ASSESSING THE EFFECTS OF THE ICT SECTOR DEVELOPMENT IN THE EUROPEAN UNION

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ABSTRACT
Starting from the latest developments from the European Union, this article analyses the impact of the dynamics of the Information and Communication Technologies (ICT) sector towards achieving sustainable economic growth. We use data panel models to assess these effects, by considering data for the member states of the European Union, for the 2008-2017 time frame. The study reveals the positive effect of the ICT sector on wealth accumulation at the European Union level, as measured by the GDP per capita indicator. A negative effect was seen on income distribution at the European level, as the development of the ICT sector may lead to increasing income inequality. These results may draw attention to those involved in adopting and implementing the measures envisaged in the European Union, in order to attain the expected sustainable goals, mainly those associated with reducing poverty and income inequality.

KEYWORDS: *ICT, income inequality, economic growth.*

1. INTRODUCTION

The recent developments in the European Union, generated by the initiatives and measures aimed at shaping the Digital Single Market are key expression of the principles and fundamentals of the European conglomerate, mainly those of free movement of persons, services and capital. The aim for the implementation of the Digital Single Market is to create a single market, without borders or regulatory walls. This market was estimated to contribute annually by 415 billion euro to the European Union economy (EC, 2015). The Digital Single Market Strategy, adopted in 2015, was devised on three pillars: better access for consumers and businesses to digital goods and services across Europe, create the level playfield for digital networks and innovative services and maximize the growth potential of the digital economy. Considering these three pillars, in the mid-term review of the Digital Single Market Strategy, completed in May 2017, the European Commission identified the necessary steps to be followed, namely the development of the European Data Economy, in order to act at its full potential, the need of tackling cyber-security challenges and the promotion of the online platforms as preconditions of a fair ecosystem (EC, 2017a).
In this respect, the creation of the Digital Single Market is considered by the European decision-makers as a mean to maximize the growth of the European Digital Economy and, therefore, leading to benefits to be enjoyed by every citizen of the European Union. A key component of this strategy refers to the strengthening of the e-government plan and measures, which is based on the interconnectivity of the business registers across Europe and the implementation of the „once only" concept that facilitates the interaction of the individuals with the public authorities (EC, 2017b).
But the implementation of this strategy is hampered by the different levels of development of the digital economy infrastructure, a reason being the very different levels of the Information and

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Communication Technologies (ICT) sector within the economies of the EU member states. Moreover, the implementation of this strategy is also influenced by the resources dedicated to the research and development, in order to make more efficient the processes and technologies involved.
All these developments are part of the general strategy adopted in 2010 by the European Commission (named Europa 2020 Strategy), with the aims of developing an European economy based on knowledge and innovation (achieving smart growth), promoting a more competitive, environment-friendly and resource efficient economy (achieving sustainable growth) and improving the inclusion and employment throughout Europe (EC, 2010). As such, the main derived objective of the European Commission is to devise a set of policies and measures that contributes to a better life of the citizens of the European Union and to tackle the disparities and inequalities that are present nowadays between different countries or regions of Europe. In order to achieve this objective, the European Commission employs a large spectrum of instruments, devoting significant resources to better assess the economy's reactions to the devised measures (most of them being reported to the Eurostat).
The process of the European Union transition to the digital era is, therefore, central for the decision-makers in Europe, but the measures that are adopted should be carefully examined, in order to avoid the occurrence of significant negative effects, especially at the individual level. The data collected by the Eurostat are an important tool to assess and follow the dynamics of main indicators, with a large spectrum of coverage.
Using data collected from Eurostat, for the 2008-2017 time frame and corresponding to the 28 member states of the European Union, this study analyzes the impacts the development of the ICT sector, as well as the business expenditures on research and development in the ICT sector have on the fundamental preconditions of better living standards and improved life quality. Therefore, the study analyzes the transition towards the digital era from the social security point of view, by assessing the impact the development of the ICT sector has on the wealth generated yearly in every member state and on the income inequality.
This article consists of five parts, alongside the first chapter, the Introduction, there is one parte dedicated to the literature review, where are discussed some of the relevant findings, a part on the methodology and data, where are outlined the used concepts, a fourth part presenting the results, where the main results are discussed and commented and, finally, the relevant conclusions derived from this study.

2. THE LITERATURE REVIEW

The concept of digital economy, or the economic activity that results from the online interaction of individuals, companies and authorities, has gained importance alongside the major improvements in the technologies and infrastructure used in the ICT sectors from around the world. The digital economy is facilitated by the rapid and fastering interconnectedness between the involved parties, mainly individuals and businesses, and it is based on the results obtained by the knowledge-intensive industries and activities. As the economic landscape is changing worldwide, the interaction between the involved parties and the generated effects were studied, mainly to address the challenges associated with the protection of personal data (in the European Union, the adoption of General Data Protection Regulation, in 2016, and its implementation, since May 25th, 2018, implies expenses for companies, but create and adequate legal frame for protecting the individuals' rights).
The development of the ICT sector has lead to a significant increase for skilled labor in the labor market in every country, irrespective of its degree of development or depth. Autor et al. (1998) analyzed the US labor market for each decade since 1940 and from 1990 to 1995, with respect to the impact of the technological changes that occurred in the American economy on the relative demand for workers with different education levels. Also, these authors analyzed also the impact of

the technological changes on the growth of US educational wage differentials. They found that, in the more recent time period analyzed (1970-1995), the relative demand for college graduates grew more rapidly on average than in the previous three decades (1940-1970). As a consequence, the wages of the skilled labor force have been rising more rapidly than those of low and middle-income workers, leading to an increase in income inequality.

Bresnahan & Trajtenberg (1995) analyzed the impact the ICT sector have on business operation within a firm and concluded that the technologies developed by this sector have the potential to be general purpose technologies, that benefit altogether the customers and suppliers (as the company is using enhanced processes and infrastructure). They also showed that the characteristics of general purpose technologies imply increasing returns to scale phenomena, that may have an important impact on the rate of technical progress and, therefore, on the overall growth rate of the economy. Bresnahan & Trajtenberg (1995) also found that for a decentralized economy, it is difficult to exploit the growth opportunities that are offered by the general purpose technologies. Bresnahan et al. (1998) analyzed the US IT labor market, by conducting an analysis of firm-level data, using cross sectional survey of organizational practices and labor force characteristics conducted in 1995 and 1996 matched to a panel detailing IT capital levels over the 1987-1994 time frame. The authors found that the increased demand for skilled labor is related to a particular cluster of technological change, involving not only increase use of IT, but also changes in workplace organizations and on product and service quality.

Sharafat & Lehr (2017) analyzed the contribution of the ICT sector to economic growth and, while agreeing with the positive impact, they stressed some facts that lead to the difficulty of a precise quantification of the effects. The authors asserted that one reason is that the ICT sector is only one of those sectors that are involved in productive activities, even though its contribution has a multiple facets (enhancing efficiency, better allocation of capital and labor etc.). Moreover, the difficulty to accurately measure the effects on economic growth is derived also from the relatively small share of factor inputs from ICT sector in total production (expressed in monetary terms). But the authors also assert that the ICT sector has the potential to enhance inclusion, by making information widely available and lowering the transaction costs and economic barriers to entry. Although considering the potential of financial inclusion, the authors also emphasize the risk of increasing income disparity, unless some additional measures are adopted by the competent authorities. Karabarbounis & Neiman (2014) analyzed the decline in the share of global corporate gross value added paid to labor over a time frame of more than 35 years (between 1975 and 2012), for 56 countries of the world with at least 15 years of available data. They found that 38 out of 56 countries exhibited downward trends in their labor shares and, from the trend estimates that are statistically significant, 34 are negative, while only 9 are positive (for the US case, two thirds of the states experienced decline over that period). A reason for this evolution lays in the within-industry changes, rather than the changes in the industrial composition. The authors also stressed the impact on the distribution of income that occurs when households have heterogeneous assets or when skills are differentially substitutable with capital. This impact is influenced by the changes in technology that have the potential to induce long-term changes in factor shares (and, therefore, induce tensions in the labor market).

A similar conclusion was derived from the „Digital dividends" report issued by the World Bank in the 2016 (World Bank, 2016), according to which in the United States, the share of income going to routine labor has decreased from 38% to 23% since the late 1960s, whereas the non-routine labor share increased from 24% to 34%. The key risks that were identified in this report lays on the market structure, with the possible occurrence of an excessive concentration, the increased income inequality, rather than greater efficiency, and a greater control, instead of greater empowerment and inclusion. In order to address these risks, the key component envisaged by this report is the global approach in solving the issues related to the expansion of the ICT sector.

In its strategy for the 2012-2015 time frame, aimed to adopt and implement measures for fostering the ICT impact on economic growth, World Bank (2012) argues that the development of the ICT sector may lead to economic growth and job creation. As a consequence, the development of the ICT sector will help reduce poverty and achieve sustainable development, together with a wider social inclusion. The main reason for this was the positive effect induced by the development of the ICT sector on economic growth since 1990, namely by lifting more than 10% of the world's population out of poverty. But the World Bank's views on the effects derived in reducing poverty were not generally supported by the empirical evidence of the impact derived from the development of the ICT sector.

Using data for 59 countries for the 1995-2010 time frame, Niebel (2014) outlines the positive relationship between the ICT sector and GDP growth. The proposed analysis divides the selected countries in 3 groups, according to their stage of development (as measured by the GDP per capita in 1995, expressed in purchasing power parity adjusted US Dollars of 2013). Consequently, there were 18 developing countries, 22 emerging and 19 developed countries analyzed. The obtained results show that there rather small differences in the output elasticities of ICT gains between developing, emerging and developed countries. The additional tests conducted revealed that there is no clear statistical indication that developing and emerging countries are gaining more from investments in ICT than the developed countries.

The role of the ICT sector in achieving economic growth was also studied by Papaioannou & Dimelis (2010), who used an augmented production function in order to estimate the total ICT effect on labor productivity growth, alongside those induced by its main components (hardware, software, and communications). Using data for 42 developed and developing countries, for 1993-2001 time period, the authors find a positive and significant growth effect generated by the ICT sector, mainly in the developed countries. The main explanation of this result is associated with the impact on economic growth that is due to the hardware and communication components of the ICT sector. Cardona et al. (2013) analyze the impact the ICT sector has on productivity, by considering various approaches to measures these variables, showing that the effect is positive and significant. Considering the aggregate and sectorial analysis, the authors outline that there are significant differences of the ICT effect between the US and Europe. But using firm-level data, the authors reveal that the differences vanish. Also, the authors emphasize the need for more theoretical and empirical research for a better assessment of the ICT sector impact on economic growth and sustainable development. The impact of the development of the ICT sector on the income inequality is less documented by researches on the empirical data. Richmond & Triplett (2017) used panel data from 109 countries for the 2001-2014 time frame, in order to assess the relationship between the dynamics of the ICT sector and that of the income inequality. The expected effects, being positive (such as a greater inclusion of underserved population, for example) as well as negative (an exacerbated inequality, due to differential access and skill premiums) are analyzed by the authors. The conclusion derived from studying the selected data is that the effect of ICT on income inequality depends on the measures used to assess these variables. But other main finding is that the magnitude of the effect of ICT sector on the income inequality is comparable with those induced by the more traditional forms of economic infrastructure.

Bandyopadhyay (2014) studied the relationship between the mass-media and ICT technologies and the inequality and poverty. In order to conduct the analysis, the author used data available for the 1992-1997 time period, for various measures of mass-media and ICT sector penetration, as well as Gini coefficient as measure for income inequality and two variables – poverty headcount at 1 US Dollar per day and 2 US Dollar per day – as measures for poverty. The results show that the ICT expenditures, as a percentage of GDP, have a negative relationship with poverty.

With a microeconomic level approach on the Mexican ICT market, Iacovone, Pereira-Lopez & Schiffbauer (2016) obtained that the development of the ICT sector impacts the Mexican labor market, but this effect is not reflected in an enlarged wage gap between skilled and unskilled workers. An explanation of this result is the increasing sophistication of blue-collar workers, due to the organizational adjustments derived from ICT adoption.

3. METHODOLOGY AND DATA

In order to assess the impact of the ICT sector development on the living standards of the EU citizens, we considered 10 variables, as presented in Table 1. The data used in this study are extracted from the EUROSTAT web-site (available at https://ec.europa.eu/eurostat/data/database) and regard the 28 EU member states, for the 2008-2017 time-frame.

Table 1. Data description

Variable Symbol	Variable Name	Variable Description	Measurement unit
GDP_CAPITA_EUR	GDP per CAPITA	Total GDP, expressed in EUR, divided by the population	EUR/capita
GINI_COEFFICIENT	Gini coefficient	Is the relationship of cumulative shares of the population arranged according to the level of equalized disposable income, to the cumulative share of the equalized total disposable income received by them	Number
INEQ_INCOME	Income Inequality	Inequality of income distribution (income quintile share ratio)	Number
H_T_EXP	High tech exports	Total high-tech exports as a percentage of total exports	% of total
H_T_IMP	High tech imports	Total high-tech imports as a percentage of total imports	% of total
E_GOV	E-government activities of individuals via websites	Interaction of individuals with public authorities, in the last 12 months	% of individuals
ICT_GDP	Percentage of ICT sector in GDP	It is the percentage share of the Information and Communication Technology sector in the GDP	% of total
EMPLOY	Employment in knowledge - intensive activities	Annual data on employment in knowledge-intensive activities at the national level.	% in total employment
BUS_EXP_02	Business expenditure on R&D	Business expenditure on Research & Development	EUR per inhabitant
VEN_CAP	Venture capital investment	Venture capital investment in ICT sector, expressed as percentage in GDP	% of total
WORK	Average number of weekly hours of work	Average number of weekly hours of work in the knowledge-intensive activities	Number

Source: adapted from Eurostat (data available at https://ec.europa.eu/eurostat/data/database)

Two of these variables, the GDP_CAPITA_EUR and the GINI_COEFFICIENT, shall be employed to assess the results of different digital economy development measures in the EU countries have on the intracommunity citizens living standards. We considered the GDP_CAPITA_EUR as a common measure for the living standards in each of the 28 European Union member states, while the GINI_COEFFICIENT measures the disparity in terms of the revenue and wealth distribution, representing an index of the inequalities in a society (the bigger this coefficient, the more inefficient the distribution of wealth/revenues in a society).
Moreover, in order to evaluate the distribution of inequality of revenues in each member state analyzed, we employed the INEQ_INCOME, that measures inequality of income distribution.
In order to assess the interaction between the traditional and the digital societies, we employed the E_GOV variable presenting the percentage of the citizens who used web-sites for their interaction with governmental institutions, ICT_GDP that shows the GDP distribution in the ITC sector, as well as the H_T_EXP and H_T_IMP variables indicating the commercial processes (exports/imports) involving ITC products. We also used indexes measuring the innovation and research in the ITC sector, such as the BUS_EXP_02 and VEN_CAP, showing the R&D expenditures in the private sector and the ITC investments ratio in the GDP. In order to assess the human capital component, we considered the WORK variable, which is the average number pf usually weekly hours of work in knowledge-intensive activities, and the EMPLOY variable, that represents the annual data on employment in knowledge-intensive activities at the national level (percentage of total employment). Moreover, in order to assure the comparability of data, we used the first difference of those variables that are not expressed in percentage form, namely GDP_CAP_EUR, BUS_EXP_02 and, respectively, WORK.
In this context, aiming to assess the impact of the variables that characterize the digital society on the wealth accumulation and income inequality in the member states of the European Union, we use panel data regressions, considering the model proposed by Schmidheiny (2016):

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

where:

i= cross-section dimension (transversal section);
t=time (time series dimension);
α, β= the equation's coefficients;
X'_{it}= the *it* observation of the explaining variables;
u_{it}= individual effect;
ϑ_{it}= residual.

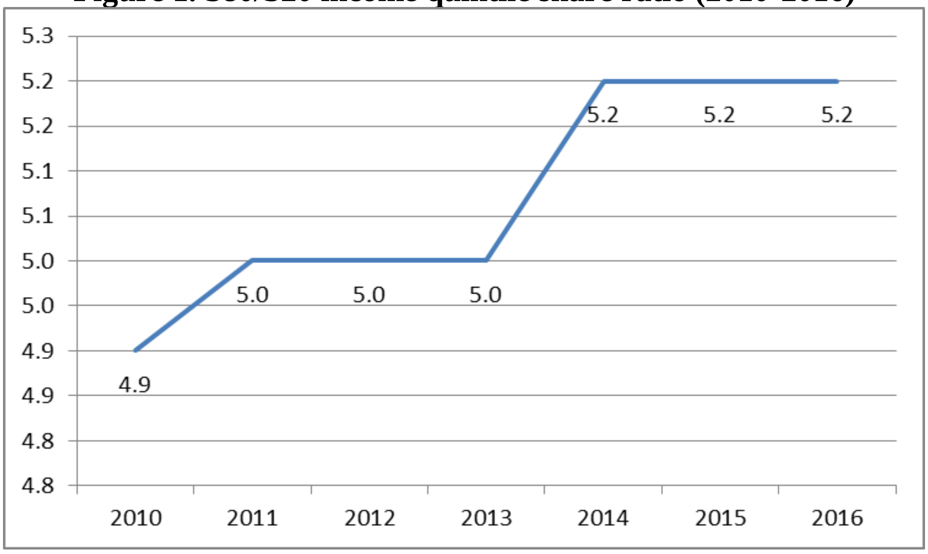
Using panel data regressions, we start from the hypothesis that the living conditions and income inequality in the European Union are influenced by measures adopted for the implementation of the digital society. As such, we consider the following research hypothesis:
H_1: The development of the ICT sector, as measured by the share in the GDP, has a positive impact on wealth accumulation;
H_2: The labor force employed in the ICT sector, as percentage in total labor force, has a negative impact on wealth accumulation;
H_3: The development of the ICT sector increases the income inequality;
H_4: The consolidation of e-government activities has a positive impact on wealth accumulation;
H_5: Fostering the research and development in the ICT sector lead to a positive effect on wealth accumulation;
H_6: Fostering private-equity investments in the ICT sector enhances the living condition.
These hypothesis will be tested by using the panel data regressions, with fixed effects and random effects. The decision regarding the model we shall use is based on the results of the Hausman test, according to which, if the associated probability is less than the chosen significance level (5%), the

null hypothesis (i.e. the random effect model is appropriate) is rejected (as such, the fixed effect model is appropriate for the analyzed data set).

4. THE RESULTS

Since its set up, the EU aimed at creating a community where all the citizens get better services and products, which would increase their life standards. When launching the Europe Strategy 2020 (EC, 2010), focused on smart economic growth, the European Commission built on the understanding of the importance of the EU citizens' living standards in order to reach the social inclusion target for at least 20 million citizens who were exposed to the risk of poorness (EC, 2018).
The development of the social inclusion process at the level of the EU is quantified by the S80/S20 income quintile share ratio index, representing a mirror of the revenues distribution inequalities. In Figure 1 we include the dynamics of this indicator for the 2010-2016 time frame, indicating a growth tendency and signaling developing disparities between the high revenue persons (top quintile) and the small revenue persons (the bottom quintile).

Figure 1. S80/S20 income quintile share ratio (2010-2016)



Source: Eurostat, own calculation

Firstly, we shall look at the main characteristics of the independent variables included in panel type regressions in order to estimate the GDP_CAPITA_EUR dependent variables development as well as that of the GINI_COEFFICIENT. The descriptive characteristics of the analyzed variables are included in Table 2.
From Table 2, we can observe the existence of an extreme variability for BUS_EXP_02 variable, that is the business expenditures on research and development in each member state of the European Union, measured in eur/capita, with a maximum of 1069.50 eur/capita (for Sweden, in 2016) an a minimum of 6.90 eur/capita (for Bulgaria, in 2008).
Moreover, we can observe that the private-equity investments as a percentage in GDP is still very low, with a maximum of 1.1950% (for United Kingdom, in 2008) and a minimum of zero (Greece, in 2014 and 2015).

Table 2. Descriptive Statistics for selected variables (2008-2017)

	Mean	Maximum	Minimum	Std. Deviation
H_T_EXP	10.56563	22.20	2..70	5.455578
H_T_IMP	11.99167	20.30	6.30	3.646416
E_GOV	39.84375	81.00	5.00	18.09759
ICT_GDP	4.110208	6.68	1.83	1.025544
EMPLOY	33.56042	43.60	19.50	5.891966
BUS_EXP_02	301.1302	1069.500	6.90	310.2705
VEN_CAP	0.176823	1.1950	0.00	2.923319
WORK	38.46667	42.20	30.00	2.328888

Source: Eurostat, own calculation

In order to see the relations between the selected variables, we use the correlation matrix that is presented in Table 3. The results show stronger correlations between the trading characteristics of the ICT sector, namely between the exports and imports as percentage of total (the correlation is 0.904685), signaling the importance of the technology transfers, services and products between one country and the other. The weakest correlation is between the business expenditure on research and development (BUS_EXP_02 variable) and the imports of the ICT sector as percentage in total imports (the value being 0.109872).

Table 3. Correlation Matrix for selected variables (2007-2017)

	H_T_EXP	H_T_IMP	E_GOV	ICT_GOV	EMPLOY	BUS_EXP_02	VEN_CAP	WORK
H_T_EXP	1.000000							
H_T_IMP	0.904685	1.000000						
E_GOV	0.371730	0.220615	1.000000					
ICT_GOV	0.571821	0.556663	0.282484	1.000000				
EMPLOY	0.441879	0.248246	0.782655	0.320604	1.000000			
BUS_EXP_02	0.268063	0.109872	0.816831	0.251897	0.646669	1.000000		
VEN_CAP	0.439028	0.376092	0.363675	0.486916	0.556221	0.263136	1.000000	
WORK	-0.298173	-0.168276	-0.686016	-0.252258	-0.629763	-0.775953	-0.379423	1.000000

Source: Eurostat, own calculation

Moreover, the negative correlation of the variable that expresses the average number of usually weekly hours of work in the ICT sector and the other variables is explained by the various characteristics of the knowledge-intensive activities. As such, the correlation is very strong and negative with the variable BUS_EXP_02, representing the business expenditures on research and development (in euro/capita), a relation that is explained by the divergence between the objectives of the amount of the labor involved in the ICT sector and those of the innovation processes (that aim to reduce the costs and improve the efficiency).

Furthermore, in order to test the hypothesis, we will use the regression equations based on models derived from data panel, where the dependent variables are GDP_CAPITA_EUR and, respectively, GINI_COEFFICIENT. We analyze the impact of the selected independent variables (H_T_EXP, H_T_IMP, E_GOV, ICT_GOV, EMPLOY, BUS_EXP_02, VEN_CAP and WORK) on the GDP_CAPITA_EUR, in order to assess the effects of the development of the ICT sector on the living standards of population (as given by the level of the GDP per capita). On the other hand, in order to assess the effects on the social polarization in the European Union, we use the Gini coefficient, that measures the inequality of income distribution within a community.

In Table 4 there are presented the main results of the regression where the dependent variable is D(GDP_CAPITA_EUR), the first-difference of the variable GDP_CAPITA_EUR, and there are 8 independent variables. In order to decide whether the fixed effect model or the random model is appropriate, we use the Hausman test, according to which when the associated probability is below the chosen significance level (usually, 5%), the null hypothesis is rejected (meaning the fixed effect model is appropriate).

Table 4. The proposed model for D(GDP_CAPITA_EUR) variable, using 8 independent variables (2008-2017)

Correlated Random Effects – Hausman Test				
Test summary		Chi-Sq. Statistic	Chi-Sq. D.f.	Prob.
Cross-section random		9.716878	8	0.2855
Dependent variable	**Independent Variable**	**Coefficient**	**Prob.**	**R-squared**
D(GDP_CAPITA_EUR)	H_T_EXP	-0.213662	0.1702	0.460531
	H_T_IMP	0.196958	0.3767	
	E_GOV	0.034312	0.2036	
	ICT_GDP	0.825768	0.0335	
	EMPLOY	-0.204303	0.0326	
	D(BUS_EXP_02)	0.060302	0.0000	
	VEN_CAP	8.526241	0.0002	
	D(WORK)	0.165830	0.9289	
	C	-0.069212	0.9824	

Source: own computation, Eviews estimation

According to this model, there are considered 8 independent variables that explain 46.0531% of the dependent variable, meaning that 46.0531% of the change in GDP_CAPITA_EUR is explained by the percentage share of imports and exports in total imports and, respectively, exports, the percentage share of individuals that interacted with the authorities via websites, the size of the ICT sector (as measured by the share in GDP and the share in employment), as well as the investment made in the ICT sector and in the research and development activities and the dynamics of the annual average number of weekly hours in the ICT sector. In this model, there are 4 coefficients that are statistically significant at the 5% level, namely those related to the ICT_GDP, EMPLOY, D(BUS_EXP_02) and VEN_CAP variables. The coefficients of the ICT_GDP and EMPLOY, that measures the size of the ICT sector within the member states of the European Union, are statistically significant at the 5% level, but different signs. Therefore, an increase of 1% in the size of the ICT sector within the analyzed countries will lead to an increase of 0.825768% of the GDP_CAPITA_EUR, a results that emphasizes the importance of this sector within an economy. Moreover, this result confirms the first hypothesis, H_1, according to which the size of the ICT sector has a positive impact on the wealth that is accumulated within an economy.

From the results presented in Table 4, we derive that an increase of 1 percent in the labor force involved in the ICT sector (as is expressed by the increase of the percentage share of individuals employed in the ICT sector compared to the total labor force) will lead to a decrease of 0.204303% of the average wealth in the economy. This result, that confirms the H_2 hypothesis, may stress the importance of a sustainable development of the ICT sector, in tandem with the other sectors of the economy. Moreover, an emphasis in the employment in the ICT sector may lead to a decrease in the productivity in this sector (as a stretched labor market is a precondition for non-efficiencies) and, therefore, to a lower impact on the total accumulated wealth in an economy.

The impact of the research and development in the ICT sector (measured as percentage in GDP) is also positive, as the coefficient of the corresponding independent variable is positive and statistically significant. Therefore, an increase in the dynamics of the business expenditures on research and development will lead to an increase in the wealth accumulated in an economy, a result that confirms H_5 hypothesis. Specifically, an increase of 1% of the business expenditures on

research and development, will lead to an increase of 0.060302% of the wealth that is accumulated in the analyzed economies.
Furthermore, from the model presented in Table 4, we can observe that an increase of 1% in the private-equity investments made in the ICT sector (as expressed by the share in the GDP) may lead to an increase of 8.526241% in the wealth that is accumulated within a year, as measured by the GDP_CAPITA_EUR variable. This result (the coefficient of the VEN_CAP variable is positive and statistically significant) confirms the H_6 hypothesis and emphasizes the importance of the investments made in the ICT sector, especially by investors and financial institutions and its affiliates, through private-equity vehicles, entities that are well suited for investments that are considered riskier than the traditional ones.
Although it is not statistically significant, the coefficient of the independent variable E_GOV, that measures the percentage of individuals that interacted with the authorities within one year from the total individuals within a country, is positive. This result leads to a confirmation of the H_4 hypothesis.
Starting from the model that is presented in Table 4, we can eliminate the variables with coefficients that are not statistically significant, the results being presented in Table 5.

Table 5. The proposed model for D(GDP_CAPITA_EUR) variable, using 4 independent variables (2008-2017)

Correlated Random Effects – Hausman Test				
Test summary		Chi-Sq. Statistic	Chi-Sq. D.f.	Prob.
Cross-section random		0.365230	4	0.9852
Dependent variable	**Independent Variable**	**Coefficient**	**Prob.**	**R-squared**
D(GDP_CAPITA_EUR)	ICT_GDP	0.748285	0.0319	0.436173
	EMPLOY	-0.164036	0.0078	
	D(BUS_EXP_02)	0.054172	0.0000	
	VEN_CAP	8.396816	0.0002	
	C	0.445139	0.8401	

Source: own computation, Eviews estimation

Considering the results presented in Table 5, we may observe that the model explains 43.6173% of the variability of the dependent variable, D (GDP_CAPITA_EUR), considering as independent variables the percentage share of ICT sector in the GDP, the labor force that is employed in the ICT sector (as percentage of the total labor force), the business expenditures on research and development and the private-equity investments made in this sector. Moreover, the coefficients of the independent variables are all statistically significant. From this model, we may observe that the coefficients have the same signs as the corresponding ones from the previous model that is shown in Table 4. As such, also this model confirms the H_1, H_2, H_5 and H_6 hypothesis.
In order to verify the H_3 hypothesis, we use the following two models, where the dependent variable are various measures of the inequality of income distribution. In Table 6, where the GINI_COEFFICIENT variable is the dependent variable, according with the Hausman test, the fixed effect model is appropriate.

Table 6. The proposed model for GINI_COEFFICIENT variable, using 8 independent variables (2008-2017)

Correlated Random Effects – Hausman Test				
Test summary		Chi-Sq. Statistic	Chi-Sq. D.f.	Prob.
Cross-section random		36.284024	8	0.0000
Dependent variable	**Independent Variable**	**Coefficient**	**Prob.**	**R-squared**
GINI_COEFFCIENT	H_T_EXP	-0.219609	0.0282	0.970429
	H_T_IMP	-0.078071	0.5825	
	E_GOV	-0.003452	0.8425	
	ICT_GDP	1.437122	0.0027	
	EMPLOY	0.492770	0.0020	
	D(BUS_EXP_02)	-0.002983	0.3735	
	VEN_CAP	1.277102	0.3071	
	D(WORK)	0.007784	0.9897	
	C	10.50956	0.0675	

Source: own computation, Eviews estimation

According with the model shown in Table 6, that explains 97.0429% of the variability of the dependent variable, 3 out of 8 coefficients are statistically significant at the 5% threshold, respectively those of H_T_EXP, ICT_GOV and EMPLOY. Therefore, an increase of 1% of the ICT sectors within the economies of the European Union member states, will lead to an increase with 0.01437122 of the Gini coefficient, resulting in an expanding income inequality in the society (as a larger value of the Gini coefficient is associated with a deteriorating balance of the income distribution). As such, the H_3 hypothesis is confirmed by the obtained results, even though the proposed model has some limitations (especially, derived from the possible presence of the endogeneity in this model).

Table 7. The proposed model for INEQ_INCOME variable, using 8 independent variables (2008-2017)

Correlated Random Effects – Hausman Test				
Test summary		Chi-Sq. Statistic	Chi-Sq. D.f.	Prob.
Cross-section random		38.007398	8	0.0000
Dependent variable	**Independent Variable**	**Coefficient**	**Prob.**	**R-squared**
INEQ_INCOME	H_T_EXP	-0.067403	0.0775	0.958417
	H_T_IMP	-0.006459	0.9056	
	E_GOV	0.001493	0.8229	
	ICT_GDP	0.486826	0.0076	
	EMPLOY	0.218449	0.0004	
	D(BUS_EXP_02)	-0.000650	0.6127	
	VEN_CAP	0.259897	0.6871	
	D(WORK)	-0.062453	0.7879	
	C	-3.797447	0.0847	

Source: own computation, Eviews estimation

Moreover, the model proposed in Table 6 reveals the effect the increase of the ICT sector has on the inequality of income distribution, as the increase of 1% of the employment in this sector is expected to lead to an increase of 0.00492770 in the Gini coefficient (meaning an increased income inequality).

Furthermore, in order to verify the H_3 hypothesis, we consider an alternative measure of income inequality, namely the income quintile share ratio, considering the same independent variables. From the results that are presented in Table 7, the model explains 95.8417% of the variability of the dependent variable, and the fixed effect model is the appropriate one in this case (as the result of the Hausman test reveals the rejection of the null hypothesis).
According with this model, the coefficients of the variables that reveals the characteristics of the ICT sector, ICT_GDP and EMPLOY, are statistically significant and positive. For example, an increase of 1% in the share of the ICT sector within an economy will lead to an increase with 0.00486826 of the dependent variable, meaning that the strengthening of the ICT sector may deteriorate the income inequality. The same conclusion can be drawn from examining the coefficient of the independent variable EMPLOY, where an increase of 1% will result in an increase of 0.00218449 of the income quintile share ratio, a sign of an increasing income polarization.
Therefore, using panel data models and data for member states of the European Union for the 2008-2017 time frame, we made an analysis of the impact the digital society measures have on the wealth and income distribution in the selected countries. We found that the strengthening of the ICT sector in the European Union and the digitalization of public authorities, as well as the increase in the business expenditures on research and development and the investments made through private-equity vehicles in the ICT sector lead to an increase of the GDP per capita. The proposed models reveal the existence of a negative effect of the development of the ICT sector (measured as percentage in total GDP or, considering the labor market, as percentage in total work force) on the income inequality at the society level, showing the deepening of the inequalities in income.

5. CONCLUSIONS

This paper addresses the impact the measures adopted in the European Union in order to implement the transition to the digital era have on wealth and income inequality of the individuals. The subject of implementing reforms that lead to a sustainable and inclusive growth is primary for the European Commission and the European Union. Therefore, the interaction between the new technologies and the real economy and society must be well considered by the theoreticians, as well as by practitioners and decision-makers throughout the European Union.
In this respect, by aggregating data collected from Eurostat database, on 2008-2017 time-frame and for the 28 member states of the European Union, we proposed regression equations that aim to capture the impact the measures of the development of the ICT sector have on the main drivers of an enhanced living standards. Therefore, using the collected data, we derive that the development of the ICT sector may have positive effects on the wealth accumulation at the society level, a result that reveals the importance of developing new technologies and using innovative solutions for the economic processes. But the fostering of the ICT sector may also lead to an increasing income inequality within the society, a fact that must be considered by the decision-makers from all over the European Union, in addressing the problem of the income polarization.
These findings represent an additional point of view for understanding the mechanics and effects the development of the ICT sector has on the real economy. Although the main effects are positive, as the GDP per capita increases as the sector develops, there should not be neglected the negative effects, especially at the deepening of the income inequality in the analyzed countries. The findings, however, are hampered by the low number of available data (including time series with a small number of records), although international organizations (especially the European Commission and its structures, such as the Eurostat) have made progress on collecting data on this topic.

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