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Is Sustainable Economic Development Possible Thanks to the Deployment of ICT?

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Abstract: Achieving sustainable economic development is one of humanity's greatest challenges, and, in this regard, the United Nations has promoted a line of research based on sustainable economic development. In view of this, our study focused on the sustainable economic development of nations, specifically, development through the deployment of information and communication technologies (ICTs). Academic researchers recognize the importance of ICT for economic and sustainable development, but there is controversy in the literature regarding two opposing points of view. First, there is a view that advances in ICT support Gross Domestic Product (GDP) growth, while, on the other hand, the view is that there is no relationship between these two factors. In view of this, we conducted a study where the objective was to determine whether investing in ICT contributes to sustainable economic development (measured by the GDP per capita) of European Union countries. We used Eurostat data and applied the partial least-squares (PLS) method to address the study. This approach allowed us to analyze European Union countries from 2014 to 2017, using fairly rigorous data. The most outstanding result was that ICT accounted for most of the explained variance in GDP per capita (GDPpp), and, specifically, the most representative indicator was "digital public services." Therefore, we concluded that investing in the deployment of ICT supports the sustainable economic development of European Union countries. These countries should focus on investing in improved connectivity in areas with poor communications, as well as in training area inhabitants in the use and development of ICT to obtain greater development using these tools and technologies.

Keywords: ICT; sustainable development; GDPpp; European Union; PLS

1. Introduction

Information and communication technologies (ICTs) are essential for reducing poverty, improving health and education services, and creating income sources for the most disadvantaged. Thus, the role of these technologies is to drive economic development and to enhance social development and the promotion of human rights and democracy [1].

The literature reveals a trend toward promoting sustaining consumption or per capita income that does not decrease over time, and this is called the weak sustainability approach [2–6]. Some authors have included the criterion of equity in distribution under this concept [7]. However, this approach promulgates maintaining the reproductive capacity of the economic system, with the aim of sustaining growth rates in GDP per capita.

Anand and Sen [8,9] share Solow's point of view, which states that sustainability is a matter of equity in distribution, i.e., it is about sharing well-being between people of the present and those of the future. The authors agree that keeping productive capacity intact is not the same as leaving the planet as it is today. Given this, we need to preserve the opportunities of future generations.

However, according to the works of Hartwick [10,11] and Hanley [12], the environmentally adjusted gross domestic product is a good measure of sustainable development. It is useful when all the elements are valued correctly and when it is based on the economic situation of the moment. The assessment is also accurate for future predictions that relieve shortages in the coming periods, and the depreciation of natural capital is considered. In this way, an economy is deemed sustainable if this value does not decrease.

Along these lines, the UN generated a set of "Sustainable Development Indicators" [13]. Within these indicators, we find an economic block, and, within this block, we find the gross domestic product per capita (GDPpp) [13] (p. 15) as a descriptor of sustainable development [14].

If we focus on the GDP per capita, we must comment that the existing literature has identified a link between the GDPpp and ICT [15–17]. As a result, the effect of deploying ICT provides support for the economic development of nations [18,19], and some specific authors indicate that investments in ICT boost productivity [20,21].

To examine the influence of ICT on sustainable economic growth, several existing studies have been based on the exogenous growth model [22,23].

On the contrary, there is another line of thinking that questions the positive associations between ICT and economic performance. Although most of the research that studies the link between ICT and economic growth suggests a positive relationship, other studies have reported null relationships in terms of significance [24–28]. Thus, the results are far from homogeneous.

Therefore, given the research problem posed by the lack of consensus in the literature regarding the impact of ICT on economic growth [27], and the need for sustainable economic development over time, we consider it appropriate to ask the following research question: Does the deployment of ICT positively influence the economic development of countries through GDP growth per capita? To answer this research question, we analyzed the impact of ICT on the growth in GDP per capita of European Union countries.

To achieve our objective, we measured the use of ICT using data provided by Eurostat. The use of this base is appropriate for two reasons. First, it consists of a large number of indicators, so it is not only a means to verify the possible existence of the effect of ICT on economic growth, but it also makes it possible to arrange the group of ICT indicators that contribute most to the economic development of nations. This allowed us to predict whether the five constructs analyzed provide a positive variance, which is the most outstanding result. From the results, "digital public services" had the greatest impact on the development of GDP per capita. Therefore, it is the one with the highest impact on economic development.

Next, we will present the theoretical framework, the empirical framework, the results, a discussion of the results, and, lastly, the conclusions, limitations, and future lines of research.

2. Theoretical Framework

We will begin by examining the concept of the United Nations Commission on Sustainable Development (UNCSD). First, we must indicate that the UNCSD defines sustainable development as "development that meets current needs without compromising the ability of future generations to meet their own needs" [13].

However, the most widespread definition of "sustainable development" is the one from the Brudtland Commission [29] (p. 8), which defines it as "progress that meets current needs without compromising the ability of future generations to meet their own needs."

Additionally, Reference [30] defines the concept of "sustainable development" as the persistence of the integrity and structure of a system over time.

For us, the key point on which this research was based is the "weak sustainability" approach initiated by Reference [9], which notes that "sustainable development" should not let consumption or per capita income decrease over time [2–6,8,9], with equal distribution provided among the population [7].

Thus, in 1995, the United Nations Commission on Sustainable Development approved the Work Program on Sustainable Development Indicators, and the result was the Sustainable Development Indicators Chart [13]. In this report, we find the GDP per capita to be an indicator of Sustainable Development, belonging to the Economic Activity sub-theme, which falls within the Economic Structure Theme [13,14] (p. 15), (p. 223) and allows us to focus our research on the development of this indicator.

2.1. ICT and Sustainable Environment

As indicated in the introduction, international organizations such as the Organisation for Economic Co-operation and Development (OECD) assign a decisive role to ICT in achieving sustainable development, especially to reduce poverty and to promote social equality and democracy [1].

From a more academic point of view, it is possible to find researchers who stress the importance of ICT to achieve sustainable growth objectives. For example, Bhujabal & Sethi (2019) [31] (pp. 1–2) point out a number of benefits derived from ICT, among which we highlight: (a) global integration, which allows developing countries to adopt and benefit from the technologies of developed countries, (b) the ability of these technologies to overcome both geographical and cultural barriers, which promotes convergence between advanced and non-advanced economies, (c) promotion of government transparency by reducing corruption, and (d) access to new opportunities and information for the population.

Along the same lines, Toader, Firtescu, Roman, and Anton [32] identify a number of investigations that show the positive impacts of ICT on the economy as a whole. For our study, we chose those directly related to sustainable development (Table 1).

Table 1. Positive ICT impacts.

Impact of ICT on Sustainability	Author
Promotion of sustainable development of entrepreneurship and small and micro enterprises: it improves financing by reducing information asymmetry and reducing the cost of the agency.	[33]
Cohesion in regional differences.	[34]
Quick and easy access to information not only for economic agents, but also for the whole society.	[35]
Access of human capital through teleworking	[36]
Fast and effective business communication: reducing costs and increasing productivity.	[37]

Source: Toader, Firtescu, Roman, and Anton (2018) [32].

It is also possible to find examples beyond the traditional parameters such as economic development. In the field of education, Kim's work [37] emphasizes the capacity of ICT to reduce inequalities in education. Specifically, his study showed how the application of ICT was useful for reducing the gap between immigrant and non-immigrant students in the United States.

2.2. ICT and the Environment

Information and communication technologies are given key roles in the environment by some academics. These technologies are of vital importance, not only for economic growth but also for environmental sustainability, since they are capable of reducing carbon emissions [38]. By applying them, it is possible to protect the environment and to promote environmental sustainability and rural sustainable development [39]. In addition, "they have enriched people's daily lives, providing users with great freedom" [40] (p. 16).

An example of the importance that researchers give to ICT regarding sustainability is shown in studies that have defined particular theoretical frameworks on ICT, whose objective is to achieve sustainable development [41].

However, the impact of information and communication technologies is not absolutely positive. In this sense, some academics assume a dual classification to describe the environmental effects of ICT. These effects can be direct and indirect [42,43]. The direct effects, which are also called first-order effects, are related to the demand for materials and energy throughout the life cycle of the ICT product [44]. The direct effects refer to the resources used, the emissions caused by the production, and the use and disposal of ICT products [42]. Indirect effects, or second-order effects, reflect the result of applying ICT in other dimensions that involve environmental changes, such as changes in consumption [45,46]. One example of discussion generated by the environmental impact of ICT is found in Truby [47], where the author focuses on Bitcoin technology.

In any case, we find several empirical works that highlight the importance of ICT regarding sustainability. For example, the work of Batool et al. [38], focused on the South Korean economy, argues that ICT helps reduce environmental degradation over the medium and long-term. In his research on ICT and environmental protection, Ruth [48] concluded that it would be appropriate to adopt ICT to create green environments, which would result in reducing carbon emissions. This author based his work on the fact that ICT is essential for sectors related to waste processing, smart networks, or big data software. Moyer and Hughes [49] proposed the development of ICT infrastructures with the objective of reducing the cost of renewable energies and whose expected result would be a positive impact in terms of emissions. Therefore, with this measure, they predicted that total carbon emissions would be reduced in the long term (50 years according to their estimates). Jacob [50] studied the relationship between cities, climate change, and ICT. This author pointed out various concepts related to ICT as fundamental factors for reducing emissions, including smart logistics practices, smart buildings, and smart supply networks. Shabanpour, Golshani, Tayarani, Auld, and Mohammadian [51] explored the potential of teleworking in the city of Chicago by concluding that it can be a useful tool, not only for reducing traffic congestion in cities, but also for mitigating vehicle emissions. In the same line, Giovanis [52], in his Switzerland study during the period of 2002–2013, established that teleworking can be a tool that reduces traffic volume and improves air quality. Asongua, Rouxa, and Biekpeb [53] assessed the impact of ICT together with CO^2 emissions on inclusive human development in a study of 44 countries in sub-Saharan Africa during the years of 2000–2012. His research suggested that ICT can be used to mitigate environmental pollution in human development.

But how can ICT favor sustainable development? Batool et al. [38] (p. 25343) explained different ways in which ICT favors sustainability, and we can highlight the following as examples: (a) information systems [54], (b) big data applications [55], (c) energy efficiency and waste management [56], (d) sustainable smart cities [57], (e) low-carbon emissions [58], and (f) climate change education [59]. On the other hand, Andreopoulou [39] (pp. 2–3) identified four dimensions through which ICT promotes environmental sustainability: first, the reduction of emissions by applying ICT that optimizes energy use; second, an increase in environmental awareness through information dissemination, training, and education; third, through effective communication for environmental projects and networks; and, lastly, through sustainable environmental governance. This concept consists of promoting citizen participation in decision-making, which also motivates governments to be more responsible, transparent, and effective.

2.3. Growth Theories and ICT

Within this framework, researchers have linked ICT and economic growth, mainly based on the Exogenous Theory [19–21,60].

The scientific literature outlines the different means by which ICT generates economic growth and highlights the direct effects, which usually refer to productivity improvements, that arise explicitly from applying ICT [20,21,61–65].

On the contrary, we find authors who question the existence of a relationship between ICT and economic development [66–69].

In this study, we focused on whether the deployment of different ICT components was a realistic alternative to achieve sustainable economic development (measured by the GDPpp). Therefore, we find ourselves within the group of authors who claim that ICT improves economic development, and we propose the following hypotheses.

To study our objective, we established the general hypothesis that ICT influences sustainable economic growth. In this sense, we used the methodology of the European commission to measure ICT. Because ICT consists of five constructs in our methodology (connectivity, human capital, use of Internet, technological integration, and public services), we established a hypothesis for each of them.

Hypothesis 1: *There is a causal and positive relationship between connectivity and economic development.*

Hypothesis 2: *There is a causal and positive relationship between ICT Human Capital and economic development.*

Hypothesis 3: *There is a causal and positive relationship between the Use of Internet and economic development.*

Hypothesis 4: *There is a causal and positive relationship between Technological Integration and economic development.*

Hypothesis 5: *There is a causal and positive relationship between Digital Public Services and economic development.*

3. Empirical Framework

First, we will present the data used in the field study, and, then, we present the statistical technique used to test the hypotheses proposed in the theoretical section. The broad set of indicators used to measure ICT was grouped into five constructs (connectivity, human capital, use of Internet, technological integration, and public services) from the European Commission (see Appendix A). The variable used to measure economic development is GDP per capita, which was all obtained from Eurostat.

We considered that the variables of the model were COMPOSITE analyzed since they represent theoretical concepts that are measured through observable variables. In this case, authors such as Rigdon et al. [70] and Hair et al. [71] indicate the use of PLS for composite variables. In addition to carrying out the analysis, secondary or archival data were used. In this case, authors such as Gefen, Rigdon, and Straub [72] and Rigdon [73] justify the use of this technique.

Thus, the period analyzed was from 2014 to 2017, which gave rise to a sample of 112 cases that was used to build the data pool, where the sample unit is a country in a specific year.

The study was carried out in a European region. Therefore, the number of countries analyzed was not very large, which is why it can be considered that a small sample size has been used. In this case, the recommendations followed for this type of analysis were those by authors such as Richter et al. [74].

In addition, we eliminated indicators that had more than 15% of lost data, which complies with the above limitations, and the number of cases also comprised the entire sample [75].

Once we reached this point, and because the characteristics of our variables were continuous and secondary, the use of Partial Least-Squares (PLS) was considered appropriate [76–80].

Although the objective of the work analyzes the influence of some variables on the GDP, this tool enabled us to determine those variables that could predict the dependent construct. In this case, we wanted to identify the drivers of GDP behavior. Following Shmueli et al. [80] and Hair et al. [71], PLS supports predictive analysis. Predictive research will help us to carry out new observations at different moments in time and to be able to compare with the current results.

The structural equations approach allows us to test the hypotheses and, in addition, to analyze the contribution of each of the ICT constructs for economic development, which is why we provided a confirmatory analysis [72,73,75]. In short, the chosen technique will allow us to assess both the measurement model and the structural model in a unique, systematic, and integrative way with variance-based methods [72,81].

Lastly, SmartPLS was used (version 3.2.8) to predict latent variables based on the estimation of ordinary least-squares and principal component analyses. Thus, a causal-predictive analysis in complex situations was carried out, but only after obtaining theoretical information, such as in our case [75–84].

4. Results

To test the hypotheses using PLS, we conducted the study in three phases. First, we made an overall outline of the model. Second, we assessed the measurement model, in which we refined the indicators. Lastly, we assessed the structural model together by testing our hypotheses.

We started with a conceptual model (Figure 1) whose aim was to outline the indicators that made up the constructs of the overall model.

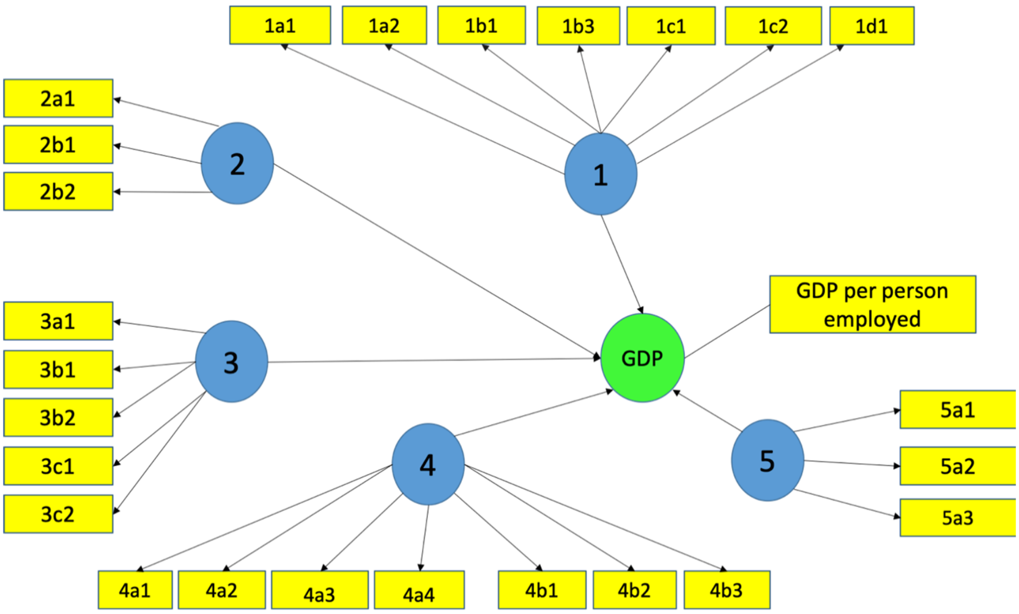

Figure 1. Initial Model. Source: Own elaboration based on data obtained with SmartPLS software.

Regarding the evaluation of constructs, they were all of quality, and once the indicators with the lowest scores were refined, the results were consistent (see Table 2).

Table 2. Construct reliability and validity.

Reflective Construct	Cronbach's Alpha	Rho_A	Composite Reliability	Average Variance Extracted	Discriminant Validity
1_Connectivity	0.644	0.693	0.781	0.549	YES
2_Human Capital	0.915	1.043	0.957	0.918	YES
3_Use of Internet	1	1	1	1	YES
4_Tech. Integration	0.666	0.738	0.806	0.585	YES
5_Dig. Pub Services	0.827	1.080	0.867	0.692	YES
GDP			1		YES

Source: Own elaboration based on SmartPLS.

After having evaluated the constructs of the proposed model with SmartPLS, and having eliminated the indicators that did not meet the SmartPLS quality criteria (see Table 3), we proceeded to analyze the significance of the proposed hypotheses.

Table 3. Parametric values justification.

Analysis	Parameter	Values Higher Than	Justification
Individual reliability	Loadings	0.4	[84,85]
Construct reliability	Cronbach´s Alpha	0.7	[86]
	rho_A	0.7	[87]
	Composite Reliability	0.6	[86,88]
Convergent validity	Average variance extracted (AVE)	0.5	[89,90]
Discriminant validity	It compares the AVE with the correlations between constructs	AVE > Correlations	[84,90]
	Heterotrait-monotrait ratio (HTMT)	0.85	[77]

Source: own elaboration based on Fernández-Portillo et al. (2016) [91], Fernández-Portillo et al. (2018) [92] Robina-Ramírez, Fernández-Portillo, and Díaz-Casero (2019) [93].

To test the hypotheses, we performed bootstrapping of 10,000 iterations. However, to validate a hypothesis, the sign of the path coefficient must be positive, which indicates that the results have the same direction as the hypothesis proposed. There is statistical significance measured by the t coefficient, and that confidence intervals do not contain zero (see Table 4).

Table 4. Results of hypothesis testing using the PLS technique.

Hypothesis	Evaluation	Confidence Level	*t*-Statistic	Path Coefficient
1_Connectivity → GDP	Accepted	Yes	3.110 (***)	Yes (0.358)
2_Human Capital → GDP	Accepted	Yes	4.037 (***)	Yes (0.367)
3_Use of Internet → GDP	Accepted	Yes	3.272 (***)	Yes (0.188)
4_Tech. Integration → GDP	Rejected	Yes	2.691 (***)	No (–0.366)
5_Dig. Pub Services → GDP	Rejected	Yes	5.632 (***)	No (–0.436)

*** p (0.01), ** p (0.05), *p (0.1). One-tailed Student's t test. Source: Own elaboration based on data obtained with SmartPLS.

Once the sample was analyzed, the hypotheses were tested and the model was validated (see Figure 2) by following the corresponding guidelines set by the PLS technique.

The results of the analysis indicated that hypotheses 1, 2, and 3 were accepted, with levels higher than 99% (see Table 4). Therefore, we can say that connectivity, human capital, and the use of the Internet had positive influences on GDP development, as seen through an improvement in GDP per capita. On the contrary, hypotheses 4 and 5, which refer to technological integration and the use of digital public services, were rejected. In this case, the reason for rejection was that the path coefficient was negative, even though the relationship was significant. This indicates the existence of a GDP relationship, which, while it could be interpreted as negative, when analyzing the correlation and the impact of the variance explained for each exogenous construct on the dependent construct (see Table 4), we can see that the contribution of both hypotheses to the GDP is positive. Digital public services contributed most to the explained variance of the model, which reached a value of 14.26%. Therefore, it should be studied in greater depth in future research. In addition, we can say that this model contained 42.6% of the explained variance of the GDP, corresponding, in this case, to ICT development. The value of R^2 was considered moderate, being between 0.33 and 0.67 [83]. In addition, the predictive capacity of the model was high at 0.359 [83].

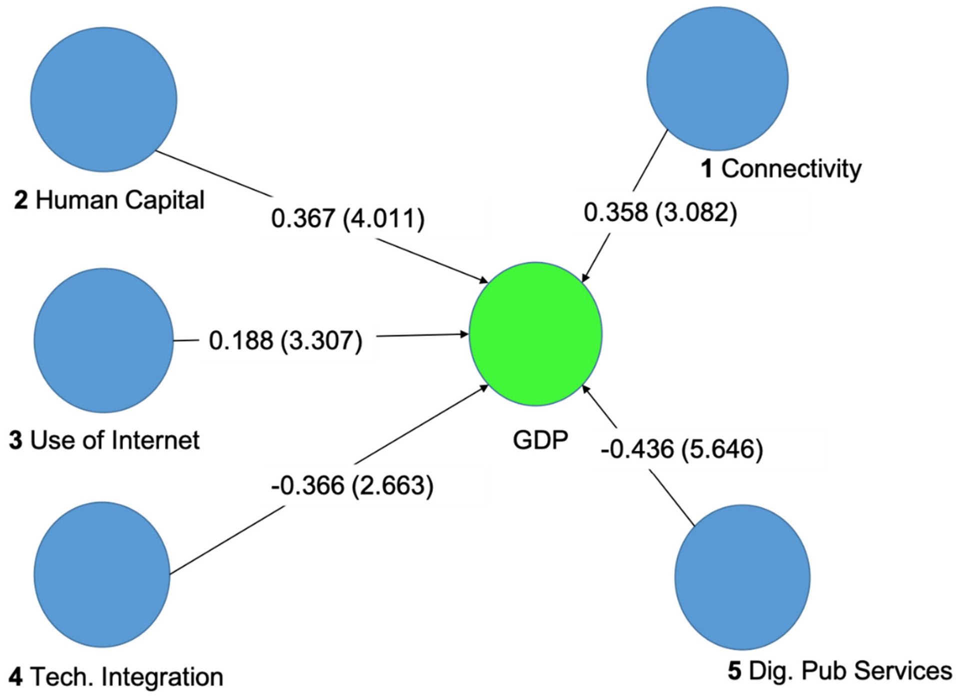

Figure 2. The resulting model of the empirical study. Source: Own elaboration based on data obtained with SmartPLS.

Lastly, in Table 5, we can see the breakdown of the explained variance, the correlation between the constructs, and the results of the predictive relevance. In the case of this last parameter, according to Reference [94], a value of 0.359 was reached, which was an average value (Q2 > 0.25 y Q2 < 0.5).

Table 5. Evaluation of the R^2 level of the model.

Hypothesis	R^2	Q^2	Path	Correlation	Variance Explained
H1_Connectivity→GDP			0.358	0.305	10.92%
H2_Human Capital→GDP			0.367	0.224	8.22%
H3_Use of Internet→GDP			0.188	0.205	3.85%
H4_Tech. Integration→GDP			–0.366	–0.146	5.34%
H5_Dig. Pub. Services→GDP			–0.436	–0.327	14.26%
ICT	**0.426**	**0.359**			

Source: own elaboration.

5. Discussion

The scientific literature has questioned the impact of ICT on economic growth. In our study, we analyzed the impact of these technologies on sustainable economic growth measured by GDPpp. In this sense, we must emphasize that, contrary to authors who question the existence of a relationship between ICT and economic development [25,27,28], the most outstanding result shown in our study was that the five constructs analyzed provided a positive variance on the economic development of countries. Therefore, our results are aligned with research reporting that ICT generates economic growth in such a way that it improves productivity [20,61–64].

If we focus on the results obtained by each construct and hypothesis proposed, we see that hypotheses 1, 2, and 3, which refer to Connectivity, Human Capital, and the Use of Internet, respectively, were accepted with levels higher than 99%. Therefore, they have a positive influence on the economic development of countries. In addition, we can conclude that Connectivity contributed 10.92% of the explained variance of the GDP per capita, and Human Capital related to ICT contributed 8.22%. This is a clear indicator that countries that want to promote sustainable economic development must invest in improving connectivity in the most isolated areas and train their inhabitants how to use and develop ICT. On the contrary, hypotheses 4 and 5, which refer to technological integration and the use of digital public services, were rejected. However, this should be a motive for future research because the Student T test values were considered significant, and so is the impact from the explained variance. Thus, we see that the contribution to GDP of both constructs is positive. In this sense, and coinciding with the line marked by Kemp, Parto, and Gibson [93], it is necessary to indicate that digital public services was the construct that generated the highest contribution to the explained variance of the model, where it reached a value of 14.26%. Therefore, this should be studied in detail because this construct is directly controlled by the public administrations of countries. It is the indicator that is the easiest to enhance a priori by administrations in order to improve the sustainable economic development of a country.

Regarding the environmental impact of these technologies, as indicated in the theoretical framework, there is scientific debate over the costs and benefits of the generation and application of these technologies on the environment. It was not the objective of our research to study this environmental impact, but we consider it appropriate to comment on this controversy.

6. Conclusions

This paper analyzed the impact of ICT on sustainable economic development (measured by the GDPpp). For this purpose, a study of European economies was carried out from 2014 to 2017. The main conclusion of our investigation is that the deployment of ICT can help realize sustainable economic development, at least within the European Union.

If we focus on the constructs analyzed, administrations should place special emphasis on opting for digital administration, which is followed by investment in connectivity and training in the area of ICT. Consequently, ICT offers countries a great opportunity to achieve sustainable economic development over time. In short, we can say that connectivity, human capital, and the use of the Internet positively influenced GDP development.

In addition, it is necessary to highlight that the "digital public services" construct was most representative of the variance, which reached a value of 14.26%. In this sense, the proposed model represents 42.6% of the explained variance of GDP per capita, which reached a level described by the statistical technique theory as moderate.

In short, as the most outstanding result, it is necessary to emphasize that the five constructs analyzed provide positive variances. Countries that want to promote sustainable economic development must invest in improving connectivity in the most isolated areas, and in training their population in the use and development of ICT, to obtain maximum performance from these tools and technologies.

On the contrary, relationships regarding the digital administration and technological integration with ICT have not been validated in our study, and these should be evaluated in alternative studies.

The main contribution of our study is the proposal of a structural model that shows the causal relationships between ICT variables and GDP. The model allows new variables to be incorporated into the proposed model in future studies by using the PLS technique.

As a limitation of this work, we can highlight that our sample was at the country level. It would be interesting to carry out the same study by analyzing the regions that make up the countries and, thus, compare the results of the less-developed regions with the more-developed ones.

Another limitation of our study is that it does not analyze the environmental impact of ICT, and the results and conclusions should be interpreted under a weak sustainability approach (measured by the GDPpp).

With regard to future research, several studies can be carried out once we know in which aspects it would be interesting for more information to be collected and, therefore, studied. Therefore, we propose the following.

- It would be interesting to investigate in-depth the reasons why hypotheses 4 and 5 obtained a negative path when applying the PLS algorithm.

- Lastly, it would be interesting to carry out the study at the regional level, by comparing the results of less-developed regions with more-developed regions to see if they contribute to sustainable development.

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Appendix A

Table A1. ICT variables from the European Commission.

CODE	DIMENSION/SUBCATEGORY/INDICATOR
1	**CONNECTIVITY**
1a	**Fixed broadband Allocated spectrum for wireless broadband in EU harmonized bands Speed**
1a1	Full standard broadband coverage
1a2	Households with fixed broadband access
1b	**Mobile bandwidth**
1b1	Penetration of active mobile broadband users
1b3	Spectrum allocated to wireless broadband in EU harmonized bands
1c	**Speed**
1c1	Full broadband coverage of new generation access
1c2	Subscriptions of fixed broadband with speed >=30 Mbps
1d	**Affordability**
1d1	Monthly Internet access rate with download speed above 12 and up to 30 Mbps (internet only)
2	**HUMAN CAPITAL**
2a	**Basic skills and use**
2a1	Individuals who use Internet regularly
2a2	Individuals with basic or above basic digital skills
2b	**Advanced skills and development**
2b1	Employed people with ICT specialist skills
2b2	Tertiary graduates in Science and Technology
3	**USE OF INTERNET**
3a	**Content**
3a1	Individuals who use the Internet to read online newspapers/magazines
3a2	Individuals who use the Internet to play or download games, images, films, or music
3a3	Households subscribed to some form of video-on-demand

Table A1. *Cont.*

CODE	DIMENSION/SUBCATEGORY/INDICATOR
3b	**Communication**
3b1	Individuals who use the Internet to make video calls
3b2	Individuals who use the Internet to participate in social networks
3c	**Transactions**
3c1	Individuals who use the Internet for Internet banking
3c2	Individuals who use the Internet to order goods and services
4	**TECHNOLOGICAL INTEGRATION**
4a	**Digitalization of companies**
4a1	Companies that have enterprise resource planning (ERP) software packages to share information between different functional areas
4a2	Companies that use radio frequency identification technology (RFID) as part of the production and service delivery process
4a3	Companies that use two or more of the following social media: social networks, blog or micro blog of the company, websites for sharing multimedia content, and knowledge-sharing tools based on wiki
4a4	Companies that send electronic invoices corresponding to the appropriate format for automatic processing
4a5	Companies that buy medium-high satisfaction cloud computing services
4b	**E-commerce**
4b1	SMEs that sell at least 1% of total sales online
4b2	Total electronic sales by SMEs, as a percentage of their total turnover
4b3	Companies that have made electronic sales to other EU countries different to theirs
5	**DIGITAL PUBLIC SERVICES**
5a	**E-government**
5a1	Individuals who use the Internet to deal with public authorities, broken down by the purpose of submitting completed forms
5a2	Amount of data that is previously filled in the online Public Services forms
5a3	Degree of completion of online services, assessment from 0 to 100
5a4	Marking of information of the public sector

Source: European Commission (2018) [95].

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