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Profound Impact of Economic Openness and Digital Economy towards a Sustainable Development: A New Look at RCEP Economies

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Abstract: Sustainable development has become a serious challenge for the globe. Therefore, globalization and the digital economy are considered crucial factors for sustainable development (SD). The current study tries to estimate the link between trade openness and information and communication technology (ICT) with sustainable growth via a linear function in which economic growth, urbanization, and human capital are taken as independent variables. The study employs the Interactive Fixed Effect (IFE) and Dynamic Common Correlated Effect (D-CCE) to quantify the long-term association among variables in a multiplicative framework. The obtained outcomes show a significant contribution of globalization and the digital economy to sustainable growth. Likewise, economic growth and human capital cause a decline in sustainable growth. Moreover, the empirical outcomes show the discouraging role of urbanization in sustainable development. Additionally, a bi-directional association exists between sustainable development and trade openness and economic growth, trade openness and economic growth, urbanization and human capital, and economic growth and urbanization. Such findings further strengthen policymakers' belief in other nations to promote sustainable development. Moreover, to alleviate the economic growth losses, we suggest setting up a sustainable development sharing mechanism among regions.

Keywords: globalization; digital economy; human capital; sustainable development; RCEP economies

1. Introduction

The progression of humanity as a whole for the past few decades has resulted in increasing natural catastrophes, adverse climate changes and conflicts, and instability on political, socioeconomic, and other fronts [1]. The actions of humans have had a bad impact on the surrounding atmosphere, putting both the continued existence of life on Earth and the lives of future generations in jeopardy. Consequently, there has been a shift in behavior toward more rational and efficient use of all reserves, which will reduce environmental stress and the need for resources [2]. In the 1970s and 1980s, when the concept of sustainable development began to emerge, this kind of responsible behavior was considered to ensure long-term economic exploitation without jeopardizing subsequent generations [3]. Development (social and economic growth within ecological constraints), needs (resource redistribution to ensure a high standard of living for all), and future generations all play a role in the concept of sustainable development. Concepts such as development, needs, and future all refer to the redistribution of resources in order to ensure that everyone can enjoy a high standard of living (the possibility of long-term usage of resources to ensure the necessary quality of life for future generations) [4]. To achieve

sustainable development, it is necessary to strike a balance between the three pillars of sustainability: environmental sustainability, which aims to preserve the quality of the environment so that economic activity can continue while also improving the lives of people; social sustainability, which promotes equality and human rights; and political sustainability, which aims to ensure political stability. As long as all of these pillars are balanced, sustainable development can be achieved, but this is not an easy task. This is because each sustainability pillar must respect the interests of other sustainability pillars to avoid throwing them into disarray while achieving its goals. Thus, while one sustainable development pillar may become more sustainable, others may become less sustainable [5]. This is especially important regarding environmental sustainability, which is closely tied to a country's overall capacity for economic growth.

Academics, industry representatives, and policymakers are all paying a growing amount of attention to sustainable development (SD). The discussion on SD has touched on many different topics, but one of the most important ones is how innovations can help improve sustainability. Because innovations constantly alter both the external environment and the way we live, it is an essential component for applying sustainability in communities, organizations, supply chains, regions, institutions, and countries [6]. The body of academic research agrees that innovative methods should be prioritized when addressing the issue of sustainability [7]. In reality, the pace of change toward a more sustainable world is excruciatingly slow, and there are urgent calls for companies, schools, universities, and governments to develop additional investment opportunities and initiatives to implement innovative multidisciplinary approaches to solve our current and pressing sustainability challenges [8].

It has been found by numerous international organizations, most notably the World Bank and the World Trade Organization, that there is a robust connection between global commerce and environmentally-friendly economic growth. In order to promote economic growth while also safeguarding the environment for future generations, these organizations have focused on a wide range of programs related to sustainable development and trade [9]. An economic growth engine fueled by international trade was suggested at the United Nations Conference on Trade and Development (UNCTAD). Economic development goals have evolved into a significant mission, and they now target many countries all over the world, one of which is Saudi Arabia. One of the most important questions in the field of economics, which has seen a resurgence in interest in recent years, is the connection between openness to trade and the prospect of achieving sustainable development [10].

The phrase achieving sustainable development goals (also abbreviated as SDGs) has become ubiquitous in discussions about development in recent years [11]. While this may be the case, many countries continue to face difficulties or have a pessimistic outlook on achieving their set goals. This is especially the case if their policy reforms do not respect desired or targeted deadlines. The postponements in the completion of incremental targets that lead to the achievement of the Sustainable Development Goals can be attributed to a number of different factors. One of these, among many others, is the lack of a communication tool that allows for the spread of information and, as a result, a reduction in the amount of ignorance linked with the efforts and processes required to achieve these goals [12]. Tools for information and communication technology (ICT) and their continued growth have opened up various new and expanded channels for disseminating information via the internet and other forms of media. The diffusion of information and communication technologies has various effects on the economy, ranging from monetary growth to fiscal development to educational results and even environmental sustainability [13]. However, these effects vary depending on the industry, and their impact on sustainability has garnered increasing attention in current years. With the rise of globalization, the spread of ICT across countries located in different regions of the world and separated by long distances presents a wide range of sustainable and inclusive development outcomes. Despite this, the results of sustainable development must be designed so that the three most important facets of sustainable development—the

economic, social, and environmental dimensions—are taken into account in a way that is symmetrical and well-balanced [14]. In addition, policymakers should be concerned about the environmental dimension and tailor relevant policies so eco-friendly innovations are prioritized to minimize the environmental impacts of economic activities. This is necessary to reduce the negative effects of economic activities on the environment.

When viewed from the perspective of the environment, information and communication technologies can have negative and positive effects on the world around them. However, the costs of transactions and travel associated with CO_2 emissions can be reduced thanks to information and communication technology advancements. As a matter of fact, by lowering the information costs associated with CO_2 emissions, information and information and communication helps close the information gap related to environmental sustainability. CO_2 emissions will be reduced due to the development of smarter cities, power grids, industrial processes, transportation systems, and energy-saving gains. A decrease in CO_2 emissions will be achieved by implementing smarter cities, transport networks, electrical networks, and industrial processes [15]. A rise in CO_2 emissions occurs due to increased energy consumption by both individuals and businesses due to the use of ICTs. In addition, the improvement of the financial system and the flow of information brought about by advances in ICT leads to a greater degree of financial integration and an increase in economic activities. Increased economic activity is responsible for the accompanying rise in CO_2 emissions. Consequently, the effects of ICT on the preservation of the natural environment can either be detrimental or beneficial, depending on the circumstances. As a result, many academics have argued for a nexus between the two concepts that resembles an upside-down U-curve [16].

In the following ways, this paper contributes to the existing body of literature. First, while previous research has concentrated on the connections between communications technology (ICT) and information and specific aspects of sustainable growth, the current investigation takes a different tack than previous research by examining the impact of ICT on sustainable growth through the lens of the composite sustainable development index. This index is comprised of a number of different subcomponents. Second, the research investigates the transmission mechanisms that are responsible for the influence of ICT on sustainability. In particular, the globalization of trade was investigated and validated as a potential transmission mechanism. In essence, given the rapidly expanding globalization pattern, accompanied by importing technology from other countries, ICT would improve economic activities and productivity. Because of the increased economic activity, domestic companies are increasingly looking to sell their wares in international markets. As a result, this will have an impact on the environmental, social, and economic aspects of sustainable development. Third, the effect is examined more closely for a number of countries. In essence, the development of information and communication technologies is not the same in every region of the world. The ability of various economies to invest more in information and communications technology (ICT) and other sectors that will facilitate sustainable development varies. In addition, countries' geographic location may either be an advantage or a disadvantage in meeting the requirements for sustainable growth.

The remaining parts of the paper are organized in the following way. In the second section, we conduct a short-term review of prior empirical studies that analyzed the influence of openness to trade on the relationship between financial growth and ecological quality. In Section 3, we present the numerous ARDL models that were estimated along with the data utilized throughout the study. We will discuss and interpret our findings in the following section (Section 4). The report comes to a close with Section 5, which presents some conclusions and the policy implications of those conclusions.

2. Literature Review

2.1. Nexus of Openness with Sustainable Development

Each of the three aspects of sustainability—economic, social, and environmental—has been subjected to in-depth analysis, and a significant body of written material is devoted

to the topic. Since the 1970s, economists, environmentalists, and social commentators have been debating the relative benefits of free trade. Advocates of trade liberalization consider it an absolute necessity for economic expansion in underdeveloped nations. As a result, these nations should adhere to a pro-trade agenda at the international level [17]. In classical and mercantilism, the importance of open trade has been emphasized more widely. One can find a much greater emphasis on trade openness in today's endogenous growth models. Outward-oriented trade regimes, for example, were directly linked in these models to growth [18]. Manufacturing exports are the key to resolving low-income countries' economic woes, according to a United Nations survey of the global economy. Additionally [19], argued that trade creates patterns of catch-up and overtaking, which contribute to sorting economies into high and low-growth countries. Static gains are realized when resources are efficiently redistributed. At the same time, dynamic advantages include an expanded domestic market for domestically produced goods, changes in attitudes and universities, growing competition, greater investment flows, faster productivity growth, learning by doing, and acquiring new knowledge and ideas, all of which contribute to a more dynamic economy [20]. Furthermore, exposure to foreign externalities improves the performance of non-export sectors, which increases overall economic growth. The reduction in deadweight losses suffered by residential monopolies and oligopolies as a result of increased competition brought about by trade liberalization also brings about additional gains.

Despite the optimistic assessments made by advocates, [21] raised doubts about how trade openness could be measured. The study could not find a direct causal link between economic growth and international trade; however, such a link is contingent on a number of factors external to the country and specific to the nation itself. This new wave of economic integration is also feared by environmentalists, who believe that the politics of economic growth, which has been shown to contribute to the degradation of the biosphere, is lurking beneath it. A strong moral stance is taken by those opposed to free trade because they believe it will harm the environment and society as a whole. As reported by the media, increasing trade leads to global pillage [22]. Economic growth necessitates a large amount of energy use, which has a negative impact on the environment [23]. Increasing trade could put less-developed nations at risk of falling into the specialization trap by keeping those nations dependent on primary exports. According to the findings of [24], an increase in the amount of money made through trade can contribute to an increase in the amount of pollution in the world. Ref. [25] presented the argument that further liberalization would only lead to an increase in the level of resource exploitation, which is unsustainable. These heated debates are causing countries to reevaluate their trade approach to alleviate their concerns regarding the possible release of carbon. According to [26], most previously conducted research has focused on how the globalization of trade influences social welfare programs, specifically how it makes the less fortunate more susceptible to harm while benefiting those who are already prosperous. According to dependency theorists, international trade is a form of neo-colonialism that threatens democracy and social ties worldwide. Because openness is linked to recurrent upsets, it places vulnerable populations in a precarious position [27]. In emerging countries where there has been an increase in the trade of manufactured goods, there is evidence of a reduction in the coverage of social protection programs for both the general population and the poor. According to [28], critics of trade liberalization argue that it decapitalizes less developed nations by encouraging an increase in the inappropriate repatriation and consumption of resources by multinational corporations. Furthermore, business organizations and stockholders in countries in the process of liberalization are putting pressure on administrations to lower taxes and reduce the bargaining power of employees. Even though the volume of trade is expanding at a rate that has never been seen before, the empirical debate is not yet resolved. This is because economic growth brought about by open trade is widely regarded as a panacea for all problems relating to society and the environment. Sustainable growth cannot be achieved by increasing GDP alone because this metric ignores many other crucial factors. According to [29], the measurement of

economic well-being has frequently been equated with the gross domestic product (GDP), although GDP primarily measures market production. When attempting to gauge the level of prosperity of a population, equating market production with economic well-being can be an extremely misleading indicator. In addition, it ignores a number of extremely important concerns, such as the unorganized market, the distribution of economic goods, and the costs of pollution, amongst others.

Although the existing literature has produced mixed results regarding the implications of trade openness, the predominant message is that outward-oriented trade policies improve the standard of living and economic performance. Many studies identify trade openness as a means of achieving economic, social, and environmental prosperity. Cetin et al. (2018) [30] used a computable general equilibrium (CGE) model with two partial and deep trade liberalization scenarios. They found that trade liberalization growth was augmenting, albeit the distribution of gains was largely shifting towards industrialized countries. In terms of measurement, trade openness, which leads to economic prosperity, deteriorates social development, and has adverse environmental consequences, is contingent upon a particular country's income level. Shahbaz et al. (2013) [31] found similar results while assessing major negotiations, such as multilateral trade liberalization in the Doha Declaration of the WTO, and their consequential impact on the sustainable development of developing countries. However, the favorable outcome of trade openness on monetary growth was criticized for high energy demands leading to environmental degradation [32]. While examining the trade–environment relationship in a holistic framework and considering the environmental Kuznets curve (EKC) hypothesis, Le et al. (2016) [33] found that trade openness benefits developed countries but deteriorates developing ones. For poorer countries, trade openness deteriorates due to their increasing dependence on primary products, leading them to a specialization trap. [34] examined the determinants of environmental pollution by CO_2 emissions. It was found that trade openness, along with FDI inflows, increased pollutant emissions and therefore caused environmental damage. However [35], argued that the negative influence of trade on environmental excellence indicated by the earlier studies was due to endogeneity rather than causality. The duo attempted to tackle the endogeneity issue by means of an exogenous geographic instrumental variable.

In recent years, most studies have concentrated on the association between the commercial sector and carbon emissions to demonstrate sustainable development or environmental protection. In the environmental study, the effects of increased commercial exchange can generally be broken down into two distinct schools of thought. The first hypothesis is based on the supposition that the effect of free trade on pollution is not well understood and can be broken down into three categories: the scale effect, the technology effect, and the composition effect. The Pollution Haven Hypothesis is the name of the second theory [36]. The liberalization of trade encourages investment from overseas directly. Polluting businesses will choose to yield in countries with relatively lax environmental standards, which will cause those countries to become known as pollution havens because different countries have different environmental standards. Consequently, it is necessary to consider the effect a country's level of economic openness has on the environment. Two theories and research findings led to four hypotheses. (1) There is a positive correlation between carbon emissions and trade openness, and (2) no relationship between trade openness and carbon emissions.

The evidence that supports hypothesis (1) shows that trade openness has a long-term positive impact on Pakistan's carbon emissions, as discovered using the vector error correction model (VECM). An investigation at the federal level led to this discovery. In addition, an increase in trade openness has been linked to an increase in pollution, according to research. Three different models have been used to validate these findings: the panel vector error correction model, the panel dynamic ordinary least squares model, and the fully modified ordinary least squares model (PFMOLS) [37]. Regarding the second hypothesis, research has been conducted on China in the context of globalization using VECM causality

and the ARDL bounds test [38]. The causal test demonstrated the unidirectional Granger causality of carbon emissions to trade openness and was found to be true. In addition, the findings of a number of different international organizations suggested that environmental regulations have a significant influence on international commerce. The term bidirectional causality is being used to refer to the relationship between trade openness and carbon emissions. Using the panel regression model, a study that covered 105 countries determined a bidirectional causal relationship between the global group and the middle-income group at the global level [39]. Trade openness has both a positive and a negative impact on carbon emissions, depending on how you view it. Although there isn't much evidence to back up this hypothesis, the fourth hypothesis asserts that there is no connection between increased trade openness and increased carbon emissions. The use of a linear econometric model has been argued to be difficult at the national level to find a causal relationship between trade and the environment. For this reason, a large portion of the global economy is based on trade. A panel regression model was used to examine the impact of trade on the environmental Kuznets curve (EKC) at the transnational level. The results of this model showed that openness to international trade was not generally linked to an increase in greenhouse gas emissions. The results of various studies can support many different hypotheses.

2.2. Nexus of ICT with Sustainable Development

Both as facilitators of societal change toward sustainable development and as drivers of resource consumption that is not sustainable, ICTs are perceived in both of these roles. How can we use information and communication technologies (ICTs) to support management techniques that allow companies, administrations, and cultures to subsidize sustainable development? The relevant debates begin with the hardware of information and communication technologies and center on the characteristics and sizes of the material and energy flows caused by the life cycle of devices, as well as the methods by which their significance to the achievement of sustainable development can be evaluated [40]. For instance, there are growing environmental and communal inferences associated with the accumulation of electronic waste (also known as e-waste) both in industrialized nations and in economies that are still developing. Growing demand for rare chemical elements related to information and communications technology is expected because ICT devices require more than half the elements listed in the periodic system to be produced [41]. Utilizing information and communication technology (ICT) as a technology that permits the optimization of other technologies and processes or its substitution for those technologies and processes can have much more significant effects on sustainability, both positively and negatively. Both academics and industry professionals are looking for ways to better use information and communications technology (ICT) to reduce the number of resources wasted during the manufacturing and consumption processes. Which applications have the potential to kickstart a long-term structural shift toward a more environmentally friendly economy, and under what conditions might this be possible? Climate change adaptation and using ICTs to reduce greenhouse gas emissions is a major issue currently under investigation. Coordinating efforts at the local, national, and international levels are all necessary in this case. Sustainable production, increased resource efficiency, and dematerialization are all goals that ICTs can help achieve (decoupling total material consumption from GDP).

According to international organizations such as the Organization for Economic Co-Operation and Development (OECD), information and communications technology (ICT) plays an important role in achieving sustainable development. Particularly in poverty reduction, social justice, and democratic governance [42]. Researchers who emphasize the importance of information and communications technology (ICT) for achieving long-term economic goals can be found. An academic's point of view informs this viewpoint. ICT has a wide range of advantages. These benefits include (a) global integration, which enables developing countries to benefit from advanced technologies, (b) the ability of these technologies to overcome both geographical and cultural barriers, which promotes conver-

gence between advanced and non-advanced economies, (c) the promotion of government transparency by reducing corruption, and (d) access to knowledge and information. Some academics believe that communication and information technologies should play pivotal roles in protecting the environment. Because of their ability to lower carbon emissions, these technologies are of critical significance not only for the economy's expansion but also for maintaining a healthy environment. Protecting the environment, promoting environmental sustainability, and fostering sustainable rural development are all possible outcomes of putting these practices into practice. Additionally, they have enriched people's daily lives by providing users with great freedom.

It is easy to see the importance researchers place on ICT in achieving sustainable development when looking at studies that have defined specific theoretical frameworks for the technology. Studies such as these show how important ICT is to scientists to ensure sustainability [43]. Although advances in information and communication technology have a positive impact, they can also have negative consequences. As a result, some academics use a dual classification to describe the impact of ICT on the surrounding environment. These effects may be referred to in either a direct or indirect manner here. Throughout the life cycle of the information and communications technology product in question, there will be direct effects, also known as first-order effects, which are associated with the demand for various materials and energy. The term direct effects refers to the resources consumed, the emissions produced as a result of production, and the consumption of and waste generated by the products. The application of ICT in other dimensions that involve changes to the environment, such as changes in consumption referenced here, can have indirect effects, also known as second-order effects [44]. These effects reflect the result of this application. One example of a discussion that has been generated as a result of the impact ICT has had on the environment can be found by following the reference here, where the author focuses on Bitcoin technology.

In any event, we come across a number of empirical works that emphasize the significance of information and communication technologies for sustainability. For instance, the research that Ben Lahouel et al. (2021) [45] conducted on the economy of South Korea claims that information and communication technology (ICT) helps reduce the rate of environmental degradation over the medium and long term. Using information and communications technology (ICT) to create green environments would reduce carbon emissions, Zhao et al. (2022) [46] concluded after researching ICT and environmental protection. This author based his work on the idea that information and communications technology (ICT) is necessary for industries that deal with big data software, smart networks, or waste processing. Praničević and Zovko (2016) [47] projected the growth of ICT infrastructures with the goal of lowering the cost of renewable energies, with the expected result being a meaningful impact in terms of emissions. In their proposal, these infrastructures aim to lower the cost of renewable energy. Thus, they predicted that overall carbon emissions would be reduced over the long term if this measure was implemented. Ref. [48] studied the link between climate change, urban areas, and information and communication technology. Some of the author's ideas revolved around ICT and how it can be used to reduce emissions. Smart supply chains, smart infrastructure, and smart buildings are just a few examples of these ideas. They found that teleworking could be useful for reducing traffic congestion and vehicle emissions in cities such as Chicago. In the same vein, Zafar et al. (2022) [49] found that teleworking can be a useful tool for lowering the overall volume of traffic and raising air quality.

2.3. Research Gap

Although there is no consensus about the influence of worldwide trade on economic growth and environmental degradation, very few studies have investigated the impact of international trade on sustainable development in a selection of economies. This is because there is no agreement regarding the impact of international trade on economic growth and environmental degradation. In addition, the body of academic research offers

a wide range of possible explanations for the lack of conclusive findings regarding the links between international trade and economic growth and the links between international trade and environmental degradation. There are various reasons for this, some of which include the various proxies used for trade openness, the various periods, and the various methodologies utilized. In addition, the liberalization of trade is accompanied by a number of other policy measures, which cannot be captured by methodologies that use longitudinal data. To that end, this study employs the IFE and D-CCE cointegration frameworks, along with annual data spanning from 2000 to 2020, to investigate the effects of trade openness on an indicator of sustainable development. We think economic growth and environmental quality improvements should be the cornerstones of sustainable development. We investigate trade openness's effect on the sustainable development index using human capital, information and communication technology, urbanization, and economic growth as control variables. This study is notable for being the first to investigate trade openness's influence on the sustainable development index. This is one of the original aspects of the research. It is one of the few studies that attempt to explain sustainable development by combining factors such as trade openness, human capital, information and communication technology (ICT), urbanization, and fiscal growth. In addition, even though certain economies are well known, those that are well known have not functioned together to advance a plan to investigate the effects of trade openness on the country's sustainable development.

3. Data and Methods

3.1. Data Source and Description

We used annual panel data from 2000 to 2020 for 10 countries in the RCEP regional comprehensive economic relationship. Indicators of global economic development are derived from data on various variables, such as GDP (2010 USD constant), the sustainable development index, the digital economy (ICT), trade openness, human capital, and urbanization. According to the selected years, the dataset and the descriptive statistics of variables used in the study are summarized in Tables 1 and 2.

Table 1. Description of Variables.

Variable	Explanation	Sources
SDGI	Sustainable development goal index (The Sustainable Development Index proposed is a composite index of five indicators: education, life expectancy, income, CO_2 emissions, and material footprint.	https://www. sustainabledevelopmentindex. org/methods (accessed on 2 June 2022)
GDP	GDP per capita (constant 2010 USD)	WDI
URB	Urbanization (% of the total population)	WDI
HC	Human capital (tertiary education % of gross enrolment)	WDI
ICT	Information and communication technology (ICT, number of internet users)	WDI
TO	Trade openness (exports + imports/GDP in current USD)	WDI

The descriptive statistics for the variables above are depicted in Table 2 for a sample of 10 economies spanning from 2000 to 2020. The table also includes a summary of the data. All of the variables are first converted into natural logarithm form, as was mentioned previously in the source of the data. The sustainable development index is then calculated. Economic growth is on average 9.325, which is equally large with a standard deviation of 1.203 compared to sustainable development index (M = 12.032, SD = 2.331), urbanization (M = 5.182, SD = 1.220), and ICT (M = 3.897, SD = 1.112). Table 2 contains the data, which is presented in a descriptive manner. A standard deviation of 1.896 was recorded for human capital, but its mean value was higher, at 9.452 points. With an average of 4.96 and a standard deviation of 1.654, trade openness was next in line. An observed

series must have a normal skewness value of zero if it is to be considered symmetrical or normally distributed.

Table 2. Descriptive Statistics of Variables.

Statistics	SDI	GDP	URB	ICT	LHC	LTO
Mean	12.032	9.325	5.182	3.897	9.4523	4.856
Maximum	25.142	14.523	9.235	9.456	24.964	10.598
Minimum	4.0245	2.654	0.002	1.258	3.8745	1.693
Std. Dev.	2.331	1.203	1.220	1.112	1.896	1.654
Skewness	0.456	0.203	2.452	0.453	1.002	0.896
Kurtosis	1.235	2.782	8.523	3.856	2.726	2.752
J-B	69.568	41.581	52.124	37.856	21.745	46.521
Prob.	0.000	0.000	0.000	0.000	0.000	0.000

Table 3 displays the results of Pearson correlation analysis among the panel series. Correlations between SDI and LGDP, LURB, LICT, LHC, and trade openness are highly significant. Economic growth is positively related to SDI and ICT, and human capital and trade openness positively correlate with the sustainable development index. On the other hand, urbanization negatively correlates with the explained variable at 5% significance.

Table 3. Pairwise Correlation test.

Variable	SDI	LGDP	LURB	LICT	LHC	LTO
SDI	1					
LGDP	0.6542 *	1				
LURB	−0.7302 **	0.4522 **	1			
LICT	0.2358 *	0. 7089 *	0.5974 **	1		
LHC	0.6931 *	0.3269 **	−0.6345 *	0.6931 *	1	
LTO	0.5968 **	0.2385 **	0.2965 *	0.3674 **	0.5289 *	1

Note: * and ** indicate the 1% and 5% significance level.

3.2. Selection of Countries

Models were then developed using data from 10 (RCEP) countries, which account for nearly a third of the world's population and 29% of global GDP, between 1990 and 2018, following the theoretical framework presented earlier in this section. First and foremost, the selected countries represent a wide range of socioeconomic conditions, including low-, middle-, and high-income countries, ensuring that the results represent the entire world. Because our sample countries account for a large portion of the world's GDP, our findings apply to a large portion of the world's nations. As a final point, previous studies have focused on a single region or continent. Our paper focused on the most critical aspect of this agreement when selecting a sample. Because the agreement aligns rules of origin for all countries from different regions or continents, RCEP participants can more easily integrate into the same production chain. Members of the RCEP could gain a greater share of global value chains (GVCs) and become more specialized as a result of this. Investing and trading can be done more quickly and easily when people can move around more easily.

Likewise, after the basic tests, we can write our proposed variables in a single model, such as:

$$SDI = f(GDP, URB, ICT, HC, TO) \tag{1}$$

In the given equation, SDI presents sustainable development growth, GDP presents economic progress, URB shows urbanization, HC shows human capital, ICT shows digital economy, measured by information and communication technology, and describes globalization as measured by trade openness. The given model can be transformed into a lin-log model, as shown:

$$SDI_{it} = \beta_0 + \beta_1 \, LGDP_{it} + \beta_2 \, LURB_{it} + \beta_3 \, LICT_{it} + \beta_4 \, LHC_{it} + \beta_5 \, LTO_{it} + U_{it} \tag{2}$$

Equation (2) shows the natural log of economic growth, urbanization, information and communication technology, human capital, and trade openness, while I present the cross-sections and t shows the period.

3.3. Estimation Strategy

While analyzing macro panel data, one might run into two distinct types of issues: CSD and heterogeneity. The first one will probably happen because there is a higher degree of economic integration between the countries. Usman et al. (2021) [50] explained the significant biases that can arise when the CSD is neglected to be taken into account. It is possible that the second problem, known as the slope of heterogeneity, is not always valid across the sample of economies. This is because each country's economic development (ED) and economic growth vary greatly. Therefore, checking for CSD and heterogeneity is the first thing to be done. Second, the CSD results help direct the appropriate unit root tests. In order to obtain reliable results, the second-generation panel unit root tests that also consider CSD have supplanted the conventional tests as the method of choice. In addition, if the variables are integrated, the panel cointegration test will be utilized to identify whether a long-run association is present. In order to address the issues mentioned above, we performed the econometric procedure and then measured the relevant parameters. Both the IFE model developed by Bai (2009) [51] and the D-CCE model developed by Kim et al. (2020) [52] are utilized in this article. Bai developed the IFE model. The final step involves applying the heterogeneous non-linear panel causality method in order to determine the direction of a causal association.

3.4. CSD and Slope of Homogeneity

As was just mentioned, certain economies may demonstrate strong interdependencies as a result of the implementation of conventional policies for the preservation of the natural environment. It is essential to exercise control over the interdependencies in the data; failing to do so may result in significant bias in the findings. In light of this, CSD is subjected to empirical testing. The study concentrated on the homogeneity of the slope by Pesaran and Yamagata (2008) [53] following to comprehend the heterogeneous nature of the states of concern. In a broader sense, the CSD test, as developed by Pesaran (2004) [54], is acceptable for a panel in which $T \rightarrow \infty$ and $N \rightarrow \infty$. In addition, the general forms of these examinations are presented below in the form of Equations (3)–(5).

$$\text{CSD} = \sqrt{2T/N(N-1)} \left(\sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \rho ij \right) \qquad N\,(0,\,1) \tag{3}$$

$$\text{FRI} = (T-1) \left[\frac{2}{N} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \gamma ij + 1 \right] \qquad \chi \tag{4}$$

$$\text{FRE} = \frac{(T-1) \left[\frac{2}{N} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \gamma ij + \frac{1}{T} \right]}{SE(Q)} \qquad N\,(0,\,1) \tag{5}$$

In this equation, estimated represents the coefficient of residual correlation in individual OLS regression. Pesaran (2004) [54] presented the CSD test for heterogeneous dynamic models that included multiple breaks in the slope coefficient.

3.5. CADF and CIPS Panel Unit Root Tests

After ensuring that CSD and heterogeneity are present in the panel data, it is necessary to implement a reliable unit root. Pesaran (2007) [55] proposed using the Dickey–Fuller-based panel unit root test as an alternative to the traditional tests due to its superiority in addressing CSD, heterogeneity, and break in the series. This research uses the unit root tests, enabling CSD to arrive at reliable findings.

3.6. Westerlund Panel Cointegration

Error correction-based cointegration is used to test whether or not the variables of interest are linked over the long term by considering CSD [56]. The endogenous nature of repressors causes irritation, which is why the Westerlund test is chosen. In order to determine whether or not the panel is cointegrated, four null hypotheses of no cointegration are formulated, and two statistical tests are run. CSD and other non-strictly exogenous regressor tests are based on the error correction equations outlined below.

$$y_{it} = \alpha_{0i} + \alpha_{1it} + Z_{it} \tag{6}$$

$$X_{it} = x_{i,t-1} + \mu_{it} \tag{7}$$

Here $i = 1, 2, 3, \ldots \ldots N$, and $t = 1, 2, \ldots \ldots \ldots, T$ with the Z_{it} specified as

$$\delta_i(L)Z_{it} = \delta_i(Z_{it-1} + \gamma_1, x_{i,t-1}) + \beta_i(L)\mu_{it} + \varepsilon_{it} \tag{8}$$

$$\delta_i(L)\Delta y_{i,t} = \theta_{0i} + \theta_{1it} + \delta_i(y_{i,t-1} - \gamma_1, x_{i,t-1}) + \beta_i(L)\mu_{it} + \varepsilon_{it} \tag{9}$$

where the deterministic components are given by the $\theta_{0i} = \delta_i$ (1) $\alpha_{1i} - \delta_i \alpha_{0i} + \delta_i\alpha_{1i}$ and similarly, $\theta_{1i} = -\delta_i \alpha_{1i}$. Further, panel and group statistics can be written as in general form as,

Pτ = δ-hat/γ-hat$_{\delta\text{-hat}}$, ... , P$_\alpha$ = T$_{\delta\text{-hat}}$ and Gτ = $\frac{1}{N} \sum_{i=1}^{N} \delta - hat/\gamma - hat\delta - $hat, ..., G$_\alpha$ which is equal to $\frac{1}{N} \sum_{i=1}^{N} T\delta - hat/\delta_i$ (1), thus this cointegration test recommended using the bootstrap method to deal with the CSD issue.

3.7. Interactive Fixed Effect

According to previous research, regression models with factor error structures can be quantified in two ways. There are two papers on this topic. The first one discusses the D-CCE method, which was developed by Chudik and Pesaran (2015) [57] as an extension of Pesaran (2006) [58]. In linear static panel models with both a homogenous and a heterogeneous coefficient, Pesaran (2006) [58] developed the CCE technique. As a substitute for the factor component, the estimator employs the cross-sectional average of the explained and explanatory variables as a proxy for common factors. But the estimator does not measure the factor component, which can be extremely important in econometric settings. D-CCE method was used in this study for a variety of reasons, including the following. The data are solved by taking into account the cross-sectional and lagged mean values of the variables that are being explained to take into account both cross-sectional and lagged cross-sectional data. This method is robust against omitted variable bias and bidirectional feedback for various proxies and determinants of the environment. Bai (2009) [51] introduced the IFE strategy, which he referred to as a strategy of choice. Through an iterative approach, the factor element and regression coefficient are calculated simultaneously. For this purpose, the following Equation (10) is evaluated because it is found to be extremely suitable for the methodology of this study.

$$Y_{i,t} = X'_{I,t}\alpha + \varphi_i + s_t + e_{i,t} \tag{10}$$

where $Y_{i,t}$ is the ED indicator in an economy i for period t.

$$e_{i,t} = \Gamma'_i F_t + \mu_{i,t} \tag{11}$$

Unit specification reactions to standard shocks are captured in Equation (14). Ft is an r multiplied by 1 vector of unobserved time-specific common shocks, and the error term is i,t. Factoring and regression coefficients were developed by Pesaran (2006) [58] using Equation (SSR) in order to minimize the sum of residual squares (SSR) (12).

$$SSR = \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{i,t} - X'_{I,t}\alpha - \varphi_i - s_t - \Gamma'_i F_t)2 \tag{12}$$

The above equation can be presented in two different means to measure the factor structure and the regression coefficient; firstly, if the factor structure $\Gamma'_i F_t$ is identified, then the regression coefficient can be measured by minimizing the SSR.

$$SSR_1 = \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{i,t}^{(1)} - X'_{I,t}\alpha - \varphi_i - s_t)2 \tag{13}$$

where $Y^{(1)}_{i,t} = Y_{i,t} - \Gamma'_i F_t$. Secondly, if the regression coefficients are known, then we can apply principal component analysis where $(\{\Gamma'_i\}^N_{i=1}$ and $\{F_t\}^T_{t=1}$ are quantified by minimizing SSR with the commonly used normalization $T^{-1} \sum_{t=1}^{T} F_t F't = Ir$:

$$SSR_2 = \sum_{i=1}^{N} \sum_{t=1}^{T} (Y_{i,t}^{(2)} - \Gamma'_i F_t)2 \tag{14}$$

$$y^{(2)}_{i,t} = Y_{i,t} - X'_{I,t}\beta - \varphi_i - s_t$$

Starting with the SSR1 and SSR2 measurements, Bai (2009) [51] suggested iterating until the difference in the SSR is less than a pre-determined benchmark set.

3.8. D-H Panel Causality Test

The Dumitrescu and Hurlin (D-H) panel causality test is an improved version of the original panel causality test [59]. The test is used to look for a link between the variables to see if one causes the other. The causality in heterogeneous panel data methods is examined using this methodology. The technique has three advantages: it takes into account the CSD ratio, it takes into account the time dimension and the size of the cross-section about one another, and it allows for adequate findings to be obtained even if the data are not balanced.

4. Results and Discussion

4.1. The Results of Cross-Sectional Dependence Tests

The countries represented on this panel are connected on a geographical scale. As a result, panel data might be affected by something called cross-sectional dependence. It could be the result of spatial or spillover effects or unobserved factors common to both. If cross-sectional dependence is ignored, standard panel estimators' unbiasedness and uniformity properties may be affected. Cross-sectional dependence tests can be found in a wide range of academic literature. The Breusch and Pagan (1980) [60] LM test, the Pesaran (2007) [61] scaled LM test, and the Pesaran CD (2007) test were used in this study to verify cross-sectional dependence. To ensure the validity of the results, this was done. Table 4 shows the results of the cross-sectional dependence test. The study's findings clearly showed that there was a cross-sectional dependence (Table 4). Because the probability values of the three tests' statistics do not support the null hypothesis of cross-sectional independence, this hypothesis is rejected.

Table 4. The results of the cross-sectional dependence test.

Test	Statistics	Prob.
Breusch-Pagan LM	541.20	0.000
Pesaran scaled LM	49.885	0.005
Pesaran CD	4.8561	0.000

4.2. Panel Unit Root Tests

Table 5 summarizes the results of the panel unit root tests conducted using Pesaran's CADF and CIPS. These tests are reliable even in the presence of heterogeneity and cross-sectional dependence. In this study, the estimation with a constant plus trend is considered so that potential hidden features can be uncovered. Accordingly, it cannot be ruled out

that the variables are not non-stationary. Although the variables have unit roots at their levels, this provides compelling evidence that the first difference of the variables does not have unit roots. A panel cointegration test was used to determine whether or not variables share a long-term relationship after establishing that the variables had unit roots at their respective levels but were stationary at their first difference. This was performed to see if there was any correlation between the variables.

Table 5. Pesaran's CADF and CIPS test results.

Variable	CADF Test		CIPS Test	
DSI	−2.995 **	−5.1489	−3.445 *	−5.8988
LGDP	−1.2561	−3.2896 *	−2.0854	−4.8852 *
LPA	−1.4127	−5.8425 *	−1.8952	−5.9632 *
LHC	−2.9962 *	−6.7432	−3.7496 *	−5.8512
LICT	−1.2375	−3.7465 *	−1.6589	−4.8596 *
LTO	−2.1245	−7.6541 *	−1.4523	−5.9182 *

Note: * and ** indicate the 1% and 5% significance level.

4.3. Panel Cointegration Test

Table 6 summarizes the results of Westerlund and Edgerton's bootstrap panel cointegration test. The result with sustainable growth as the response variable reveals that all variables are cointegrated according to their respective robust probability values for various panel country groups. This is because the hypothesis that there is no cointegration is rejected at a significance level of 1% based on the statistics. Moreover, this is the case because when applying the robust p-values to each of the different variables, the same null hypothesis is shown to be incorrect when using the statistic at a significance level of 1%. The findings based on the robust p-values give stronger proof that the variables analyzed are cointegrated. Because of this, we can conclude that the variables that are being examined have a connection that is sustained over time.

Table 6. Results of Westerlund and Edgerton's bootstrap panel cointegration test.

Statistics	G_t	G_a	P_t	P_t
Value	−7.0963	−2.4126	−11.2741	−5.4562
Z-value	5.8512	1.0856	5.7465	2.8745
p-value	1.000	1.000	0.002	1.000
Robust p-value	0.000	0.999	0.000	0.005

4.4. IFE and D-CCE Estimators

After it has been established that the variables in question are cointegrated for the group in question, it is important to pinpoint and estimate both the long-term and short-term effects and investigate the causal connections between them with the help of the IFE and D-CCE estimators. As a consequence, the summary of the most important findings from the IFE and D-CCE estimation method is presented in Table 7. In a similar vein, the first factor that determines sustainable development is how economic growth is being utilized in the economies that are being considered. The positive linkage with sustainable development is demonstrated by the coefficient values of GDP when estimated using the IFE and D-CCE methodologies. To put it another way, an increase of 1% in this factor would result in an increase of 0.896% and 0.716%, respectively, in the standard deviation. The goal of decision-makers should be to achieve sustainable development, which considers the issue's economic, environmental, and social aspects. Both theorists and practitioners of development have placed a significant emphasis on achieving maximum economic growth as a primary objective. The purpose of this study was to investigate whether or not optimal economic growth is sustainable, as well as the conditions under which this might or might not be the case. This was accomplished by analyzing the costs and benefits of growth under various scenarios. During the early stages of economic growth, the number of selected

economic systems will continue to grow. A positive correlation between the GDP and sustainable economic development integrated subsystems' interaction coefficients is also observed. It is also true that as the economy expands, so does the carrying capacity of the different subsystems. This finding has had a positive impact on the spatial spillover effect of the economic systems that were selected.

Table 7. IFE and D-CCE Estimators.

Variable	IFE Estimator		D-CCE Estimator	
	Coef.	**Std. Error**	**Coef.**	**Std. Error**
LGDP	0.89621 *	0.12853	0.71697 *	0.23745
LURB	−0.2546 **	0.01258	−0.54328 **	0.11234
LHC	0.98234 *	0.23841	0.61895 *	0.18452
LICT	0.54238 *	0.19527	0.75614 *	0.09811
LTO	0.47593 **	0.10427	0.43851 *	0.17632
−Cons.	2.5689 *	0.73859	1.85637 **	0.56912

Note: * and ** indicate the 1% and 5% significance level.

In the same vein, the coefficient value of urbanization has a negative association with sustainable development. This suggests that a 1% significant increase in urbanization would decrease sustainable development by 0.254% and 0.543%, respectively. This demonstrated a direct connection between SDI and URB over a longer period; however, unplanned and rapid URB can potentially lead to the devastation of the environment on Earth. To put it another way, people move to metropolitan and urban cities to expect a better and more promising future there. Though, if this procedure is not carefully planned, urban areas will not be able to accommodate the large number of people moving in from rural areas. This puts strain on various urban amenities, including sanitation, water, and sewerage systems, which in turn contributes to the deterioration of the surrounding environment. There has also been an increase in deforestation as a result of the huge flood of visitors and unplanned housing developments, which has exacerbated the situation. Kasman and Duman (2015) [62] revealed the URB-environmental link for the Nigerian economy, and they concluded that the two variables are inversely related. Khan et al. (2021) [63] also illustrated the same linkage for a selection of South Asian countries, leading the authors to conclude that rapid urbanization is one of the most significant factors lowering environmental quality. Yang et al. (2019) [64] found that urbanization can lead to a rise in the amount of environmental degradation in the case of Pakistan, which is a developing economy. Therefore, it is imperative that developing economies place their attention on urbanization that is sustainable.

Because the coefficient of human capital has a positive association with sustainable development, we can deduce that an increase of 1% in human capital would lead to an increase in the sustainable development of 0.982% and 0.618%, respectively, according to the requirements of IFE and DCCE. This is because human capital has a positive association with sustainable development. The economic rationale can be discussed further in this context. For the 21st century, this new measure of leadership resources should be used to assess how well leaders can manage human capital sustainability. This is the case despite the limitations that have been mentioned above. This leadership style emphasized the long-term viability of human capital, which helped organizations work toward more sustainable forms of growth. A workforce and organizations that place a greater emphasis on promoting resources and well-being at both the individual and organizational level may produce more productive and efficient workers and organizations. Employee autonomy and self-actualization, as well as positive relationships and positive workplaces, according to Yang et al. (2020) [65], sustain well-being for healthy individuals and organizations, according to [66]. In addition, this human capital-focused management approach might help employees better leverage their unique skillsets and grow professionally. According to Lv et al. (2018) [67], sustainable human capital development and leadership can be used

to help build a more sustainable human environment and support the growth of human resources and organizations while promoting healthy businesses.

The application of information and communication technology is shown to be effective in raising sustainability. As a result, the estimated results demonstrate the significant contribution ICT has made to the sustainable development of certain economies. The preliminary findings point to some intriguing discoveries. Concentrating on the ICT variables produces interesting results because it is both positively significant and significant at the 1% level. According to the findings, there is a correlation between an increase in the rate of internet penetration and an increase in SDI. The findings demonstrate a consistently good relationship between internet penetration and significant contributions to sustainable development. It is also exciting to note that the influence of subscribing to mobile phone service on improving SDI is more significant in terms of the magnitude of its effect. The findings are consistent with previous and more recent research that supports the role of ICT in increasing environmentally sustainable practices [68]. This could be because the economies that participated in the study encouraged adopting ICT sector development across the region after the digital economy was put into practice. Their goals are to encourage monetary transformation and improve quality of life by developing an infrastructure for information and communications technology that can support new technologies that are cleaner and more efficient. In the meantime, the estimated results stand in stark contrast to recent studies, which found that ICT has an insignificant influence on the environment and may even be harmful [69].

Trade openness is also considered to be another factor that determines sustainable development, and it positively correlates with the variable being explained. This suggests that an increase of 1% point in trade openness would increase the standard deviation of 0.475% points (IFE) and 0.438% points (D-CCE). This result can be rationalized by appealing to economic logic. Trade openness was also found to have a bad influence on SDI, which was found in conjunction with these results. International trade opens the door for the transfer of technology across national boundaries. As a result, countries can gain access to more environmentally friendly technologies, which, in turn, can bring about a reduction in emissions, an improvement in environmental quality, and ultimately an increase in sustainable development. This portion of the findings is consistent with the findings by Alataş (2021) [70] for EU countries and contradicted the Agboola et al. (2021) [71] finding for Qatar. It is interesting to note that increasing international trade led to a decrease in emission levels. The sign of trade is supposed to be positive for emerging countries, but the result is the opposite of what was expected, as we cover in this article's Model section. Because of such a result, the governments of certain economies might start paying more attention to the influence their actions have on the environment by learning from the experiences of industrialized nations. As countries whose economies are dependent on trade, we must require all businesses to transition to environmentally friendly methods of production; we must also put an end to the export of goods produced in industries with higher pollution levels, and we must promote the purchase of environmentally friendly products and services from other nations. In addition, free trade can encourage the transfer of advanced technologies, which in turn can reduce emissions. The findings are consistent with those of Lee and Shepley (2020) [72] for a sample of the top 23 countries in terms of renewable energy, but they contradict the findings of Saadaoui (2022) [73] for a sample of the 15 new countries that have joined or are applying to join the European Union.

A causality test developed by Human et al. (2021) [74] was used to determine the direction of the relationships between the variables as a final step in the analysis. Table 8 lists the predicted outcomes. Trade openness and sustainable development are linked in a two-way relationship [75]. Trade openness and SDI have a feedback effect in some panels, implying that trade openness and SDI have a long-term, bidirectional relationship. Economic expansion and SDI have been found to have a long-term, bidirectional causal relationship. Likewise, a two-way causal association was found between sustainable development and economic growth. This infers that any change in economic progress would

cause an increase in sustainable development [76]. In addition, the feedback hypothesis between trade openness and economic progress infers that any change in economic progress would increase the level of trade and vice versa. Moreover, there was a bi-directional causal association between ICT and human capital and economic growth. In simple words, we can say the policies relevant to economic growth, ICT, and human capital are working together to boost the level of sustainable development. Additionally, there was a two-way causal association between human capital and urbanization and GDP and urbanization rate [77]. Likewise, there was a unidirectional causal association between SD and ICT and human capital, from URB to sustainable development, urbanization to trade openness, and human capital to GDP.

Table 8. Causality analysis.

Null Hypothesis	W-Stat	Z-Stat	Prob.	Causality
SD >> LTO	7.2351	4.7896	0.000	Bi-directional
LTO >> SD	10.245	5.7412	0.001	
SD >> LICT	1.7456	0.85412	0.999	Uni-Directional
LICT >> SD	5.8796	2.8745	0.000	
SD >> LHC	2.4563	1.0456	0.223	Uni-Directional
LHC >> SD	6.2258	3.4569	0.005	
SD >> LGDP	5.3641	3.4789	0.001	Bi-directional
LGDP >> SD	7.2224	4.8512	0.000	
SD >> LURB	1.9987	0.1285	0.095	Uni-Directional
LURB >> SD	4.2563	2.4125	0.000	
LTO >> LICT	2.8965	1.8542	0.885	Neutral
LICT >> LTO	1.4446	0.9963	0.123	
LTO >> LHC	3.5698	1.8547	0.074	Neutral
LHC >> LTO	1.6354	0.4178	0.111	
LTO >> LGDP	5.8852	2.1115	0.001	Bi-directional
LGDP >> LTO	7.5412	4.5462	0.000	
LTO >> LURB	1.2569	0.5214	0.325	Uni-Directional
LURB >> LTO	3.8562	1.7789	0.001	
LICT >> LHC	5.2365	2.8745	0.000	Bi-directional
LHC >> LICT	7.9961	4.2256	0.006	
LICT >> LGDP	6.1124	4.5523	0.001	Bi-directional
LGDP >> LICT	5.4895	3.7845	0.000	
LICT >> LURB	1.8542	0.5567	0.224	Neutral
LURB >> LICT	2.5596	1.0963	0.536	
LHC >> LGDP	8.5261	4.2589	0.002	Uni-directional
LGDP >> LHC	3.6589	1.8791	0.063	
LHC >> LURB	6.8546	2.8569	0.000	Bi-directional
LURB >> LHC	4.1254	2.0214	0.000	
LGDP >> LURB	5.2569	3.7852	0.000	Bi-directional
LURB >> LGDP	3.8512	2.1287	0.000	

5. Conclusions and Policy Recommendations

This study evaluated the effects of ICT, open economy, human resources, economic growth, and urbanization on sustainable growth by focusing on the 10 RCER economies. Because previous studies failed to account for the possibility of CSD, our results indicate that estimates from prior studies showing a long-term nexus should be interpreted cautiously. This is because our findings suggest that the possibility of CSD exists. Similarly, this study uses the D-CCE and IFE economies to analyze the long-term impact, and it has obtained reliable results. As a result of the findings of our long-run estimation, we have discovered the positive effect of economic growth on SDI; consequently, the long-run environmental effect of GDP is beneficial in the chosen panel. The findings also showed that openness to trade and the use of ICT are both factors that contribute to an increasing SDI. We also discovered that there is a negative correlation between the rate of urbanization and SDI. The

most recent D-H panel study also applied the causality test to check for a causal association between the variables.

While it is important to recall the negative influence that open trade can have on an ecological footprint, it is also important to create jobs. The political leaders of these countries should look to international commerce as a means to preserve the quality of the environment to be successful. Smaller players in the industry may not be able to develop endogenously clean production processes, so international trade may be used to import cleaner technologies that those smaller-scale players can use. As a result, participants at all levels of the industry will have ample time to develop their own environmentally friendly production processes while also benefiting from imported technology's advantages during development. In this way, open trade can not only help reduce carbon emissions but also give these countries the time they need to develop cleaner production methods at home and alternative energy sources that will raise the overall level of sustainable development. In this way, open trade can help reduce carbon emissions while giving these countries the time they need.

According to the implications drawn from all of the findings, only a select number of economies are capable of providing sustainability while also experiencing economic growth [78]. As a result, these nations should strengthen some environmental regulatory standards, particularly those regarding renewable energy technologies. The introduction of environmental taxes, the elimination of harmful subsidies, and the delineation of public property rights could be the focus of these regulatory actions. Internalizing the detrimental environmental externalities that are a direct result of human activities is one of the primary goals of the regulatory enforcements that are being carried out. While the regulatory standards are being improved, policymakers should also consider ensuring that the regulations are followed. Raising environmental consciousness among the general public is one way to achieve this goal. For this reason, governments in these countries should support the public–private partnerships that have been formed. Depending on the outcomes of these partnerships, the target countries may be able to achieve the Sustainable Development Goals [79].

The chosen economies should keep working together to implement joint policies on sustainable production and consumption, as well as the growth of the information and communications technology sector and the cultivation of human capital. Because agriculture and industry are the region's two most important economic activities, recent decades have seen a rise in economic activity, which has led to serious environmental problems. Additionally, these activities strain an already overburdened energy demand dominated by fossil fuels, which can lead to additional carbon emissions. According to UNFCCC and the Kyoto Protocol, the concerned economies have supported climate change issues. Still, the latest coronavirus pandemic has also shown that increased online activities can reduce carbon emissions significantly. This is true despite adherence to the Kyoto Protocol and the UN Framework Convention. If all economic activity were halted, the findings suggest that increasing human capital in the information and communications technology (ICT) sector could reduce carbon emissions.

Additionally, we believe there are promising avenues for further investigation into the role that social entrepreneurs, technologies, and organizational aspects play in creating, delivering, and capturing value in sustainable development. Researchers expect to conduct these investigations in the future. Sustainable development can be seen as a hybrid process because it incorporates a variety of logic and objectives, some of which are in direct opposition to one another. A focus on social entrepreneurship and other aspects of sustainable development should be investigated in future studies. While social entrepreneurship has been hailed as a powerful tool for alleviating poverty and bringing about institutional change [74], the literature could not find any hard, lone examples of social entrepreneurship accomplishing either of those goals. According to this definition, most studies focus on one level of analysis at a time. Although social entrepreneurship is a multifaceted phenomenon, it is difficult to understand the findings of the studies conducted at only one of these levels.

Since research studies at only one level can be risky, the findings of social entrepreneurial studies can be difficult to understand.

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