

Article

Assessing the Impact of ICT Sector on Sustainable Development in the European Union: An Empirical Analysis Using Panel Data

Sorin-Iulian Cioacă ^{1,*}, Silvia-Elena Cristache ², Mariana Vuță ³, Erika Marin ² and Mihai Vuță ⁴

¹ Department of Money and Banking, the Bucharest University of Economic Studies, 010961 Bucharest, Romania

² Department of Statistics and Econometrics, the Bucharest University of Economic Studies, 010552 Bucharest, Romania; csilvia2005@yahoo.com (S.-E.C.); erika.marin@csie.ase.ro (E.M.)

³ Department of Finance, the Bucharest University of Economic Studies, 010961 Bucharest, Romania; vuta.mariana@fin.ase.ro

⁴ Department of Accounting and Auditing, the Bucharest University of Economic Studies, 010374 Bucharest, Romania; mihai.vuta@cig.ase.ro

* Correspondence: sorin.cioaca@fin.ase.ro; Tel.: +40-753-030-409

Received: 29 November 2019; Accepted: 8 January 2020; Published: 13 January 2020



Abstract: Information and communication technologies (ICT) play a central role at the European level because it fosters innovation and increases productivity through an enlarged access to information. As such, the main objective of this work was to assess the impact of various ICT core indicators at the European Union level on two of their sustainable development goals: economic growth and reduction of inequality. To this purpose, we used panel data models based on data collected from the Eurostat database. We proposed two panel data regression models, according to which we found a positive statistically significant relationship between the variable measuring level of internet access and change in GDP per capita. We also found a negative relationship between the transition towards a digital society and the dependent variable INEQ_INC, namely an increase of 1% of ICT sector share in GDP will lead to a decrease of 0.27% of income inequality distribution. This result showed that the progress made in implementing a digital society may decrease societal income inequality.

Keywords: sustainable development; income inequality distribution; information and communication technologies; internet access level; sustainable development goals

1. Introduction

From an integrated perspective, the sustainable development concept encompasses the complex development of society from several perspectives: economic, social, ecological, political, cultural, spiritual, etc. All these components are essential facets of the 2020 EU Development Strategy [1], which aims to achieve smart, sustainable, and inclusive growth at the European Union level.

One of the most cited general definitions of the sustainable development concept is provided by the Brundtland Report [2] of the World Commission on Environment and Development: “Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. The Brundtland Commission and the Rio Conference considered introducing a new vision in relation to resources, in the sense of replacing the concept of gross national product with “green national product”. This vision, according to the Brundtland Commission and the Rio Conference, has the effect of reducing inequality in terms of equitable return of vital resources between developed and underdeveloped countries. However, a distinction must be made between weak and strong durability. Poor sustainability was highlighted in relation to total

capital. Thus, it was assumed that the potential social welfare resulting from the total capital has not decreased. This welfare was not only limited to maintaining at least a constant level of consumption, but also included the values of life, heritage, and regeneration of the environment. Strong sustainability means stopping any future growth at the economic level: zero population growth and zero economic growth. Strong sustainability maintains the structure and functions of the ecosystem, its integrity, and corresponds to the precautionary principle [3].

According to Silvestri [4], the sustainable development concept also has limits derived from the current technological and societal environment. In this context, at the European Union level appears the need for an information society, which promotes innovation and increased productivity by wider and better-quality access to information.

Through its Action Plan [5], the European Union committed to develop capacity and expertise in the main digital technologies, such as connectivity, Internet of Things, cyber-security, block-chain or high-frequency computation, as well as considering the occurrence of potentially negative externalities associated with digital infrastructure, for them all to lead to the sustainable development of European countries from a technological, economic, and social perspective. Recognizing the benefits for the society and economy induced by the information and communication technologies (ICT) sector and by the internet, the European Commission launched the Digital Agenda for Europe [6] in 2010, emphasizing a set of actions aimed to increase the role of digital technologies in the sustainable development of Europe. The main objective of our paper was to determine the impact of the development of the ICT sector at the European level on the sustainable development goals (SDG) that they consider: promoting inclusive and sustainable economic growth, and reducing inequality within and between countries. Moreover, the sustainable development goals were adopted in 2015 [7] by all United Nations member states with an ambitious and common goal of reducing poverty, protecting the planet, and ensuring that all the people enjoy peace and prosperity by 2030. From the 17 integrated goals, in this article, we considered goals eight and ten [7] stated above.

At the European Union level, data collected by Eurostat showed that there are some countries (Finland, Cyprus, Italy, Greece) where GDP per capita decreased in 2018 compared to 2008 (see Figure 1).

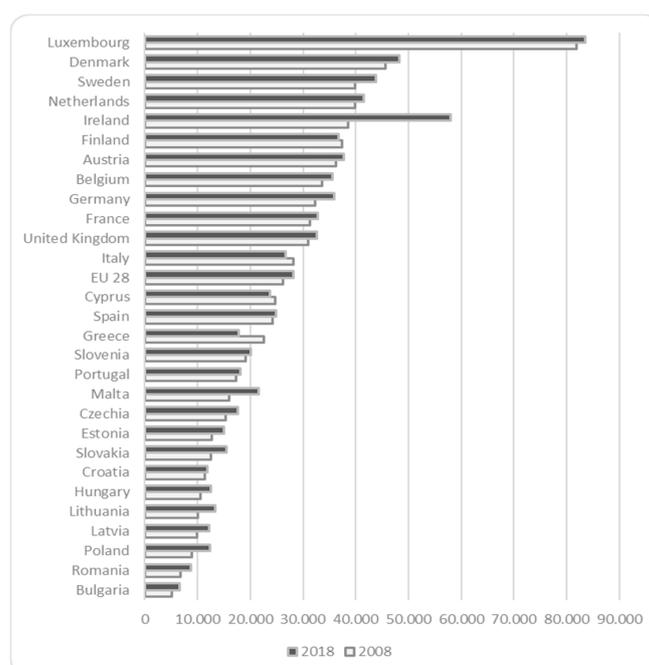


Figure 1. Real GDP per capita, chain-linked volumes (2010), euro per capita (on x-axis). Source: Eurostat [8].

Considering goal eight from the SDG, sustainable economic growth is achieved as a result of companies' efforts to assure decent work conditions that stimulate the economy, in an environmentally friendly manner. Also, good work opportunities and decent work conditions are also important for the labor force in a sustainable development approach [7].

As regards to goal ten to reduce inequalities [9], it was emphasized that despite the significant progress made by the international community in reducing poverty, there are still significant disparities at the European Union level in income inequality (see Figure 2, where Croatia is not considered, because in 2008 it was not a member state of the European Union).

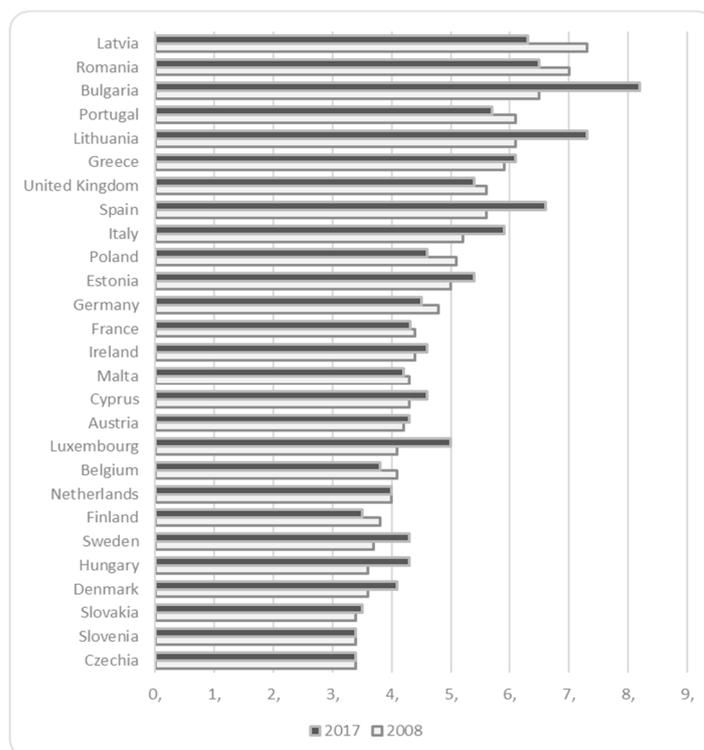


Figure 2. Income distribution, inequality of income distribution (income quintile share ratio, on x-axis are presented the scalar values of this ratio) Source: Eurostat [8].

Considering these aspects, this article emphasizes the impact of the development of the ICT sector on SDG for the European Union member states, using indicators that characterize sustainable development. We collected data from the Eurostat database [8] regarding the share of the ICT sector in GDP, level of internet access, venture capital investments, percentage change in research and development expenditures, inequality of income distribution, value added by ICT sector at current prices, percentage change of real GDP per capita, the number of companies with internet access, and the percentage of at least upper secondary educational attainment. These variables were used in panel data regression models developed using EViews [10,11]. We proposed two panel data regression models where the dependent variables are the annual change in real GDP per capita and inequality of income distribution in which independent variables characterize the development of the ICT sector. The two models considered the validation and invalidation of the research hypotheses, respectively. The research hypotheses proposed for the two models was concerned with the following aspects: the influence of the ICT sector and of the labor market on economic growth, the influence of the degree of internet access on economic growth and reduction of income inequality, and the influence of the ICT sector in reducing inequality of income distribution. Collected data covered the 2008–2018 time span for the 28 European Union member states.

The article consists of four parts: the first is dedicated to the introduction of the proposed topic, with a brief description of the ICT sector and SDG; the second part consists of a brief presentation of the conceptual framework and research methodology; the third part presents the obtained results from the panel data regression models; and the fourth part consists of conclusions, discussions, and possible future developments.

2. Conceptual Framework

2.1. Literature Review

From the economic growth perspective, digitalization—through production, communication, collection, and use of information—is considered an essential condition for sustainable economic development. Disregarding digitalization may lead to a decrease in business and, implicitly, may cause its virtual and real failure. Efforts made to attain sustainable development may be based on the use of ICT, as these technologies are less resource consuming and create jobs [12]. Also however, the ICT sector may lead, on the one hand, to economic growth, improved economic efficiency and enhanced international commerce, while on the other hand to the occurrence of social and economic problems as a result of strengthening the power of dominant companies [13–15]. Thus, at a European level, small companies face a number of difficulties in participating or creating global electronic markets. As for example, in the case of SMEs, the primary problem in achieving efficient electronic markets is the choice of specific strategies, such as strategic partnerships or arrangements regarding the division of market segments that will ensure sustainable development. That is why in model 1 we introduced the independent variable as the number of companies with internet access to see if these companies through their activities bring added value and contribute to the economic growth at a European level. Many of the studies trying to assess the ICT sector's role on economic growth used the Solow model [16], which showed that in the United States' case the economic growth from the 1919–1949 time frame was mainly generated by technology rather than by labor and capital. The impact of the ICT sector on economic growth also depends on the country's development stage, with some researchers stating that the impact is larger for developed countries when compared with less developed ones [17–20]. In the same context, other researchers [21] argue that in the new era of an information society, which is developing in Europe, scientific advancement can be seen in all activities. This has had a positive impact on the development of human society, as well as on sustainable development. These aspects are also confirmed by a number of studies conducted at the European level that emphasized the positive role and contribution of the ICT sector on development and economic growth [22–26]. However, there are also some authors that asserted that during the 2000–2005 time frame, the leverage multiplier generated by the ICT sector decreased and the growing footprint of the ICT sector on GDP only induced marginal effects on productivity in some sectors [27], which also led to the decrease of the ICT's role in economic growth [28]. The two models developed within the paper aim to introduce the percentage change of the ICT sector in GDP as an independent variable.

The European Commission included the digital economy in its 2020 Europe strategy as a main pillar for economic recovery at the European Union level. The dependent variable we used in model 1 is the change in the lognormal values of GDP per capita. Thus, Singh et al. [29] emphasized that, the existing literature focused exclusively on GDP per capita as an indicator of economic growth. It was estimated that the internet economy in the G-20 countries will double between 2012 and 2020. It was expected that this increase will be larger for developing countries, which aim to gather the benefits of broadband infrastructure investments, as was found by Czernich et al. [30] when considering 25 OECD countries during 1996–2007. In this context, in the majority of European countries it is estimated that consumption will be the main driver of internet GDP [31].

Because technological development is one of the main drivers of economic growth, the OECD [32] estimated that in Switzerland and the Czech Republic, 4% of GDP is derived from increased investments in the ICT sector, whereas in Canada, an increase of the GDP with 2.43 billion US dollars in 2016–2017

was generated by the ICT sector alongside an increase of 85,000 jobs in 2017 [33]. At the European level, investments made in the ICT sector during 2005–2010 had an impact of 1/3 from the economic growth in the European Union, compared with 1/5 in the 1995–2010 time frame [34]. This is why within the EU, programs targeting the ICT sector represent economic growth and sustainable investments. In order to increase the degree of sustainability, the financing of the ICT sector must take into account the implementation of an investment strategy that allows for the introduction of new technologies on the European market, considering that these involve major high-risk capital investments [35]. As such, in our models, one of the independent variables that was used is venture capital investments made in the ICT sector. Also, ICT sector development led to an increase in labor productivity because of robots and automated machines, and also influenced labor forces, with the negative consequences of widening social and income distribution inequalities. Using data collected from 21 OECD member states, Arntz et al. [36] showed that the risk posed by the replacement of the human labor force by automated machines was almost 9%. The risk was more present in Austria, Germany, and Spain (12%), and to a lesser extent in Finland (6%).

An analysis conducted in the European Union member states regarding the 2006–2017 time frame showed a positive impact of technological breakthroughs on social inequalities, detailing how it generates a more balanced distribution in Poland, Greece, Croatia, and Latvia, whereas in Bulgaria, Estonia, and Romania, the situation worsened [37].

The World Summit on the Information Society [11] played a crucial role in the way the United Nations incorporated the ICT sector in sustainable development initiatives, considering that unequal access to the ICT sector may cause widening economic, social, and political inequalities, leading to a weakening of the states. This opinion was also sustained by Stiglitz [38], who asserted that large income inequality also implies increased wage costs, which may harm the sustainable development process.

Information access and ICT usage may also cause increased inequality, because these concepts have very different characterizing measures between regions/segments of population [39], a fact that generates wage inequalities, as was also confirmed by Goos et al. [40] in a study regarding 16 European countries and some others [41,42] for the United States. A recent study regarding Indonesia [43] in the 2011–2016 time frame revealed that the ICT sector had a positive effect on economic growth, but also an indirect effect on the inequality of income. Considering all these aspects, we introduced the dependent variable of inequality of income distribution (as a measure of achieving goal 10 regarding the reduction of sustainable development inequalities) in model 2.

We may also point that despite the existence of worldwide and European level breakthrough technologies, the lack of qualified and specialized personnel may harm the development of the ICT sector. Access to ICT has become a necessity for both personal and professional interests. Strong knowledge of the use of computers and the internet offers greater opportunities for access to better and better paying jobs, as well as access to communication with various people in the country and abroad quickly, easily, and at lower costs. The development of the ICT sector has a strong effect on employment in the countries of the European Union, which is why we have considered it in the development of the two models. By developing this sector, the workforce at a European level will develop new skills, new specializations, and new social relations.

In this context, a measure that should be adopted in any European country regardless of its level of development is to ensure access to the internet for a large segment of the population. Therefore, as a measure to reduce disparities between member states according to the Digital Agenda for Europe, it was proposed that by 2020 at least 50% of the population should have access to the internet [44]. According to the World Bank [45], these disparities are still present as a result of a more even distribution of internet access rather than obtained revenues, a fact that was also confirmed by the results of a study conducted for a group of 60 countries in the 1995–2002 time frame by Noh and Yoo [46]. They found that internet access had negative effects on the economic growth of countries with wider inequalities of income.

Therefore, in one model we proposed a panel data regression model having the level of internet access for the European Union population as one of its independent variables. The main reason of considering this variable was the researchers' findings of a yearly increase in the number of internet users in the European Union during 2012–2018.

International studies showed that a 10% increase in GDP per capita generated a 20% increase in internet users [47], whereas a 1% increase in internet users led to a decrease in inflation by 0.42% [48]. Moreover, the more ICT technologies were used, the more economic growth occurred [49,50].

As such, we consider that the ICT sector plays an important role in attaining sustainable economic development, mainly by achieving goals 8 and 10, and has a significant impact on companies (cost reductions, increased labor productivity, easier and timely access to information), individuals, and society as a whole.

2.2. Research Methodology

In this article, we studied the interdependence between the development of knowledge intensive activities, such as information and communication technologies and measures associated with sustainable development goals using data collected from the Eurostat database for the 2008–2018 time span from the 28 European Union member states. We aimed to assess the interaction between the analyzed variables in order to get a glimpse of the effects of the ICT sector on several indicators used for evaluating the effectiveness of SDG measures.

Therefore, in this article we considered the following variables that characterize the ICT sector: percentage change of the ICT sector in gross domestic product, percentage change of value added by the ICT sector at current prices, the business expenditure on research and development, level of internet access, percentage of labor force with at least upper secondary educational attainment, and the value of venture capital investments made in the ICT sector. Of sustainable development indicators, we considered the real GDP per capita (associated to goal 8—decent work and economic growth) and inequality of income distribution (associated to goal 10—reduced inequalities). The details regarding these variables are presented in Table 1 (data were collected from EUROSTAT database [8]).

Table 1. Data description for the variables included in models.

| Variable Symbol | Variable Name | Variable Description | Measurement Unit |
|-----------------|--|---|------------------|
| D(BUS_EXPRD) | Change in business expenditure on R&D | Business expenditure on R&D. Business enterprise sector | Eur/capita |
| COL | Percentage of labor force with at least upper secondary educational attainment | Measure of human capital | % |
| ICT_GDP | Share of the ICT sector in economy | Percentage of the ICT sector in GDP | % |
| INEQ_INC | Inequality of income distribution | Income quintile share ratio | % |
| D(LNRGDP) | Change in lognormal values of real GDP per capita | Measure of the change in real GDP per capita | Scalar |
| VAL_ICT | Percentage change of value added by ICT sector at current prices | Measure of the value added by ICT sector | % |
| VEN_CAP | Venture capital investment by detailed stage of development | Percentage of GDP representing venture capital investment | % |
| EN_BRO | Enterprises with broadband access | Enterprises with broadband access—percentage of enterprises | % |
| LHO | Level of internet access | Level of internet access—households as percentage of population | % |

Abbreviations: ICT; information communication technologies. Source: Eurostat.

Moreover, in order to improve the relevance of the proposed models, we used variables to capture the possible effects of inner-existing relationships between the independent variables and the dependent variable that are also collected from the EUROSTAT database [8]. Therefore, we used instrumental variables that are aimed to control the confounding issues pertaining to the proposed relations. As such, besides the variables presented in Table 1, we also considered initial per capita income and initial real GDP per capita (expressed in logs) to control for the effect of convergence, as was previously proposed by some other researchers [51,52]. As the importance of human capital was outlined in many studies (for example, [53]), we also considered the following variable that capture characteristics of the labor market and human capital, namely the percentage of the active population with at least upper secondary educational attainment. For assessing the ICT sector, we used variables that describe the micro-components of the ICT sector, such as the extent to which internet is used by individuals (use of internet by individuals, e-government activities of individuals via websites, individuals using the internet for interaction with public authorities, and individuals using the internet for internet banking, all being expressed as percentage in population). Also, we considered company-based measures, such as enterprises with broadband access as percentage of enterprises and enterprise having received orders online (at least 1%), as a percentage of enterprises.

The development of the ICT sector is a precondition for digitalization and transition towards a digital economy at the European Union level. As such, in order to assess the ICT sector, we used the percentage change in value added by the ICT sector at current prices, expressed as percentage in total value added at factor costs and the percentage of the ICT sector in GDP [54]. We also used measures for investments made by companies in the ICT sector, namely the change in business expenditure on research and development, which was computed as the change in research and development expenditure made by business enterprises and was expressed in euro per inhabitant [55]. Moreover, we used an indicator for assessing the investments made in the ICT sector by venture capital companies, expressed in percentage of GDP [56]. We considered this variable, as the ICT sector comprises of knowledge-intensive activities, which are financially supported by a large variety of private investors (such as business angel networks, venture companies, hedge funds, foundations, high-net-worth individuals, etc.). Furthermore, this variable is a measure of investments made by private investors to foster industry innovation.

We also considered the importance of the ICT sector by assessing the results of the investments made by enterprises to implement the digitalization process as a percentage of enterprises using broadband internet access from total number of enterprises [57]. A different considered measure for the ICT sector, as a sector that supports industry innovation, is the percentage of total labor force with at least upper secondary educational attainment [58]. Moreover, as a measure for the development of the ICT sector, regarding the interaction with end-users, we used the share of the population that has an internet connection [59].

From the sustainable development indicators, we used the real GDP per capita as a measure for economic activities and for development of living standards within a country [55]. The inequality of income distribution was computed as the ratio of the total income received by the 20% of the population with the highest income and that received by the 20% of the population with the lowest income [60].

We used econometric tools provided by EViews [10] in order to estimate the relationship between the change in real GDP per capita and some determinants that characterize the ICT sector, such as the relevance of this sector within the national economies (measured by added values and share in total GDP), the investments made in the ICT sector (measured by the venture capital investments as a percentage of GDP), the research and development within the ICT sector (expressed as business expenditures on research and development), and the impact on the labor market (percentage of employees with at least upper secondary educational attainment). We also considered the interaction between measures of the ICT sector and inequality of income distribution, as an indicator associated with goal 10—reduced inequalities. The importance of the income distribution indicator derives from

the effects induced by the development of the ICT sector as a way for implementing digital society at the European Union level and what effects it may have on social inequality within the European Union.

Because the series of data related to the ICT sector are not very long, we used panel data models considering the largest time interval for which data are available at the European Union level (until 2018). The variable LNRGDP was computed using lognormal value for real GDP per capita, in order to address the potential distortions induced by different measurement scales occurring at the European Union level. We also first considered differences for variables LNRGDP and BUS_EXPRD, as was suggested by the stationarity tests made.

In order to explore the proposed relationships, we used system generalized method of moments (GMM), as econometric tools helping to solve the possible endogeneity issues pertaining to selected variables.

We studied the relationships between the development stage of the ICT sector and sustainable development indicators, considering the following research hypothesis:

Hypothesis 1 (H1). *The ICT labor market has a positive influence on economic growth.*

Hypothesis 2 (H2). *The share of the ICT sector within the economy has a positive impact on economic growth.*

Hypothesis 3 (H3). *The level of internet access has a positive influence on economic growth.*

Hypothesis 4 (H4). *The level of internet access has a positive influence on reducing inequality of income distribution.*

Hypothesis 5 (H5). *The importance of the ICT sector within the economy helps reducing inequality of income distribution.*

For the panel data model, we used the one that was proposed by Panda [53]:

$$y_{it} = \alpha + X'_{it}\beta + Y'_{it}\beta' + \vartheta_{it}; \quad i = 1, \dots, N; \quad t = 1, \dots, T \quad (1)$$

where i is the cross-section dimension (transversal section); t stands for time (time series dimension); α , β , β' are the equation's coefficients; X'_{it} is the it th observation of the explanatory variables; Y'_{it} is the it th observation of the control variables; and ϑ_{it} is the residual.

Using the data for the 2008–2018 time interval and panel data models, we assessed the relationship between the ICT sector development indicators (as presented in Appendix A) and some measures of sustainable development.

3. Results

In order to test the first three hypotheses, we used a panel data regression model, where the dependent variable was a measure of wealth within a country, namely the change in real GDP per capita for the European Union member states, and the independent variables were several ICT sector related variables. The dependent variable was derived from a measure used by the European Union to assess the attainment of goal 8—decent work and economic growth (increase in real GDP per capita being a path to be followed in order to achieve decent working conditions for employees). As such, we began our analysis by considering the impact induced on real GDP per capita, measured by D(LNRGDP) variable, by some characteristics of the ICT sector, that are considered as independent variables: VAL_ICT, ICT_GDP, VEN_CAP, EMP, D(BUS_EXPRD), LHO, COL and EN_BRO.

As the time span of available data was not very long for each of the analyzed countries (maximum 11 years in general), we chose a different econometric tool for the collected data, based on longitudinal data analysis. We used system GMM in order to estimate a relationship between the selected variables, alongside considering as instrumental variables, those that relate to the initial level of per capita income

and real GDP per capita (in logs), various measures of the ICT sector at individual and company level, as well as one-lag for the LNRGDP and the independent variables (in order to cope with the endogeneity issues). The results are presented in Table 2.

Table 2. Estimated coefficients of D(LNRGDP) (2008–2018)—model 1.

| Independent Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|----------------------|-------------|-----------------------|-------------|----------|
| VAL_ICT | −0.000192 | 0.0.000228 | 0.841419 | 0.4054 |
| ICT_GDP | −0.002623 | 0.002375 | −1.104320 | 0.0764 |
| VEN_CAP | 0.030498 | 0.048099 | 0.898017 | 0.3748 |
| COL | 0.000496 | 0.000240 | 2.064862 | 0.0458 * |
| D(BUS_EXPRD) | 0.000255 | 7.56×10^{-5} | 3.372643 | 0.0017 * |
| LNRGDP(−1) | −0.045169 | 0.005299 | −8.523854 | 0.0000 * |
| EN_BRO | −0.000608 | 0.000278 | −2.189332 | 0.0348 * |
| LHO | 0.002393 | 0.000426 | 5.622498 | 0.0000 * |
| C | 0.323169 | 0.043982 | 7.347702 | 0.0000 * |
| R-squared | 0.542644 | | | |

| Arellano-Bond Serial Correlation Test | | | | |
|---------------------------------------|-------------|-----------|----------|--------|
| Test Order | m-Statistic | rho | SE(rho) | Prob. |
| AR(1) | −0.689053 | −0.000710 | 0.001030 | 0.4908 |
| AR(2) | −1.155266 | −0.000784 | 0.000678 | 0.2480 |

* Coefficients that are statistically significant at 0.05 level. Source: own calculation, EViews estimation.

From Table 2, we may observe the positive relationship between the real GDP per capita and some variables that characterize the development of the ICT sector, such as the level of internet access, the working force with at least upper secondary educational attainment, the investments generated by venture capitals within the ICT sector, and the research and development expenditures made by enterprises from the ICT sector (the corresponding coefficients being not statistically significant only for the third variable and statistically significant for the other). These results were also obtained by other researchers, emphasizing the positive impact the international changes have on competitiveness and, implicitly, on economic growth [23,24,44,61–63].

However, from Table 2, a positive relationship may be found between the labor market within the ICT sector and the change in real GDP per capita for the analyzed countries. Moreover, the coefficient for variable COL is statistically significant, revealing the positive effects induced by the increase in labor force inserted in the ICT sector on the change of the real GDP per capita (as a proxy for economic growth). As such, the transition towards digital society by fostering employment in the ICT sector may be beneficial for real GDP per capita. From Table 2, we observed that a 1% increase in the employment share in the ICT sector will generate an increase of 0.000496% in logarithmic value for the real GDP per capita. This result confirms, therefore, the H1 hypothesis.

We may also find from Table 2, that the change in business expenditures on research and development had a positive impact, with a statistically significant corresponding coefficient, on the dynamics of the real GDP per capita, emphasizing the importance of innovative solutions in implementing sustainable development goals, such as goal 8—decent work and economic growth.

Moreover, from Table 2 we may find a negative relationship, albeit the corresponding coefficient not statistically significant, between the share of the ICT sector within the economy and dynamics of the real GDP per capita in the European Union member states. The corresponding coefficient −0.002623 is not statistically significant and showed that for a 1% increase in share of the ICT sector, a 0.002623% decrease in lognormal values of real GDP per capita is expected. This result rejects, practically, the H2 hypothesis. This result may be explained by structural changes induced in the labor market by the development of the ICT sector within an economy, as more and more educated personnel are attracted to jobs in this economic field (with possible associated depletion of talents elsewhere). According to Eurostat [64], by considering the population of a country, the GDP per capita adequately

measures the average income, as well as the living standard of the respective inhabitants (that are adjusted for price differences between countries). Despite this, the GDP per capita is a relatively simple aggregate measure, and in order to have a better understanding of the living standards we may use the distribution (rather than the average) of households. As such, it is a better option to analyze the distribution of household income using micro-level data, rather than macroeconomic aggregate measures [64].

Some authors [65] found the same negative relationship between the share of the ICT sector within the economy and economic growth, which was explained by the difficulty to assess, from a macroeconomic perspective, the impact the digital economy has on the overall economy, as the two are more and more integrated.

We may observe, from Table 2, the existence of a positive relationship between variable LHO, used to express the percentage of population that has access to internet, and the dependent variable (with the coefficient that is statistically significant), meaning that we can accept the H3 hypothesis. From model 1, an increase of 1% of the share of population with internet access may lead to a marginal positive effect on economic growth (of 0.002393%).

According to the results presented in Table 2, the regression equation is given by:

$$\begin{aligned} D(\text{LNRGDP}) = & 0.323169 - 0.000192 \times \text{VAL_ICT} - 0.002623 \times \text{ICT_GDP} + 0.030498 \\ & \times \text{VEN_CAP} + 0.000255 \times D(\text{BUS_EXPRD}) + 0.002393 \times \text{LHO} - 0.045169 \times \text{LNRGDP}(-1) \\ & + 0.000496 \times \text{COL} - 0.000608 \times \text{EN_BRO} \end{aligned} \quad (2)$$

[CX = R]

Also, from model 1, we used the Arellano-Bond serial correlation test AR(1) and AR(2) to assess the existence of serial correlation between the errors, the results being presented also in Table 2. We may see that both AR(1) and AR(2) statistics are not statistically significant, a result that can be expected when the model error terms are not correlated in levels.

We may observe that using this equation requires considering the limits of econometric models, such as the restrictive conditions that must be met by the independent variables (for example, stationarity, to avoid spurious correlation between variables). Moreover, we may also consider the existence of some other variables that may impact the dependent variable (not specified by the model), as well as the persistence of some statistical properties of the selected variables (endogeneity, for example).

In order to verify the H4 and H5 hypothesis, we used an econometric model where the dependent variable is INEQ_INC, namely the inequality of income distribution (as a measure of attaining goal 10—reduced inequalities), and the independent variables and instrumental variables were those used in model 1. The obtained results are presented in Table 3. Once again, we may consider the limitations that are present in analyzing data using panel data regressions, that may affect the use of obtained results without any further examination.

Model 2, presented in Table 3, emphasized the negative relationship between level of internet access, as a measure used to assess the transition towards digital economy, and inequality of income distribution, as a measure of attaining sustainable development goals. For example, the coefficient of LHO is -0.018454 , a result that asserts that, a 1% increase in this variable will lead to a 0.018454% decrease in the dependent variable INEQ_INC.

This decrease means an improving social balance, as the income inequality (measured [58] as the ratio of the total income received by the 20% of the population with the highest income and that received by the 20% of the population with the lowest income) is tightening. This result can be explained by the multiplicative benefits that may be induced by the transition towards digitalization, such as creation of new technologies and businesses [50]. Therefore, using this measure for social inequality, we may accept the H4 hypothesis. This result is important for decision makers in designing policies of transition towards digital society in such a manner that will lead to a decrease in social inequality.

Table 3. Estimated coefficients of INEQ_INC (2008–2018)—model 2.

| Independent Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---------------------------------------|-------------|------------|-------------|----------|
| VAL_ICT | 0.010504 | 0.058629 | 0.179163 | 0.8587 |
| ICT_GDP | −0.275097 | 0.126952 | −2.166931 | 0.0364 * |
| VEN_CAP | −0.745600 | 1.539529 | −0.484304 | 0.6309 |
| COL | 0.053582 | 0.016769 | 3.195318 | 0.0028 * |
| D(BUS_EXPRD) | −0.006941 | 0.015365 | −0.451726 | 0.6540 |
| LHO | −0.018454 | 0.033866 | −0.544919 | 0.0518 |
| C | 11.33203 | 1.714443 | 6.609744 | 0.0000 * |
| R-squared | 0.648606 | | | |
| Arellano-Bond Serial Correlation Test | | | | |
| Test Order | m-Statistic | rho | SE(rho) | Prob. |
| AR(1) | −1.1378114 | −0.649576 | 0.471352 | 0.1682 |
| AR(2) | 1.110995 | 0.288808 | 0.259954 | 0.2666 |

* Coefficients that are statistically significant at 0.05 level. Source: own calculation, EViews estimation.

Also, from model 2, we may observe the negative relationship between the transition towards digital society and the dependent variable INEQ_INC (with a statistically significant coefficient), a fact that led to the conclusion that the advances in implementing digitalization may cause the reduction of social inequalities. As such, an increase of 1% in the share of the ICT sector in GDP may lead to a decrease in social inequality indicator of 0.275097%, showing an improvement in social conditions (as a decrease in social inequality). The obtained results show that H5 hypothesis must be accepted, using the selected data and time period.

Using the results of model 2, presented in Table 3 the dependent variable INEQ_INC is expressed by a regression such as:

$$\text{INEQ_INC} = 11.332 + 0.105 \times \text{VAL_ICT} + (-0.2750) \times \text{ICT_GDP} - 0.7456 \times \text{VEN_CAP} + 0.0535 \times \text{COL} + 0.0069 \times \text{D(BUS_EXPRD)} - 0.0184 \times \text{LHO} - 0.0573 \times \text{EN_BRO [CX = R]} \quad (3)$$

The obtained results should be cautiously used for estimation purposes, as the limitations of the econometric models are present, such as the quality of input data, which are insufficient for deriving long term conclusions or the restrictive assumptions of the models.

The results obtained in model 1 can be explained taking into account the following aspects: not all member states of the European Union have a clear digitization strategy, which causes them to react differently to the increase of the ICT sector's share in the economy; there are significant differences between European Union member states in terms of the intensity of global investment, leading to different stages of development of European Union countries; a significant part of the European population does not have elementary digital competences; the number of small- and medium-sized enterprises selling their products and services in the online environment stalled; there are gender disparities in the European Union member states in terms of internet usage, digital skills, as well as specialized skills and employment in the ICT sector. Therefore, more sustained efforts are needed for the implementation of solid digital policies and the allocation of larger investments to maximize the digital single market. The European Union currently has more specialists in the digital sector than before, but there is still a gap in terms of skills.

According to the results from model 2, we can say that within each European country, policies that have the main objective to increase the level of education of the population in order to obtain better paid jobs that in time could reduce inequality of distribution, should be encouraged. This is also supported by the fact that the ICT sector at a European level is supported by the exponential growth of the digitization process. This exponential growth was registered in all sectors of activity (financial, real estate, professional, scientific, research, etc.) that use a labor force with a high level of

education and qualification. In this context, the role of digital platforms increased, which has had the effect of increasing part-time employment contracts. This has given the European workforce more flexibility. However, we must keep in mind that every member state of the EU has a different economic development stage. This is why the impact of the ICT sector on the economy of each EU member state is different, because some countries allocated a higher percentage of GDP to the development of the ICT sector, while other countries were unable to allocate a high percentage of GDP to the development of this sector (either due to non-existent or inadequate legislation regulating the single market, or due to population aging or discrepancies in the regional development of states, or because of the weak support of the venture capital markets, etc.). This is why the sustainable economic growth of each member state of the EU is an essential condition for reducing social inequalities and the poverty rate.

4. Conclusions and Discussion

Sustainable development is a paradigm where the future is a balanced interaction between economic growth and environmental protection. As such, meeting present and future needs is aimed at enhancing and developing the quality of life [66]. For the development of the ICT sector and its positive impact on sustainable economic growth at a European level, a number of programs have been launched (Digital Agenda 2010), and are the pillars of the Europe 2020 strategy that sets the EU's growth targets by 2020.

One hypothesis of the research—that the development of the ICT sector has a positive effect on the economic growth—was rejected due to the fact that, albeit a large part of the European population is excluded from the digital literacy process, more and more competent personnel are attracted towards the IT sector. As the development of this sector leads to the development of skills, knowledge and connections, these are beneficial for increasing the qualitative side of the European workforce. In order to increase the number of employees in this important sector of the European economies, it is necessary to implement curricula in the educational system that will develop their degree of knowledge regarding digitization in parallel with the allocation of substantial funds for the implementation of new technologies. In this context we can appreciate that ensuring decent work opportunities and decent working conditions are needed for the entire working age population in Europe in the context of sustainable development [7].

The technological development and the impact on economic development by accessing the internet of the European population shows that the digital economy can no longer be described as a separate part or a subset of the general economy and is characterized by a set of key characteristics: mobility, data use, and network effects [67].

The development of the digitalization process as part of the ICT sector (for traditional businesses, as well as for digital societies) has significant direct and indirect effects on the functioning of national and international fiscal systems. As the main conditions are met, the ICT sector may lead to increases in productivity and innovation, fostering the GDP growth (therefore, we consider the independent variable *ICT_GDP*, in all panel data regression models) [68].

Moreover, promotion of the ICT sector leads to the fostering of sustainable development factors, but also changes the way the value added is generated, with the resultant increased productivity. With all these positive and negative aspects of digitalization, because of the complexity of the ICT sector activity, the high qualifications regarding the workforce, and the advanced technologies implemented, the share of the ICT sector in the European economy has had and has a positive impact. The development of this sector has led to GDP growth in the less developed countries in Europe.

Regarding the labor market, we outlined the negative and positive consequences of the ICT sector development at the European Union level. In the short term, the risk of job losses is present, as robots may execute many repetitive, dangerous, or highly demanding physical tasks. In the long term, the development of digitalization may lead to improved and polarized qualifications, as well as to an increase in labor mobility. All the positive effects of the ICT sector development in the European Union may also be accompanied by negative effects, such as increased inequality between various jobs, lack

of certain capabilities and competences of the European labor force, differentiated access of European Union member states to technologies, difficulties in protecting personal data, etc. [69].

Therefore, the internet becomes more and more important nowadays, as asserted also by Pelău and Bena [70], the quantity of available and collected public information by interested parties has been exponentially increasing since the development of social media networks. Also, Ciobotar et al. [71] outlined the importance from a sustainable development perspective of digitalization in production technologies, communication technologies, and collection and analysis of information.

Considering the effects induced by the development of the ICT sector, the European Commission proposed for the next European Union budgetary exercise (2021–2027) a new program dedicated to the single market, with a total value of four billion euros. This program is intended to better protect consumers and to enhance small and medium enterprises' capability to grasp the advantages of a well—functioning digital single market [72].

Understanding the role of the ITC sector and its impact on sustainable development goals may be of interest to a large variety of users, from decision makers to professionals involved in the ICT sector, as well as individuals and institutional investors interested in this economic field.

Author Contributions: All authors equally contributed in designing the paper, gathering, and analyzing the data; S.-E.C., M.V. (Mariana Vuță) and S.-I.C. wrote the initial draft with support from E.M. regarding methodology and M.V. (Mihai Vuță) regarding the conceptual interpretation of data; all authors revised and finalized the paper. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

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

Appendix A

Table A1. Descriptive statistics for the independent variables.

| Statistic | D(BUS_EXPRD) | ICT_GDP | VAL_ICT | VEN_CAP | LHO | COL | ENBRO |
|-----------|--------------|----------|-----------|----------|----------|----------|----------|
| Mean | 5.925352 | 4.037465 | −0.528169 | 0.138141 | 68.90141 | 26.62419 | 87.54839 |
| Maximum | 53.700000 | 5.960000 | 19.05000 | 0.799000 | 91.00000 | 48.1 | 100 |
| Minimum | −93.20000 | 1.940000 | −24.7300 | 0.000000 | 30.00000 | 12.4 | 52 |
| Std. Dev. | 20.38873 | 0.964924 | 5.572490 | 0.125849 | 13.93265 | 9.776598 | 10.38548 |

Source: own calculations, EViews estimation.

References

1. European Commission, Communication from the Commission Europe 2020 A strategy for Smart, Sustainable and Inclusive Growth. 2010. Available online: <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52010DC2020&from=RO> (accessed on 15 November 2019).
2. World Commission on Environment and Development. *Our Common Future*; Oxford University Press: Oxford, UK, 1987.
3. Dragulanescu, I.V.; Dragulanescu, N. Growth, Development and Durability; Romanian Statistical Review nr. 10/2013. Available online: http://www.insse.ro/old/sites/default/files/field/publicatii/revista_romana_de_statistica_nr1_engleza_0.pdf (accessed on 20 December 2019).
4. Silvestri, F. *Lezioni Di Economia Dell'ambiente*, 2nd ed.; Clueb: Bologna, Italy, 2003.
5. Report of the Expert Group Follow-up to RIO +20, notably the SDGs. The Role of Science, Technology and Innovation Policies to Foster the Implementation of the Sustainable Development Goals. 2015. Available online: https://ec.europa.eu/knowledge4policy/sites/know4pol/files/ki0415809enn.en_.pdf (accessed on 20 November 2019).
6. European Commission. The Digital Agenda for Europe—Driving European Growth Digitally 2012. Available online: <http://ec.europa.eu/digital-agenda/en/news/digital-do-list-new-digital-priorities-2013-2014> (accessed on 10 November 2019).

7. United Nations Development Programme. Sustainable Development Goals. 2012. Available online: <https://www.undp.org/content/undp/en/home/sustainable-development-goals/background/> (accessed on 15 November 2019).
8. European Commission. Eurostat. Available online: <http://ec.europa.eu/eurostat> (accessed on 3 November 2019).
9. United Nations, Sustainable Development Goals, Goal 10: Reduce Inequality within and among Countries. 2012. Available online: <https://www.un.org/sustainabledevelopment/inequality/> (accessed on 15 November 2019).
10. EViews. *User Guide*; Version 8.0; QMS Quantitative Micro Software: Irvine, CA, USA, 2010; pp. 140–141.
11. Fisher, R.A. A Mathematical Examination of the Methods of Determining the Accuracy of an Observation by the Mean Error, and by the Mean Square Error. *Mon. Not. R. Astron. Soc.* **1920**, *80*, 758–770. [[CrossRef](#)]
12. International Telecommunication Union. ICT-Centric Economic Growth, Innovation and Job Creation. 2017. Available online: <https://www.itu.int/en/ITU-D/Pages/IMPACT-STUDY.aspx> (accessed on 18 November 2019).
13. Bresnahan, T.; Brynjolfsson, E.; Hitt, L. Information Technology, Workplace Organization, and the Demand for Skilled Labor: Firm-Level Evidence. *Q. J. Econ.* **2002**, *117*, 339–376. [[CrossRef](#)]
14. Gruber, H.; Hatonen, J.; Koutroumpis, P. Broadband access in the EU: An assessment of future economic benefits. *Telecommun. Policy.* **2014**, *38*, 1046–1058. [[CrossRef](#)]
15. World Bank. *Digital Dividends—World Development Report 2016*; World Bank: Washington, DC, USA, 2016.
16. Solow, R.M. A Contribution to the Theory of Economic Growth. *Q. J. Econ.* **1956**, *70*, 65–94. [[CrossRef](#)]
17. Kraemer, K.L.; Dedrick, J. *Information Technology and Economic Development: Results and Policy Implications of CrossCountry Studies in Information Technology, Productivity, and Economic Growth: International Evidence and Implications for Economic Development*; Oxford University Press: New York, NY, USA, 2001.
18. Dewan, S.; Kraemer, K.L. Information Technology and Productivity: Evidence from Country-level Data. *Manag. Sci.* **2000**, *46*, 548–562. [[CrossRef](#)]
19. Papaioannou, S.K.; Dimelis, S.P. Information technology as a f-Factor of of Economic Development: Evidence from Developed and Developing Countries. *Econ. Innov. New Technol.* **2007**, *16*, 179–194. [[CrossRef](#)]
20. Vu, K.M. ICT as a Source of Economic Growth in the Information Age: Empirical Evidence from the 1996–2005 period. *Telecommun. Policy* **2011**, *35*, 357–372. [[CrossRef](#)]
21. Ghita, S.I.; Saseanu, A.S.; Gogonea, R.M.; Huidumac-Petrescu, C.E. Perspectives of Ecological Footprint in European Context under the Impact of Information Society and Sustainable Development. *Sustainability* **2018**, *10*, 3224. [[CrossRef](#)]
22. Busu, M.; Gyorgy, A. Real convergence, steps from adherence to integration. *Amfiteatru Econ. J.* **2016**, *18*, 303–316.
23. Welfens, P.J.J.; Perret, J.K. Information & communication technology and true real GDP: Economic analysis and findings for selected countries. *Int. Econ. Econ. Policy* **2014**, *11*, 5–27. [[CrossRef](#)]
24. Mattioli, G.; Lamonica, R. The ICT role in the world economy: An input-output analysis. *J. World Econ. Res.* **2013**, *2*, 20–25. [[CrossRef](#)]
25. Atkinson, D.R. How ICT Can Restore Lagging European Productivity Growth, Information Tehnology and Innovation Foundation, 2018. Available online: http://www2.itif.org/2018-ict-eu-productivity-growth.pdf?_ga=2.38780577.327471103.1540791968-858400620.1530146339 (accessed on 21 November 2019).
26. Rohman, I.K. The globalization and stagnation of the ICT sectors in European countries: An input output analysis. *Telecommun. Policy* **2012**, *37*, 387–399. [[CrossRef](#)]
27. Falk, M.; Biagi, F. Empirical Studies on the Impacts of ICT Usage in Europe. *Inst. Prospect. Technol. Stud. Digit. Econ. Work. Pap.* **2015**, *14*, 1–50. Available online: <https://ec.europa.eu/jrc/sites/jrcsh/files/JRC98693.pdf> (accessed on 2 December 2019).
28. European Commission. Public Services Online, Digital by Default or by Detour?—Assessing User Centric e-Government Performance in Europe—E-Government Benchmark 2012. Available online: <https://op.europa.eu/en/publication-detail/-/publication/23d5089b-4910-4cc5-b950-aeca2ffc4f8e/language-en> (accessed on 25 November 2019).
29. Singh, N.; Nyuur, R.; Richmond, B. Renewable Energy Development as a Driver of Economic Growth: Evidence from Multivariate Panel Data Analysis. *Sustainability* **2019**, *11*, 2418. [[CrossRef](#)]

30. Czernich, N.; Falck, O.; Kretschmer, T.; Woessmann, L. Broadband Infrastructure and Economic Growth. *CESifo Working Pap. Ser.* **2009**, *121*, 505–532. Available online: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=1516232 (accessed on 20 November 2019). [CrossRef]
31. Dean, D.; DiGrande, S.; Field, D.; Lundmark, A.; O'Day, J.; Pineada, J.; Zwillenberg, P. The Internet Economy in the G-20. The \$ 4,2 Trillion Growth Opportunity. Boston Consulting Group. Available online: http://image-src.bcg.com/Images/The_Internet_Economy_G-20_tcm9-106842.pdf (accessed on 8 November 2019).
32. OECD. *OECD Digital Economy Outlook 2015*; OECD Publishing: Paris, France, 2015. [CrossRef]
33. The Information and Communications Technology Council. Digital Economy Annual Review, 2017. Available online: <https://www.ictc-ctic.ca/wp-content/uploads/2018/02/ICTC-Annual-Review-2017-EN.pdf> (accessed on 19 November 2019).
34. Koutroumpis, P.; Leiponen, A.; Thomas, L.D.W. *ICT Innovation in Europe: Productivity Gains, Startup Growth and Retention*; Imperial College Business School: London, UK, 2012.
35. OECD. *Measuring the Digital Economy: A New Perspective*; OECD Publishing: Paris, France, 2014; Available online: https://read.oecd-ilibrary.org/science-and-technology/measuring-the-digital-economy_9789264221796-en#page1 (accessed on 22 November 2019).
36. Arntz, M.; Gregory, T.; Zierahn, U. *The Risk of Automation for Jobs in OECD Countries: A Comparative Analysis, OECD Social, Employment and Migration*; OECD Publishing: Paris, France, 2016. [CrossRef]
37. Kharlamova, G.; Stavitskiy, A.; Zarotiadis, G. The impact of technological changes on income inequality: The EU states case study. *J. Int. Stud.* **2018**, *11*, 76–94. [CrossRef] [PubMed]
38. Stiglitz, J. *The Price of Inequality: How Today's Divided Society Endangers Our Future*; W.W. Norton: New York, NY, USA, 2012.
39. Quah, D. ICT Clusters in Development: Theory and evidence. *EIB Pap.* **2001**, *6*, 85–100.
40. Goos, M.; Manning, A.; Salomons, A. Job Polarization in Europe. *Am. Econ. Rev.* **2009**, *99*, 58–63. [CrossRef]
41. Autor, D.H.; Katz, L.F.; Kearney, M.S. Trends in US wage inequality: Revisiting the revisionists. *Rev. Econ. Stat.* **2008**, *90*, 300–323. [CrossRef]
42. Firpo, S.; Fortin, N.M.; Lemieux, T. *Occupational Tasks and Changes in the Wage Structure*; University of British Columbia: Vancouver, BC, Canada, 2007.
43. Untari, R.; Priyarsono, D.S.; Novianti, T. Impact of Information and Communication Technology (ICT) Infrastructure on Economic Growth and Income Inequality in Indonesia. *Int. J. Sci. Res. Sci. Eng. Technol.* **2019**, *6*, 109–116. [CrossRef]
44. Keček, D.; Hrustek, N.Z.; Dušak, D. Analysis of multiplier effects of ICT sectors—A Croatian case. *Croatian Oper. Res. Rev.* **2016**, *7*, 129–145. [CrossRef]
45. World Bank. Digital Dividends. 2016. Available online: <http://www.documents.worldbank.org/curated/en/961621467994698644/pdf/102724-WDR-WDR2016Overview-ENGLISH-WebResBox-394840B-OUO-9.pdf> (accessed on 19 November 2019).
46. Noh, Y.H.; Yoo, K. Internet, Inequality and growth. *J. Policy Modeling.* **2008**, *30*, 1005–1016. [CrossRef]
47. Andres, L.; Cuberes, D.; Diouf, M.; Serebrinsky, T. The diffusion of the Internet: A cross-country analysis. *Telecommun. Policy* **2010**, *34*, 323–340. [CrossRef]
48. Yi, M.; Choi, C. The effect of the internet on inflation: Panel data evidence. *J. Policy Model.* **2005**, *27*, 885–889. [CrossRef]
49. Baliamoune-Lutz, M. An analysis of the determinants and effects of ICT diffusion in developing countries. *Inf. Technol. Dev.* **2003**, *10*, 151–169. [CrossRef]
50. UNCTAD. Digital Economy Report 2019. Value creation and capture: Implications for developing countries. Available online: https://unctad.org/en/PublicationsLibrary/der2019_en.pdf (accessed on 18 November 2019).
51. Benhabib, J.; Spiegel, M.M. The role of human capital in economic development: Evidence from aggregate cross-country and regional US data. *J. Mon. Econ.* **1994**, *34*, 143–173. [CrossRef]
52. Panda, B. Schooling and Productivity Growth: Evidence from a Dual Growth Accounting Application to U.S. States. *J. Prod. Anal.* **2017**, *48*, 193–221. [CrossRef]
53. Chanda, A.; Panda, B. Productivity Growth in Goods and Services Across The heterogeneous States of America. *Econ. Inq.* **2016**, *54*, 1021–1045. [CrossRef]
54. European Commission. Eurostat. ICT Sector (isoc_e). Available online: http://ec.europa.eu/eurostat/cache/metadata/en/isoc_se_esms.htm (accessed on 10 October 2019).

55. European Commission. Eurostat. Real GDP Per Capita. Available online: http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init+1&language=en&pcode=sdg_8_10&plugin=1 (accessed on 10 October 2019).
56. European Commission. Eurostat. (Discontinued) Venture Capital Investments. Available online: <http://ec.europa.eu/eurostat/web/products-datasets/-/tin00141> (accessed on 11 August 2018).
57. Eurostat. At Least Upper Secondary Educational Attainment, Age Group 25–64. Available online: <https://data.europa.eu/euodp/ro/data/dataset/ap7jGLISyX2kmOsSTTU2KQ> (accessed on 2 January 2020).
58. European Commission. Eurostat. Annual Data on Employment in Knowledge-Intensive Activities at the National Level, by Sex (from 2008, NACE Rev.2). Available online: http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=htec_kia_emp&lang=en (accessed on 10 October 2019).
59. European Commission. Eurostat. Level of Internet Access—Households. Available online: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init+1&language=en&pcode=tin00134&plugin=1> (accessed on 10 October 2019).
60. European Commission Eurostat. Inequality of Income Distribution. Available online: <http://ec.europa.eu/eurostat/tgm/table.do?tab=table&init+1&language=en&pcode=tespm151&plugin=1> (accessed on 10 October 2019).
61. Onofrei, M.; Vintilă, G.; Dascălu, E.D.; Roman, A.; Firtescu, B.N. The impact of environmental tax reform on greenhouse gas emissions: Empirical evidence from European Countries. *Environ. Eng. Manag. J.* **2017**, *16*, 2843–2849. [CrossRef]
62. Armeanu, D.Ș.; Vintilă, G.; Andrei, J.V.; Gherghina, Ș.C.; Drăgoi, M.C.; Teodor, C. Exploring the link between environmental pollution and economic growth in EU-28 Countries: Is there an environmental Kuznets curve? *PLoS ONE* **2018**, *13*, e0195708. Available online: <https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0195708#sec001> (accessed on 15 November 2019). [CrossRef]
63. Pradhan, R.P.; Mallik, G.; Bagchi, T.P. Information communication technology (ICT) infrastructure and economic growth: A causality evinced by cross-country panel data. *IIMB Manag. Rev.* **2018**, *30*, 91–103. [CrossRef]
64. European Commission. Eurostat. Available online: https://ec.europa.eu/eurostat/statisticsexplained/index.php?title=Living_conditions_in_Europe_-_income_distributionand_incomeinequality (accessed on 15 November 2019).
65. Duhăneanu, M.; Marin, F. Agenda digitala pentru Europa—Riscuri si Oportunitati intr-o economie digitala. In Proceedings of the International Conference of the Institute for Business Administration in Bucharest 7th Edition, Bucharest, Romania, 30 September 2014; pp. 67–87.
66. Tita, O.; Oprean, C. *Perspective Actuale Privind Dezvoltarea Durabila*; Pro Universitaria: Bucharest, Romania, 2019.
67. McKinsey & Company. Available online: http://www.mckinsey.com/features/sizing_the_internet_economy (accessed on 10 November 2019).
68. Comisia Europeana, *Document de reflectie Către o Europa durabila pana in 2030*; Factori orizontali care favorizeaza tranzitia catre durabilitate. Educație, știință, tehnologie, cercetare, inovare și digitalizare; Comisia Europeana: Brussels, Belgium, 2019; pp. 22–23. Available online: https://ec.europa.eu/commission/sites/beta-political/files/rp_sustainable_europe_ro_v2_web.pdf (accessed on 20 November 2019).
69. McKnight, D.H.; Chervany, N.L. What trust means in e-commer customer relationships: An interdisciplinary conceptual typology. *Int. J. Electron. Commer.* **2002**, *6*, 35–59. [CrossRef]
70. Pelău, C.; Bena, I. Percepția riscului pe diferite segmente de consumatori în cadrul tranzacțiilor de comerț electronic și implicațiile asupra strategiei de marketing. *Amfiteatru Econ. J.* **2010**, *28*, 372–386.
71. Ciobotar, N.; Dumitru, I.; Francu, G.L.; Tita, R. Opinion Poll on Patient Satisfaction Assessment of Private Medical Centers, off Line Marketing Channel Support. 2018. Available online: <https://ibima.org/conference/31st-ibima-conference/> (accessed on 20 November 2019).
72. Comisia Europeana. Piața Unică: Cel Mai Bun Atu Al Europei Într-o Lume în Schimbare. Available online: https://ec.europa.eu/romania/news/20181122_comisia_europeana_apel_state_membre_instaurare_piata_unica_ro (accessed on 20 November 2019).

