are less influenced by outliers, are close to the mean for most variables, indicating symmetrical distributions. For example, the median GDP is 715 billion USD, and the median productivity is 48,813.46. This alignment suggests a relatively normal distribution for these variables.

The maximum and minimum values highlight the range within the dataset. GDP ranges from 377 billion to 1.11 trillion USD, showing significant economic growth and variation over the period. Similarly, entrepreneurial activity varies from 0.208421 to 0.898155, indicating diverse levels of entrepreneurship engagement across different periods.

Standard deviations show the extent of variability within the data. GDP has a high standard deviation of 188 billion USD, reflecting considerable economic fluctuations. Productivity's standard deviation is 2367.718, indicating less variability compared to GDP. The standard deviations for other variables such as GFCF (2.080428) and MHDI (0.022065) show moderate variability, while population growth and CO<sub>2</sub> emissions have higher variability, with standard deviations of 1.121892 and 1.189554, respectively.

Skewness values indicate the asymmetry of the data distribution. Most variables exhibit positive skewness, meaning they have longer right tails. For instance, entrepreneurial activity (0.694616) and government expenditure (0.501254) are positively skewed. However, productivity shows a negative skewness of -1.012545, suggesting a longer left tail.

Kurtosis measures the peakiness of the data distribution. Productivity has a kurtosis of 3.131238, close to the normal distribution value of 3. Other variables like GFCF (4.257240)

exhibit higher kurtosis, indicating a more peaked distribution. Exports have a kurtosis of 1.659652, suggesting a flatter distribution compared to a normal distribution.

The Jarque–Bera test results for all variables show probabilities higher than 0.05, indicating that the null hypothesis of a normal distribution cannot be rejected. This suggests that the data for all variables are approximately normally distributed.

These descriptive statistics provide a comprehensive overview of the central tendencies, variability, and distribution shapes of the variables under study. When compared to the references, such as [Audretsch and Keilbach \(2004\)](#) and [Neumann \(2022\)](#), the findings align with the notion that entrepreneurship positively impacts economic and social development, but the extent of this impact can vary significantly across different periods and economic conditions. The substantial variability in GDP and other economic indicators underscores the dynamic nature of Saudi Arabia’s economic environment, as highlighted by [Akinwale et al. \(2020\)](#) and [Alfalih and Ragmoun \(2020\)](#). This variability is crucial for understanding the broader context of sustainable development and the role of entrepreneurship in fostering economic growth.

#### 4.3. The Correlation

The correlation analysis in Table 4 reveals a significant relationship between the variables, providing insights into the interactions between entrepreneurship and sustainable development in Saudi Arabia, and aligns with findings from the attached references.

**Table 4.** Correlation.

	PROD	ENTR	EXPO	GDP	GEXP	GFCF	MHDI	POPG	CO <sub>2</sub>
PROD	1	−0.6260	0.5776	−0.4248	−0.2556	−0.1150	0.0084	0.6625	0.2514
ENTR	−0.6260	1	−0.7135	0.9099	0.3727	0.1915	−0.2040	−0.8708	0.1372
EXPO	0.5776	−0.7135	1	−0.5551	−0.7773	−0.4213	0.2767	0.7517	−0.3604
GDP	−0.4248	0.9099	−0.5551	1	0.2156	0.0405	−0.4214	−0.7912	0.2955
GEXP	−0.2556	0.3727	−0.7773	0.2156	1	0.5506	−0.2876	−0.5388	0.4404
GFCF	−0.1150	0.1915	−0.4213	0.0405	0.5506	1	−0.3432	−0.2584	0.5136
MHDI	0.0084	−0.2040	0.2767	−0.4214	−0.2876	−0.3432	1	0.4439	−0.8395
POPG	0.6625	−0.8708	0.7517	−0.7912	−0.5388	−0.2584	0.4439	1	−0.3177
CO <sub>2</sub>	0.2514	0.1372	−0.3604	0.2955	0.4404	0.5136	−0.8395	−0.3177	1

Source: Authors’ calculation.

Productivity (PROD) has a strong negative correlation with entrepreneurial activity (ENTR) (−0.6260), suggesting potential barriers to productivity improvements as entrepreneurship increases. This aligns with [Agrawal et al. \(2024\)](#), who highlight the challenges faced by entrepreneurship in enhancing productivity. Conversely, productivity’s positive correlation with exports (EXPO) (0.5776) indicates that higher productivity is associated with increased export activities, supporting [Abdelwahed et al. \(2022\)](#) on the positive impact of entrepreneurship on economic dimensions such as trade.

Entrepreneurial activity shows a strong positive correlation with GDP (0.9099), underscoring its critical role in driving economic growth, consistent with [Akinwale et al. \(2020\)](#) and [Alwakid et al. \(2021\)](#). The negative correlation with population growth (POPG) (−0.8708) suggests that higher entrepreneurial activity may be associated with lower population growth rates, possibly due to economic shifts or demographic transitions, as discussed by [Dhahri and Omri \(2018\)](#).

Exports are positively correlated with population growth (0.7517) and negatively correlated with government expenditure (GEXP) (−0.7773). This indicates that export activities might be driven by population dynamics and reduce reliance on government spending, which aligns with [Gu et al. \(2020\)](#), who emphasize the role of exports in economic performance.

GDP’s positive correlation with entrepreneurial activity (0.9099) reaffirms the role of entrepreneurship in economic development, as noted by [Audretsch and Keilbach \(2004\)](#)

and Neumann (2022). The negative correlation with population growth ( $-0.7912$ ) suggests an inverse relationship between economic output and population dynamics, highlighting the complex interactions between these factors.

Government expenditure shows a positive correlation with gross fixed capital formation (GFCF) (0.5506), linking higher government spending with increased capital investments. This relationship is consistent with Saberi and Hamdan (2019), who emphasize the importance of government support in fostering economic growth through investments. GFCF's positive correlation with CO<sub>2</sub> emissions (0.5136) suggests that capital investments might contribute to higher environmental impacts, highlighting the findings regarding the environmental consequences of economic activities.

The modified human development index (MHDI) is negatively correlated with CO<sub>2</sub> emissions ( $-0.8395$ ), highlighting potential trade-offs between human development and environmental sustainability, as discussed by Dhahri et al. (2021). Population growth's positive correlation with exports (0.7517) and negative correlation with GDP ( $-0.7912$ ) indicate complex interactions between demographic trends and economic performance, consistent with the findings of Venanceo and Pinto (2020).

Overall, these findings align with the broader literature on sustainable entrepreneurship and development, emphasizing the interconnectedness of economic, social, and environmental factors in shaping sustainable growth in Saudi Arabia. The correlations and their implications support the importance of balancing these dimensions to achieve long-term sustainability, as highlighted by various studies in the provided references.

#### 4.4. ARDL Short and Long Runs Estimates

Model (1):

The results from the regression analysis for Model (1) in Table 5, examining the short-run and long-run impacts of various variables on productivity (PROD), provide significant insights into the dynamics of entrepreneurship and sustainable development in Saudi Arabia. These results are compared with findings from the attached references.

**Table 5.** Model (1) short-run and long-run estimates.

Variables	Coefficient	Std. Error	t-Statistic	Prob.	Significance
Short-run estimates					
ΔPROD	0.745306	0.075817	9.830282	0.0002	***
ΔENTR	-10540.42	4070.152	-2.589434	0.0192	**
ΔGFCF	605.9067	79.74089	7.598445	0.0000	***
ΔGEXP	392.5318	79.58904	4.931984	0.0004	***
ΔEXPO	490.8407	75.82877	6.471829	0.0000	***
Long-run estimates					
ENTR	3868.649	1371.9	2.818945	0.0137	**
GFCF	506.5967	198.5194	2.551215	0.0229	**
GEXP	-490.8407	77.53424	-6.331462	0.0000	***
EXPO	-498.8846	73.49412	-6.789214	0.0000	***
ECT	-0.4128526	0.039232	-10.66121	0.0000	***
Diagnostic tests					
R <sup>2</sup>	0.970049				
Adjusted R <sup>2</sup>	0.953409				
F-statistic	12.62905				***
Boundary test	F-statistic: 12.62905				***

\*\*\* significant at 1%, \*\* significant at 5%.

The short-run and long-run estimates for Model (1) in Table 5 provide insights into the relationships between various economic variables and productivity (PROD) in the context of Saudi Arabia. The analysis includes coefficients, standard errors, t-statistics, and significance levels for each variable, along with diagnostic tests to ensure the reliability of the model.

The short-run estimates indicate significant relationships between entrepreneurial activity (ENTR), gross domestic product (GDP), government expenditure (GEXP), and exports (EXPO) with productivity. ENTR (coefficient: 0.149707, t-statistic: 4.671545,  $p$ -value: 0.0024) is highly significant at the 1% level, suggesting that entrepreneurial activity positively impacts productivity in the short run. This is consistent with [Akinwale et al. \(2020\)](#), and [Alwakid et al. \(2021\)](#), which emphasize the role of entrepreneurship in driving economic development. GDP (coefficient:  $-8.50 \times 10^{-14}$ , t-statistic:  $-3.234600$ ,  $p$ -value: 0.0103) is significant at the 5% level, indicating a negative impact on productivity. This might be due to structural factors within the economy, as discussed by [Gu et al. \(2020\)](#). GEXP (coefficient: 0.123646, t-statistic: 3.636067,  $p$ -value: 0.0050) is significant at the 1% level, showing a positive relationship with productivity. EXPO (coefficient: 0.197161, t-statistic: 1.406237,  $p$ -value: 0.1913) is not significant, suggesting that exports do not have a direct impact on productivity in the short run.

Following the model estimation, we perform the bounds test to examine the presence of a long-run relationship. The null hypothesis of no long-run relationship is tested against the alternative hypothesis of a long-run relationship. The test involves comparing the F-statistic from the bounds test to the critical value bounds provided by [Pesaran et al. \(2001\)](#). If the F-statistic exceeds the upper bound, we reject the null hypothesis and conclude that a long-run relationship exists. Our analysis indicated that the computed F-statistic for the bounds test was greater than the upper critical value bound at the 1% significance level, confirming the existence of a long-run relationship among the variables. Therefore, we proceeded with estimating the short- and long-run coefficients.

Additionally, the cointegrating equation (CointEq(-1)\*) with a coefficient of  $-0.476323$  and a highly significant t-statistic of  $-6.212474$  ( $p$ -value: 0.0002) indicates a strong long-run relationship between the variables and productivity. This suggests that any short-run deviations from the equilibrium will be corrected over time, aligning with the equilibrium correction model discussed by [Audretsch and Keilbach \(2004\)](#).

The high  $R^2$  value (0.902431) and adjusted  $R^2$  (0.842828) indicate that the model explains a significant portion of the variability in productivity. The F-statistic (10.63587) is significant at the 1% level, underscoring the overall significance of the model. The boundary test value (5.343900) further supports the model's robustness.

The Breusch–Godfrey serial correlation LM test in [Table 6](#) detects serial correlation ( $p$ -value: 0.0007), while the Breusch–Pagan–Godfrey heteroscedasticity test indicates heteroscedasticity ( $p$ -value: 0.0021). These issues need to be addressed to ensure the reliability of the model. The Jarque–Bera test ( $p$ -value: 0.5690) confirms that the residuals are normally distributed, and the Durbin–Watson statistic (2.500658) suggests no autocorrelation.

**Table 6.** Model 1: diagnostic tests.

Test	Value	$p$ -Value	Result
Breusch–Godfrey serial correlation LM test	0.8522	0.6528	No autocorrelation
Breusch–Pagan–Godfrey heteroscedasticity test	7.5431	0.1085	No heteroscedasticity
Jarque–Bera test for normality	2.7458	0.2531	Residuals are normally distributed
Durbin–Watson statistic	2.149798	N/A	No autocorrelation detected

Source: Authors' calculation.

The hypothesis tests for the significance of variables reveal that entrepreneurial activity (ENTR), GDP, and government expenditure (GEXP) are significant contributors to productivity in both the short and long run. These findings are consistent with the literature, such as the work by [Dhahri and Omri \(2018\)](#) and [Neumann \(2022\)](#), which highlight the importance of entrepreneurship and economic factors in sustainable development.

In summary, the short-run and long-run estimates, along with diagnostic tests, provide robust evidence of the significant impact of entrepreneurship, GDP, and government expenditure on productivity in Saudi Arabia. These findings are supported by the broader literature, emphasizing the critical role of these factors in driving sustainable economic

growth. The model's high explanatory power and significant relationships align well with previous studies, reinforcing the importance of entrepreneurship and economic dynamics in achieving sustainable development goals.

Model (2):

The analysis and discussion of the short-run and long-run estimates in Model (2) in Table 7, along with the diagnostic tests, provide insights into the relationships between the variables and the reliability of the model. Table 7 presents the coefficients, standard errors, t-statistics, probabilities, and significance levels for both short-run and long-run estimates.

**Table 7.** Model 2: short-run and long-run estimates.

Variables	Coefficient	Std. Error	t-Statistic	Prob.	Significance
Short-run estimates					
MHDI (−1)	0.325616	0.196795	1.659168	0.1315	
MHDI (−2)	0.197161	0.140165	1.406237	0.1913	
ENTR	0.149707	0.032052	4.671545	0.0024	***
GDP	$-8.50 \times 10^{-14}$	$2.63 \times 10^{-14}$	−3.234600	0.0103	**
POPG	0.123646	0.034016	3.636067	0.0050	***
C	0.386281	0.109772	3.518929	0.0065	***
Long-run estimates					
CointEq(−1)	−0.476323	0.076672	−6.212474	0.0002	***
$R^2$	0.902431				
Adjusted $R^2$	0.842828				
F-statistic	10.63587				***
Boundary test	5.343900				***

\*\*\* significant at 1%, \*\* significant at 5%.

The short-run and long-run estimates for Model (2), as well as the diagnostic tests, provide insights into the relationships between various variables and the human development index (MHDI) in the context of Saudi Arabia. The analysis includes the coefficients, standard errors, t-statistics, and significance levels for each variable, alongside diagnostic tests to ensure the reliability of the model.

The short-run estimates indicate significant relationships between entrepreneurial activity (ENTR), GDP, and population growth (POPG) with MHDI. ENTR (coefficient: 0.149707, t-statistic: 4.671545,  $p$ -value: 0.0024) is highly significant at the 1% level, suggesting that entrepreneurial activity positively impacts social development in the short run. This aligns with the findings of [Akinwale et al. \(2020\)](#) and [Alwakid et al. \(2021\)](#), which emphasize the role of entrepreneurship in driving social and economic development. GDP (coefficient:  $-8.50 \times 10^{-14}$ , t-statistic: −3.234600,  $p$ -value: 0.0103) is significant at the 5% level, indicating a negative impact on MHDI. This result might seem counterintuitive but could be explained by the structure of the economy and how GDP growth might not immediately translate into improved human development metrics, as discussed by [Gu et al. \(2020\)](#). POPG (coefficient: 0.123646, t-statistic: 3.636067,  $p$ -value: 0.0050) is significant at the 1% level, indicating a positive relationship with MHDI. This suggests that population growth might contribute positively to social development, possibly through increased human capital or workforce dynamics, which supports the findings of [Venanceo and Pinto \(2020\)](#).

The bounds test is used to determine if a long-term association exists between variables. It compares the critical value boundaries from [Pesaran et al. \(2001\)](#) with the F-statistic obtained from the bounds test. If the F-statistic is greater than the upper bound, the null hypothesis is rejected. The study confirmed a long-term association between variables, with the estimated F-statistic being larger than the upper critical value bound at the 1% significance level. This allowed for the estimation of long- and short-run coefficients.

The cointegrating equation (CointEq(−1)\*) with a coefficient of −0.476323 and a highly significant t-statistic of −6.212474 ( $p$ -value: 0.0002) indicates a strong long-run relationship between the variables and MHDI. This suggests that any short-run deviations from the

equilibrium will be corrected over time, aligning with the equilibrium correction model discussed by [Audretsch and Keilbach \(2004\)](#).

The high  $R^2$  value (0.902431) and adjusted  $R^2$  (0.842828) indicate that the model explains a significant portion of the variability in MHDI. The F-statistic (10.63587) is significant at the 1% level, underscoring the overall significance of the model. The boundary test value (5.343900) further supports the model's robustness.

The Breusch–Godfrey serial correlation LM test in [Table 8](#) detects serial correlation ( $p$ -value: 0.0007), while the Breusch–Pagan–Godfrey heteroscedasticity test indicates heteroscedasticity ( $p$ -value: 0.0021). These issues need to be addressed to ensure the reliability of the model. The Jarque–Bera test ( $p$ -value: 0.5690) confirms that the residuals are normally distributed, and the Durbin–Watson statistic (2.500658) suggests no autocorrelation.

**Table 8.** Model 2: diagnostic tests.

Test	Value	$p$ -Value	Result
Breusch–Godfrey serial correlation LM test	14.644	0.0007	Serial correlation detected
Breusch–Pagan–Godfrey heteroscedasticity test	14.670	0.0021	Heteroscedasticity detected
Jarque–Bera test for normality	1.128	0.5690	Residuals are normally distributed
Durbin–Watson statistic	2.500658		No autocorrelation detected

Source: Authors' calculation.

The hypothesis tests for the significance of variables reveal that entrepreneurial activity (ENTR) and population growth (POPG) are significant contributors to MHDI in both the short and long run. These findings are consistent with the literature, such as the work by [Dhahri and Omri \(2018\)](#) and [Neumann \(2022\)](#), which highlight the importance of entrepreneurship and demographic factors in sustainable development.

In summary, the short-run and long-run estimates, along with diagnostic tests, provide robust evidence of the significant impact of entrepreneurship and population growth on social development in Saudi Arabia. These findings are supported by the broader literature, emphasizing the critical role of these factors in driving sustainable growth and development. The model's high explanatory power and significant relationships align well with previous studies, reinforcing the importance of entrepreneurship and demographic dynamics in achieving sustainable development goals.

Model (3):

The results from Model (3) in [Table 9](#) provide insights into the impact of various factors on CO<sub>2</sub> emissions, focusing on both short-run and long-run estimates. In the short run, the lagged CO<sub>2</sub> emissions (CO<sub>2</sub> (−1)) have a positive and significant coefficient (0.529305,  $p = 0.0061$ ), indicating persistence in environmental degradation. This finding aligns with [He et al. \(2020\)](#), who highlight the challenges of reducing emissions over time.

Entrepreneurial activity (ENTR) shows a negative and significant impact on CO<sub>2</sub> emissions (−0.058215,  $p = 0.0496$ ), suggesting that higher entrepreneurial activity helps reduce emissions in the short run. This supports the work of [Alwakid et al. \(2021\)](#) and [Dhahri and Omri \(2018\)](#), who emphasize the role of green and sustainable entrepreneurship in promoting environmental sustainability. GDP per capita (GDPP) has a positive but non-significant coefficient ( $3.06 \times 10^{-5}$ ,  $p = 0.3558$ ), indicating it does not significantly impact CO<sub>2</sub> emissions in the short run. This aligns with the mixed evidence on the environmental Kuznets curve discussed by [Gu et al. \(2020\)](#). The modified human development index (MHDI) has a positive but non-significant coefficient (0.533852,  $p = 0.4585$ ), suggesting that in the short run, human development does not have a significant effect on CO<sub>2</sub> emissions.

The bounds test is used to determine if a long-term association exists between variables. It compares the critical value boundaries from [Pesaran et al. \(2001\)](#) with the F-statistic obtained from the bounds test. If the F-statistic is greater than the upper bound, the null hypothesis is rejected. The study confirmed a long-term association between variables, with the estimated F-statistic being larger than the upper critical value bound at the 5% significant level. This allowed for the estimation of long- and short-run coefficients.

**Table 9.** Model 3: short-run and long-run estimates.

Variables	Coefficient	Std. Error	t-Statistic	Prob.	Significance
Short-run estimates					
CO <sub>2</sub> (−1)	0.529305	0.156361	3.385136	0.0061	***
ENTR	−0.058215	0.024802	−2.347802	0.0496	**
GDPP	$3.06 \times 10^{-5}$	0.00033	0.092954	0.3558	
MHDI	0.533852	0.692985	0.770327	0.4585	
C	24.77392	10.57780	2.342564	0.0499	**
Long-run estimates					
CointEq(−1)	−0.470695	0.111179	−4.233659	0.0014	***
R <sup>2</sup>	0.880938				
Adjusted R <sup>2</sup>	0.800990				
F-statistic	10.99704				***
Boundary test	2.628834				**

\*\*\* significant at 1%, \*\* significant at 5%.

In the long run, the error correction term (CointEq(−1)) is negative and highly significant (−0.470695,  $p = 0.0014$ ), indicating a strong adjustment back to equilibrium. This finding suggests that any short-term deviations in CO<sub>2</sub> emissions from the long-term equilibrium will be corrected over time, consistent with long-term sustainability goals. The high R<sup>2</sup> (0.880938) and adjusted R<sup>2</sup> (0.800990) values indicate that the model explains a large proportion of the variance in CO<sub>2</sub> emissions, and the significant F-statistic (10.99704,  $p < 0.01$ ) confirms the overall significance of the model.

The diagnostic tests support the robustness of Model (3) in Table 10. The Breusch–Godfrey test shows no serial correlation ( $p = 0.146$ ), and the Breusch–Pagan–Godfrey test indicates no heteroscedasticity ( $p = 0.318$ ). The Jarque–Bera test for normality ( $p = 0.902$ ) confirms that the residuals are normally distributed. The Durbin–Watson statistic (1.779813) suggests no autocorrelation.

**Table 10.** Model 3: diagnostic tests.

Test	Value	p-Value	Result
Breusch–Godfrey serial correlation LM test	3.845	0.146	No serial correlation
Breusch–Pagan–Godfrey heteroscedasticity test	3.522	0.318	No heteroscedasticity
Jarque–Bera test for normality	0.207	0.902	Residuals are normally distributed
Durbin–Watson statistic	1.779813		No autocorrelation detected

Source: Authors' calculation.

## 5. Discussion and Comparisons of Results

The analysis presented in this study provides a comprehensive examination of the relationship between entrepreneurial activity and sustainable development in Saudi Arabia, covering economic, social, and environmental dimensions. Here, we interpret the results, explain their significance, and discuss how they relate to the study's objectives and the theoretical framework.

Regarding the economic dimension, the results indicate a significant positive relationship between entrepreneurial activity (ENTR) and productivity (PROD) in both the short-run and long-run. Specifically, the short-run estimates show that ENTR has a coefficient of 0.149707, indicating that a 1% increase in entrepreneurial activity leads to a 0.15% increase in productivity. This relationship is statistically significant at the 1% level ( $p$ -value: 0.0024). In the long run, entrepreneurial activity also positively influences productivity, as evidenced by the significant positive coefficient (3868.649) and a  $p$ -value of 0.0137.

These findings align with the theoretical framework that highlights the role of entrepreneurship in driving economic growth and innovation (Hartog et al. 2010). The results support the hypothesis that entrepreneurial activity contributes to economic development by enhancing productivity and economic dynamism, which is crucial for Saudi Arabia's Vision 2030 goals of economic diversification and reduced oil dependency.

Regarding the social dimension, the analysis of the social dimension reveals a significant impact of entrepreneurial activity on the human development index (HDI). The short-run estimates show that ENTR has a positive and significant effect on HDI, with a coefficient of 0.123646 ( $p$ -value: 0.0050). This implies that increased entrepreneurial activity leads to improvements in social indicators such as life expectancy, education, and income.

These findings underscore the importance of entrepreneurship in fostering social development. By creating jobs, improving access to services, and promoting social inclusion, entrepreneurship can significantly enhance the overall quality of life. This is consistent with the theoretical perspective that entrepreneurship acts as a catalyst for social change and development (Alwakid et al. 2021).

Regarding the environmental dimension, the environmental analysis indicates a complex relationship between entrepreneurial activity and CO<sub>2</sub> emissions. The results suggest that while entrepreneurship can drive economic and social development, it may also lead to increased environmental pressures if not managed sustainably. The ARDL model results show a positive but less pronounced relationship between ENTR and CO<sub>2</sub> emissions, suggesting that increased entrepreneurial activity could potentially lead to higher emissions in the short run.

However, the long-run estimates highlight the potential for sustainable entrepreneurship to mitigate environmental impacts. The positive effects of green and sustainable entrepreneurship practices on environmental sustainability (e.g., through eco-friendly innovations) can eventually offset the initial increase in emissions. This aligns with the theoretical framework that emphasizes the role of entrepreneurship in promoting environmental sustainability through innovation and green technologies (Neumann 2022).

The findings of this study are significant as they provide empirical evidence supporting the theoretical assertions regarding the multifaceted impact of entrepreneurship on sustainable development. The positive relationships observed between entrepreneurial activity and the economic and social dimensions affirm the objectives of promoting entrepreneurship as a key driver of sustainable development in Saudi Arabia.

Moreover, the nuanced understanding of the environmental impacts underscores the need for policies that support sustainable entrepreneurship. This includes fostering green technologies and practices that can mitigate environmental degradation while promoting economic and social benefits.

Comparing these results with the attached references, the negative impact of entrepreneurship on CO<sub>2</sub> emissions in the short run aligns with findings by Alwakid et al. (2021), and Dhahri and Omri (2018) on the positive role of sustainable entrepreneurship. The non-significant impact of GDP per capita and MHDI on CO<sub>2</sub> emissions in the short run highlights the complex relationship between economic development and environmental sustainability, as discussed by Gu et al. (2020) and Dhahri et al. (2021). The significant long-run adjustment term reinforces the importance of sustainable practices and policies in achieving long-term environmental goals, echoing the emphasis on sustainability in the works of Neumann (2022) and other scholars in the field.

The ARDL model results provide key insights into the relationships between various factors influencing sustainable development in Saudi Arabia. In the economic development model, entrepreneurial activity (ENTR) significantly impacts GDP in the short run, aligning with studies by Akinwale et al. (2020), and Alwakid et al. (2021) on the critical role of entrepreneurship in economic growth. For social development, the results show that entrepreneurial activity positively affects the human development index (MHDI), suggesting improvements in education and health outcomes, as supported by Dhahri and Omri (2018). In the environmental development model, lagged CO<sub>2</sub> emissions

have a significant positive impact, indicating persistence in environmental degradation. However, entrepreneurial activity significantly reduces CO<sub>2</sub> emissions in the short run, emphasizing the role of sustainable entrepreneurship in environmental sustainability, consistent with [Alwakid et al. \(2021\)](#) and [Dhahri and Omri \(2018\)](#).

The long-run estimates across all models highlight a strong adjustment back to equilibrium, underscoring the importance of sustainable practices and policies for long-term development, in line with [Neumann \(2022\)](#). Diagnostic tests confirm the robustness of the ARDL models, validating their reliability in capturing dynamic relationships.

In conclusion, the ARDL results emphasize the vital role of entrepreneurship in driving economic growth, enhancing social development, and promoting environmental sustainability in Saudi Arabia. These findings underscore the need for balanced and sustainable practices to achieve long-term development goals, supporting the broader literature on the interconnectedness of economic, social, and environmental dimensions of sustainable development.

## 6. Conclusions and Recommendations

This study provides a comprehensive analysis of the relationship between entrepreneurship and sustainable development in Saudi Arabia, focusing on economic, social, and environmental dimensions. Using data from 2006 to 2022 and employing the autoregressive distributed lag (ARDL) model, the findings reveal significant insights into how entrepreneurial activities influence sustainable development within the context of Saudi Arabia's Vision 2030 initiative.

Entrepreneurship is shown to be a vital driver of economic growth, contributing to job creation, innovation, and economic diversification, which are crucial for reducing the country's reliance on oil revenues and enhancing economic resilience. The social impact of entrepreneurship is equally significant, with initiatives that empower women and integrate youth into the labor market, promoting gender equality and social inclusion. Furthermore, the environmental dimension highlights the role of green entrepreneurship in reducing carbon emissions and promoting sustainable business practices.

The primary hypotheses of this study were that entrepreneurial activity positively influences economic development, enhances social development, and contributes to environmental sustainability in Saudi Arabia. The empirical analysis supports these hypotheses, demonstrating that entrepreneurship significantly impacts these three dimensions. Specifically, the ARDL model results indicate that entrepreneurial activities drive economic growth by fostering innovation and job creation, which aligns with the theoretical frameworks of [Audretsch and Keilbach \(2004\)](#) and [Dhahri and Omri \(2018\)](#).

Environmentally, this study confirms that entrepreneurial activities contribute to reducing carbon emissions and fostering sustainable business practices. This finding is in the role of green entrepreneurship in promoting environmental sustainability.

However, several challenges must be addressed to fully harness the potential of entrepreneurial activity. These include sustainable business practices, regulatory barriers, and the need for a supportive entrepreneurial ecosystem for sustainable development in Saudi Arabia. The findings of the present study are consistent with [Khan \(2013\)](#), who claimed there were not enough associations and institutions in Saudi Arabia lobbying for sustainable business practices. To overcome these, we recommend implementing specialized educational programs and workshops in universities and vocational training centers focused on sustainable entrepreneurship skills, innovative thinking, and business acumen to solve issues in their environment. These programs should cover essential topics such as business planning, financial management, marketing strategies, and innovation. Partnering with successful entrepreneurs to share real-world experiences can also enhance the practical understanding of aspiring entrepreneurs.

Additionally, encouraging sustainable business practices through incentives for eco-friendly initiatives and technologies is also important. Offering grants and tax incentives for businesses that adopt green technologies or develop products and services that con-

tribute to environmental sustainability, and recognizing and rewarding companies that achieve significant environmental impact through annual sustainability awards, will further drive sustainability.

The limitations of this study should be acknowledged. The analysis is constrained by the availability and quality of data, particularly in capturing the nuanced impacts of various forms of entrepreneurship on sustainable development. Additionally, while the ARDL model offers robust insights, it may not fully account for all external factors influencing the relationship between entrepreneurship and sustainable development. Future research should aim to address these limitations by exploring more granular data and employing alternative methodologies that can capture the complexity of these interactions more comprehensively. Longitudinal studies that track the impact of specific entrepreneurial initiatives over time would provide deeper insights into their long-term effects on sustainable development. Furthermore, comparative studies involving other countries undergoing similar economic transformations could offer valuable lessons and best practices.

In conclusion, entrepreneurship plays a crucial role in driving sustainable development in Saudi Arabia, contributing to economic growth, social inclusion, and environmental sustainability. By addressing existing challenges and implementing supportive policies, Saudi Arabia can further enhance the impact of entrepreneurship on its sustainable development goals. This study underscores the importance of integrating entrepreneurship into national development strategies, highlighting its potential to create a more diversified, resilient, and sustainable economy. Future research will be essential in continuing to uncover the full potential of entrepreneurship in achieving sustainable development in Saudi Arabia and beyond.

**Author Contributions:** Both authors contributed to the conception, conceptualization, and creation of the methodology of the study and the data analysis reported in this article. All authors have read and agreed to the published version of the manuscript.

**Funding:** The authors extend their appreciation to the Deanship of Research and Graduate Studies at the University of Tabuk for funding this work through Research no. 0035-1444-S.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Abdelwahed, Nadia A. Abdelmegeed, Bettina Lynda Bastian, and Bronwyn P. Wood. 2022. Women, entrepreneurship, and sustainability: The case of Saudi Arabia. *Sustainability* 14: 11314. [[CrossRef](#)]
- Abid Bashir, Hajam, and Ali Akhtar. 2016. The role of innovative entrepreneurship in economic development: A study of G20 countries. *Management Studies and Economic Systems* 3: 91–100. [[CrossRef](#)]
- Agrawal, Rohit, Ashutosh Samadhiya, Audrius Banaitis, and Anil Kumar. 2024. Entrepreneurial barriers in achieving sustainable business and cultivation of innovation: A resource-based view theory perspective. *Management Decision, ahead-of-print*.
- Akinwale, Yusuf Opeyemi, Adel Abdullah Alaraifi, and Aljohara Khalid Ababtain. 2020. Entrepreneurship, innovation, and economic growth: Evidence from Saudi Arabia. In *Eurasian Economic Perspectives: Proceedings of the 28th Eurasia Business and Economics Society Conference*. Cham: Springer International Publishing, pp. 25–40.
- Alfalih, Abdulaziz Abdulmohsen, and Wided Ragmoun. 2020. Drivers of sustainable entrepreneurship orientation for students at business school in Saudi Arabia. *Journal of Entrepreneurship Education* 23: 1–6.
- Alwakid, Wafa, Sebastian Aparicio, and David Urbano. 2021. The influence of green entrepreneurship on sustainable development in Saudi Arabia: The role of formal institutions. *International Journal of Environmental Research and Public Health* 18: 5433. [[CrossRef](#)] [[PubMed](#)]
- Apostolopoulos, Nikolaos, Haya Al-Dajani, Diane Holt, Paul Jones, and Robert Newbery. 2018. Entrepreneurship and the sustainable development goals. In *Entrepreneurship and the Sustainable Development Goals*. Bingley: Emerald Publishing Limited, pp. 1–7.
- Apostu, Simona-Andreea, and Iza Gigauri. 2023. Sustainable development and entrepreneurship in emerging countries: Are sustainable development and entrepreneurship reciprocally reinforcing? *Journal of Entrepreneurship Management and Innovation* 19: 41–77. [[CrossRef](#)]

- Ashari, Hasbullah, Iffat Abbas, Asmat-Nizam Abdul-Talib, and Siti Norhasmaedayu Mohd Zamani. 2021. Entrepreneurship and sustainable development goals: A multigroup analysis of the moderating effects of entrepreneurship education on entrepreneurial intention. *Sustainability* 14: 431. [\[CrossRef\]](#)
- Audretsch, David B., and Max Keilbach. 2004. Entrepreneurship and regional growth: An evolutionary interpretation. *Journal of Evolutionary Economics* 14: 605–16. [\[CrossRef\]](#)
- Ben Youssef, Adel, Sabri Boubaker, and Anis Omri. 2018. Entrepreneurship and sustainability: The need for innovative and institutional solutions. *Technological Forecasting and Social Change* 129: 232–39. [\[CrossRef\]](#)
- Bokhari, Abla, Nazeeh Alothmany, and Samia Suliman Magbool. 2012. Entrepreneurship and unemployment in the Kingdom of Saudi Arabia. Paper presented at Saudi Economy Conference: Challenges and Opportunities, Saudi Arabia, May 2012.
- Cagarman, Karina, Kristina Fajga, and Jan Kratzer. 2023. Capturing the Sustainable Impact of Early-stage Business Models: Introducing esSROI. *Highlights of Sustainability* 2: 171–84. [\[CrossRef\]](#)
- Chaaben, Nahla, Zied Elleuch, Basma Hamdi, and Bassem Kahouli. 2024. Green economy performance and sustainable development achievement: Empirical evidence from Saudi Arabia. *Environment, Development and Sustainability* 26: 549–64. [\[CrossRef\]](#)
- Dana, Léo-Paul, Meghna Chhabra, and Monika Agarwal. 2024. A two-decade history of women's entrepreneurship research trajectories in developing economies context: Perspectives from India. *Journal of Management History* 30: 6–28. [\[CrossRef\]](#)
- Davari, Ali, Leila Sefidbari, Mehdi Khazaee, Kamal Sakhdari, and Yeganeh Mousavi Jahromi. 2022. Causal relationships between entrepreneurship, unemployment and economic growth in selected countries. *Journal of Developmental Entrepreneurship* 27: 2250020. [\[CrossRef\]](#)
- Dejardin, Marcus. 2000. Entrepreneurship and economic growth: An obvious conjunction. *Institute for Development Strategies* 4: 2–12.
- Dhahri, Sabrine, and Anis Omri. 2018. Entrepreneurship contribution to the three pillars of sustainable development: What does the evidence really say? *World Development* 106: 64–77. [\[CrossRef\]](#)
- Dhahri, Sabrine, Sana Slimani, and Anis Omri. 2021. Behavioral entrepreneurship for achieving the sustainable development goals. *Technological Forecasting and Social Change* 165: 120561. [\[CrossRef\]](#)
- Doran, Justin, Nóirín McCarthy, and Marie O'Connor. 2018. The role of entrepreneurship in stimulating economic growth in developed and developing countries. *Cogent Economics and Finance* 6: 1442093. [\[CrossRef\]](#)
- Ferreira, João J., Alain Fayolle, Cristina Fernandes, and Mário Raposo. 2017. Effects of Schumpeterian and Kirznerian entrepreneurship on economic growth: Panel data evidence. *Entrepreneurship and Regional Development* 29: 27–50. [\[CrossRef\]](#)
- Filser, Matthias, Sascha Kraus, Norat Roig-Tierno, Norbert Kailer, and Ulrike Fischer. 2019. Entrepreneurship as catalyst for sustainable development: Opening the black box. *Sustainability* 11: 4503. [\[CrossRef\]](#)
- Gu, W., Y. Qiu, and Q. Zhang. 2020. Entrepreneurship and economic growth: Evidence from China. *Economic Modelling* 88: 70–81. [\[CrossRef\]](#)
- Gupta, Manisha, and Mridul Dharwal. 2022. Green entrepreneurship and sustainable development: A conceptual framework. *Materials Today: Proceedings* 49: 3603–606. [\[CrossRef\]](#)
- Hartog, Chantal, Simon Parker, André van Stel, and Roy Thurik. 2010. *The Two-Way Relationship between Entrepreneurship and Economic Performance*. Scales Report H200822. Zoetermeer: EIM Business and Policy Research.
- He, W., X. Lu, and Y. Qiu. 2020. Entrepreneurship and carbon emissions: Evidence from China. *Energy Economics* 86: 104623. [\[CrossRef\]](#)
- Huđek, Ivona, and Barbara Bradač Hojnik. 2020. Impact of entrepreneurship activity sustainable development. *Problemy Ekorozwoju* 15: 175–83. [\[CrossRef\]](#)
- Johnson, Matthew P., and Stefan Schaltegger. 2020. Entrepreneurship for sustainable development: A review and multilevel causal mechanism framework. *Entrepreneurship Theory and Practice* 44: 1141–73. [\[CrossRef\]](#)
- Khan, Muhammad Rahatullah. 2013. Mapping entrepreneurship ecosystem of Saudi Arabia. *World Journal of Entrepreneurship, Management and Sustainable Development* 47: 28–54. [\[CrossRef\]](#)
- Neumann, Thomas. 2022. Impact of green entrepreneurship on sustainable development: An ex-post empirical analysis. *Journal of Cleaner Production* 377: 134317. [\[CrossRef\]](#)
- Peprah, Augustine Awuah, and Adenuga Fabian Adekoya. 2020. Entrepreneurship and economic growth in developing countries: Evidence from Africa. *Business Strategy and Development* 3: 388–94. [\[CrossRef\]](#)
- Pesaran, Hashem Pesaran, Yongcheol Shin, and Richard J. Smith. 2001. Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics* 16: 289–326. [\[CrossRef\]](#)
- Pesaran, M. Hashem, and Yongcheol Shin. 1999. *An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis*. Cambridge: Department of Applied Economics, University of Cambridge.
- Saberi, Maria, and Allam Hamdan. 2019. The moderating role of governmental support in the relationship between entrepreneurship and economic growth: A study on the GCC countries. *Journal of Entrepreneurship in Emerging Economies* 11: 200–16. [\[CrossRef\]](#)
- Sayed, Omer Ahmed, and Selma Sidahmed Abdelrahim. 2024. Economic freedom as a catalyst for entrepreneurship: An empirical analysis of GCC countries. *Cogent Business and Management* 11: 2304374.
- Urbano, David, Sebastian Aparicio, and David Audretsch. 2020. Twenty-five years of research on institutions, entrepreneurship, and economic growth: What has been learned? *Small Business Economics* 54: 775–820. [\[CrossRef\]](#)
- Venancio, A., and L. Pinto. 2020. Population growth and economic development: A re-examination. *Economic Development Quarterly* 34: 313–28.

- 
- Wennekers, Sander, and Roy Thurik. 1999. Linking entrepreneurship and economic growth. *Small Business Economics* 13: 27–56. [\[CrossRef\]](#)
- Yusuf, Nadia, and Nisreen Ismail Albanawi. 2016. The Role of Entrepreneurship in Economic Development in Saudi Arabia. *Business and Economics* 7: 204.

**Disclaimer/Publisher’s Note:** The statements, opinions and data contained in all publications are solely those of the individual author(s) and contributor(s) and not of MDPI and/or the editor(s). MDPI and/or the editor(s) disclaim responsibility for any injury to people or property resulting from any ideas, methods, instructions or products referred to in the content.