Journal of Economic and Social Studies (JECOSS)
Volume 2. Issue 2.
2022

How does the use of ICTs impact developing economies in terms of GDP? A cross country-level analysis.

Ezana Ćeman, Nermina Durmić

International Burch University

Bosnia and Herzegovina

ezana.ceman@stu.ibu.edu.ba

nermina.durmic@ibu.edu.ba

Abstract**:** *The purpose of this research is to find the direct and/or indirect relationship between information and communications technologies (ICTs) and the economic development of transitioning countries. Specifically focusing on how technology can be used to advance a developing economy, this paper consists of conceptual background in terms of ICTs as well as a country-level analysis cross-referencing Albania, Armenia, Bosnia and Herzegovina (BiH), Croatia, Serbia, and Slovenia. These countries were categorized as European Union (EU) member states and non-EU countries solely to analyze the factors that can be used to advance a transitioning economy into a developed economy. Out of the selected ICT indicators in the study, it was found that fixed telephone subscriptions, fixed broadband subscriptions, research and development expenditures, and mobile cellular subscriptions all play a significant role for an increase in gross domestic product (GDP).*

Keywords: *Economic Growth; Information and Communications Technologies; Gross Domestic Product*

JEL Classification: *O40, O52*

Introduction

Information and communications technologies have changed every aspect of the world we live in since their inception. In both public and private settings, ICTs have positively impacted the everyday lives of individuals all over the world. Even the smallest thing that most of us take for granted today, such as internet usage, can change the lives of millions of people in developing countries if implemented. In both developing and transitioning countries, factors such as the lack of investments in research and development (R&D), unwillingness to adopt new ICTs, not up-to-date education standards when observed on a worldwide scale, etc. impose on a country's potential of reaching economic growth and overall socio-economic contingency.

This paper focuses on the use of ICTs in developed and developing countries in both the Southern European region and Eurasia to find if the use of ICTs positively impacts the economy of a developing country. The country selection pool of this study analyzes Albania, Armenia, Bosnia and Herzegovina, Croatia, Serbia, and Slovenia. One of the main reasonings behind this study was the underlying fact that research in terms of the impact ICTs have on the GDPs of the respective countries combined in this study are sparse. To put it lightly, meaning either outdated or nonexistent to an extent where the primary focus of other works is not solely based on ICTs, GDPs, and developing economies regarding the countries in this study. There is data available for the countries individually in terms of ICT adoption and a few works were found focusing on GDP growth from ICT usage. However, this study will take a different route. Using a cross country-level analysis method, the impact ICTs have on smaller, less known, and transitioning countries will be proven. The findings of this research will show that through the use of technology, economic growth will prevail.

Impacts of ICTs

The impacts of ICTs range from aiding a country's growth in economic terms, bettering the quality of life for citizens, providing a backbone for sustainable development both in the present day and the future, as well as an impact on overall productivity and efficiency in all sectors. The implementation of technology in economies worldwide is crucial today and it can only start with the open-mindedness that comes with adopting new methods. This goes further than countries simply importing and bringing in new technology, but rather implementing the development of these technologies to ensure sustainable development for the future (Archibugi and Pietrobelli, 1999). The benefits of technology are endless and we use multiple forms of a technology on a daily basis, both directly and indirectly. To serve as an official definition of ICTs for use throughout this study, the Food and Agriculture Organization of the United Nations (UN) classifies ICTs as "a broader term for Information Technology (IT), which refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form (AIMS, 2021)." ICTs refer to various forms of technologies and therefore encompass the field of IT as a whole.

In a 2017 report published by the International Telecommunication Union (ITU) titled "ICT-Centric Economic Growth, Innovation and Job Creation", the differences in ICT use and implementation are shown between developed countries and developing countries in addition to

the socio-economic impacts of ICTs. The overall consensus was that ICTs serve as extremely beneficial ways to lead to sustainable development and growth which are crucial in this day and age (Sharafat and Lehr, 2017). Figure 1 below shows us ICT penetration levels by level of development, e.g., the level of how developed countries use basic ICTs versus developing countries that serves as a base for our hypothesis in this study. What can be seen is the obvious divide between the penetration levels between developed countries and developing countries in all categories from fixed-telephone subscriptions to mobile-cellular subscriptions and so on. Although these levels are increasing on a daily basis for developing countries, there is still a widening gap between usage measures which in turn hinders saturation.

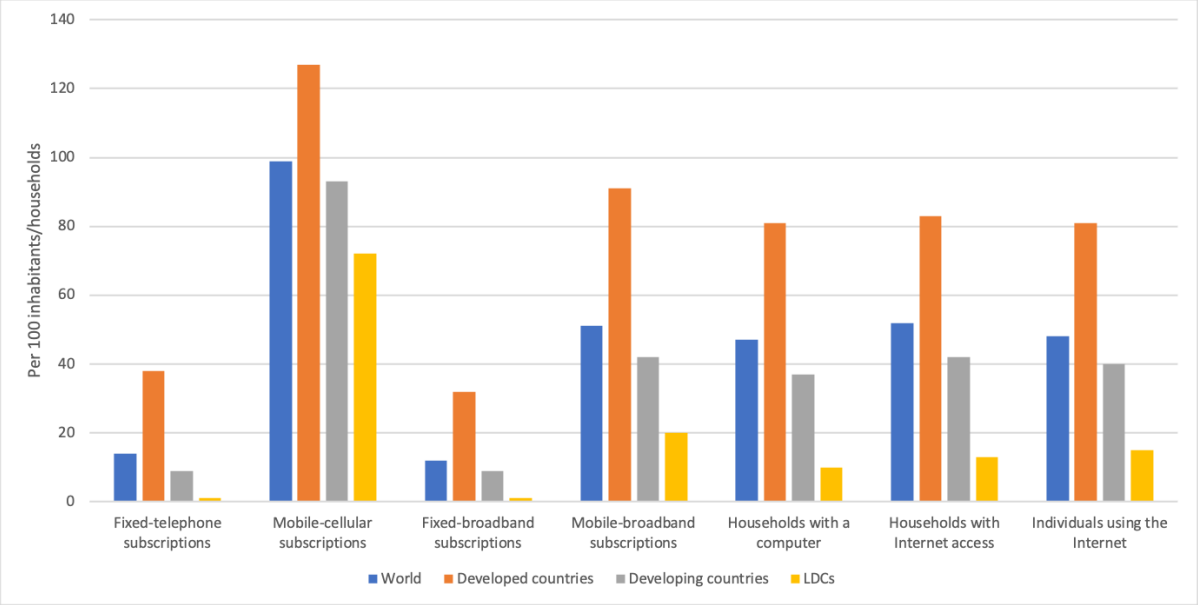

Figure 1: ICT Penetration Levels by Level of Development (Sharafat and Lehr, 2017)

As previously stated, when looking at the literature focusing specifically on the impact of technology on European developing economies, there are not many current studies to go by. A study by Madden and Savage from over 25 years ago showed a strong positive relationship between economic growth and telecommunication infrastructure investments when cross-referencing 27 various Central and Eastern European countries (Madden and Savage, 1998). Although the data analyzed is relatively old, we do not see there being a huge difference in the findings if using current data. Evangelista et al. (2014) conducted a study in which 27 EU member states were analyzed and cross-referenced with each other and it was found that ICTs and digitalization majorly impacted factors such as labor productivity, economic growth, and employment growth. It was also found that these ICTs and digitalization techniques can be utilized by non-EU European countries that hope to join the EU and see foreseeable economic growth in the near future. The literature shows that anywhere around the world, advances in the manufacturing technology industry can lead to economic growth, increased productivity, improved output/trade, poverty reduction, employment increase, sustainable environmental benefits, etc. (Massa, 2015).

Research shows that ICTs have been found to raise a nation's economy, encouraging R&D, reducing costs benefitting the entire nation to have more to give back to the people, and overall

progression in productivity and efficiency (Vreese, 2017). Jalava and Pohjola (2002) found that in the case of the United States, "the production and use of ICTs have been the factors behind the improved economic performance". When looking at a comparison between the economies of the United States and the EU, it has been found that the United States is a larger economy nonetheless due to its GDP per capita being considerably higher than the EU (Feldstein, 2017). When looking at ICTs at a whole, both production and usage directly benefit us in the long run. Looking at how far technology has come today, everything from finances to buying a car or property to sending money overseas has become easily accessible with a click of a few buttons with our mobile devices. In turn, ICTs effectively stimulate economic growth as entire economies have become digitally based over the past few decades.

One study found that in the European Union, ICT development was a direct factor on economic growth within all of the advanced economies (Fernández-Portillo et al., 2020). Bahrini and Qaffas (2018) analyzed developing countries in the Middle East, North Africa (MENA) region, and the Sub-Saharan Africa (SSA) region and found that heavy investment in ICTs infrastructure would greatly drive economic growth in all of the countries studied with the necessary implementation of new policies which is understandable as countries that are less advanced have not had the proper means and/or guidance to implement such infrastructure. Waverman et al. (2005) found that investment in telecommunications technologies is necessary for economies looking to advance and develop although it is recognized that policy change will be needed for such implementation which was the same consensus found within Bahrini and Qaffas' study. Through these various studies we can see that ICTs have had a positive impact on economies everywhere, not just in advanced nations as they have greater means for implementation.

ICTs adoption in Albania

According to the 2019 Global Competitiveness Report, Albania is currently ranked 75th/141 in terms of ICT adoption and the most recent data available in terms of ICT adoption are depicted in Table 1 below (Schwab, 2019).

Table 1: ICT Adoption – Albania

	Value	**Score**	**Rank/141**	**Best Performer**
ICT adoption	-	52.9	75	Korea, Rep.
Mobile-cellular telephone subscriptions per 100 pop.	94.2	78.5	110	Multiple (63)
Mobile-broadband subscriptions per 100 pop.	62.8	N/A	86	United Arab Emirates
Fixed-broadband Internet subscriptions per 100 pop.	12.5	25.0	67	Switzerland
Fibre internet subscriptions per 100 pop.	1.7	N/A	58	Korea, Rep.
Internet users % of adult population	71.8	71.8	62	Qatar

Source: Schwab (2019)

Based on the data, we can see that most of the population (approximately 95%) use mobile devices yet only an estimated 71% of the adult population are internet users. For comparison purposes, the United States as of 2019 has had an estimated 85.5% internet user penetration rate (Johnson, 2021). For comparison purposes, as of 2019, Qatar has had a 100% population rate of individuals using the internet (The World Bank, 2021). Although the status of these nations cannot be directly compared due to different historical backgrounds, population, as well as many other factors, the purpose of these comparisons is to have an overview of where different nations of the world are from a technological standpoint.

In regards to Albania, the data shows that there are positive trends in terms of the ICT centric innovation system, yet there are multiple areas for improvement which have been identified (ICT Centric Innovation Ecosystem, 2016). Sevrani and Bahiti (2013) found that ICTs have been directly linked to the growth of small and medium-enterprises (SMEs) in Albania as well. Prodani et al. (2018) found that in the specific case of Albania, ICTs have greatly increased the impact on every area of human life. It was found that innovation factors stemming from ICTs are the way to go to increase productivity and improve the quality of life (Prodani et al., 2018). Kordha Tolica et al. (2015) in a case study of Albania analyzed the use of ICTs and social development and it was found that the development of the ICT sector depends not only on the political, economic, and social conditions of a country, but also on the phase of e-readiness of the society. It does not only come down to having the available means necessary to purchase ICTs, but rather to the implementation and openness of the people to make the necessary changes to move to a digital age, which is ultimately our future.

ICTs adoption in Armenia

According to the 2019 Global Competitiveness Report, Armenia is currently ranked 59th/141 and the most recent data available in terms of ICT adoption are depicted in Table 2 below (Schwab, 2019).

Table 2: ICT Adoption – Armenia

	Value	**Score**	**Rank/141**	**Best Performer**
ICT adoption	-	62	59	Korea, Rep.
Mobile-cellular telephone subscriptions per 100 pop.	121.3	100	62	Multiple (63)
Mobile-broadband subscriptions per 100 pop.	75.9	N/A	70	United Arab Emirates
Fixed-broadband Internet subscriptions per 100 pop.	11.8	23.5	71	Switzerland
Fibre internet subscriptions per 100 pop.	5.5	N/A	40	Korea, Rep.
Internet users % of adult population	64.7	64.7	77	Qatar

Source: Schwab (2019)

The World Bank (2020) report titled "Realizing Armenia's High-Tech Potential" shows that Armenia is essentially thriving in the ICT services exports sector. Over the past 10 years, these ICT service exports have doubled. However, it was still found that ICT services are still directly responsible for a small portion of economic growth. As simply stated, there is always room for improvement. The European Training Foundation (2020) found that there has been a halt when it comes to digitalization in the private sector which is a recurring theme we have found within all the countries in the study. Hovhannisyan and Chobanyan (2018) found that, from both a micro and macro standpoint, several indicators ranging from e-commerce to R&D to ICT adoption and so on are all directly linked to a growth in GDP. In addition, it was forecasted that with additional policies to be set in stone by the government of Armenia, a growing ICT industry will inadvertently not only benefit Armenia, but the world.

ICTs adoption in Bosnia and Herzegovina

According to the 2019 Global Competitiveness Report, BiH is currently ranked 80th out of 141 in terms of technological readiness (Schwab, 2019). Cvetkovic (2001) in a developmental study of IT in BiH found that "[as] BiH continues to transition into a market-based economy, and as observed in any other economy (developed or developing), ICTs will be required to play a vital and central role to the development of the BiH economy and society" and this finding supports our claim that the use of ICTs is necessary for economic growth. In BiH, there are limiting factors described as: "Lack of growth in the manufacturing and business sectors, and as a consequence, lack of ICT-related investments within the manufacturing and business sectors, a lack of focus and support for ICT within the BiH Government, [and] a lack of focus and support for ICT development throughout the IT (Cvetkovic, 2001)." It was found that "The BiH workforce does not yet possess the level of experience or knowledge (skill sets) that is required to facilitate such Internet-based or consultancy-based employment opportunities" but this can all be subject to change with the right mindset, willing government, and investors, and ready and able open-minded workforce (Cvetkovic, 2001). Table 3 below depicts the most recent data available relating to ICT adoption in BiH with BiH ranked as 80th/141 in terms of ICT adoption. (Schwab, 2019).

Table 3: ICT Adoption – Bosnia and Herzegovina

	Value	**Score**	**Rank/141**	**Best Performer**
ICT adoption	-	51.6	80	Korea, Rep.
Mobile-cellular telephone subscriptions per 100 pop.	104.1	86.8	92	Multiple (63)
Mobile-broadband subscriptions per 100 pop.	55.4	N/A	97	United Arab Emirates
Fixed-broadband Internet subscriptions per 100 pop.	20.9	41.7	50	Switzerland
Fibre internet subscriptions per 100 pop.	0.1	N/A	100	Korea, Rep.
Internet users % of adult population	70.1	70.1	67	Qatar

Source: Schwab (2019)

In addition, Digital Innovation Profile Bosnia and Herzegovina (2018) reported that when it comes to government spending in BiH, "Government procurement does not include advanced technical products, and the private sector is not encouraged to invest in R&D."

ICTs adoption in Croatia

According to the 2019 Global Competitiveness Report, Croatia is currently ranked 60th/141 in terms of ICT adoption and the most recent data available in terms of ICT adoption are depicted in Table 4 below (Schwab, 2019).

Table 4: ICT Adoption – Croatia

	Value	Score	Rank/141	Best Performer
ICT adoption	-	60.7	60	Korea, Rep.
Mobile-cellular telephone subscriptions per 100 pop.	105.6	88	90	Multiple (63)
Mobile-broadband subscriptions per 100 pop.	79.5	N/A	63	United Arab Emirates
Fixed-broadband Internet subscriptions per 100 pop.	27.0	53.9	39	Switzerland
Fibre internet subscriptions per 100 pop.	1.3	N/A	67	Korea, Rep.
Internet users % of adult population	72.7	72.7	60	Qatar

Source: Schwab (2019)

Martinovic et al. (2014) found that the ICT industry in Croatia has had a significant impact on the country's GDP. Čutura and Selak (2017) found that that Croatian ICT sector grows ~10% per year and that the government itself is overall the largest investor in the ICT sector. By investing in the ICT sector, they are essentially working towards an input-output flow method that serves as a win-win situation on both sides. Keček et al. (2016) found that as with all national economies, economic growth and development in terms of ICTs are directly related as well.

Serbia Current State: ICTs

"Serbia is becoming one of Europe's most attractive IT hot spots" and it was found that the nation is flourishing in terms of ICTs positively impacting the economy (ICT Sector in Serbia, 2015). According to the 2019 Global Competitiveness Report, Serbia is currently ranked 77th/141 in terms of ICT adoption. The country went down seven rankings from the previous year which shows quite the negative decline but due to the integration of ICTs in Serbia, there is still an advantage to be noted. In a study conducted by the European Commission, it was found that "While many indicators show the growing importance of the ICT sector in the Serbian economy, there is a need to evaluate industry performance, its main trends and key challenges in terms of future development plans, particularly taking into account the strategic position of the industry for the country's competitiveness" (Kleibrink et al., 2018). This is the reoccurring factor we continue to see for all of the countries listed in this study. Table 5 below shows the data regarding ICT adoption in Serbia.

Table 5: ICT Adoption – Serbia

	Value	Score	Rank/141	Best Performer
ICT adoption	-	52.6	77	Korea, Rep.
Mobile-cellular telephone subscriptions per 100 pop.	97.6	81.4	104	Multiple (63)
Mobile-broadband subscriptions per 100 pop.	60.7	N/A	89	United Arab Emirates
Fixed-broadband Internet subscriptions per 100 pop.	16.8	33.5	57	Switzerland
Fibre internet subscriptions per 100 pop.	0.9	N/A	73	Korea, Rep.
Internet users % of adult population	73.4	73.4	58	Qatar

Source: Schwab (2019)

In addition, Matijević and Šolaja (2020) found that modernization of the Serbian economy with the help of ICTs is ultimately what will drive the continual annual GDP growth.

ICTs adoption in Slovenia

According to the 2019 Global Competitiveness Report, Slovenia is currently ranked 40th/141 in terms of ICT adoption, proving to be the country with the highest ICT adoption rate out of all of the countries in this study. Table 6 below shows the most recent data available in terms of ICT adoption in regards to Slovenia (Schwab, 2019).

Table 6: ICT Adoption – Slovenia

	Value	Score	Rank/141	Best Performer
ICT adoption	-	69.2	40	Korea, Rep.
Mobile-cellular telephone subscriptions per 100 pop.	118.7	98.9	67	Multiple (63)
Mobile-broadband subscriptions per 100 pop.	77.7	N/A	64	United Arab Emirates
Fixed-broadband Internet subscriptions per 100 pop.	29.5	59.0	30	Switzerland
Fibre internet subscriptions per 100 pop.	9.4	N/A	27	Korea, Rep.
Internet users % of adult population	79.7	79.7	44	Qatar

Source: Schwab (2019)

To our surprise, with Slovenia ranking first out of the countries in our study in terms of ICT adoption, there was hardly any publicly-available research on how ICTs impact the country's GDP. Bucar et al. (2006) found that investments in the ICT sector significantly impact economic growth. However, there is still a gap in penetration levels. According to the OECD Economic Survey for Slovenia, a similar trend in BiH's case was seen where there is a need for better training and education on ICT usage overall which can ultimately lead to digitalization and economic growth (OECD, 2020).

Research Methodology

The overall theme of this study is to find how much of an impact specific ICTs have on the GDP of developing countries, through the use of a cross country-level analysis. The countries of focus in this study are Albania, Armenia, Bosnia and Herzegovina, Croatia, Serbia, and Slovenia and 10 specific indicators (listed below) will be analyzed. Through the use of a regression model, it will be possible to determine how much of an impact these specific ICTs have on the economic development of a country and how ICTs should be continued to be used and implemented to ensure further development. Stata, a statistical software, will be used to test the hypothesis of a positive effect of ICT diffusion on the economic growth of the 6 countries in the selection pool, for a period of 18 years (2000-2018). The data for the indicators being used were provided by the World Bank. Value -99 replaces missing values throughout the entire process.

The data set used for this research includes a total of 10 indicators: 1 dependent variable and 9 independent variables. It also includes an EU or non-EU indicator and the purpose of having this indicator is to categorize the countries. The EU countries being Croatia and Slovenia and the non-EU countries being Albania, Armenia, Bosnia and Herzegovina, and Serbia. It is important to note that the EU countries are classified as developed economies while the non-EU countries are classified as developing economies. These distinctions will play a valuable role in the latter portion of the study in terms of interpretation of results. Table 7 below shows the indicators used and their respective abbreviations.

Table 7: Definitions of the variables and their abbreviations

Variable	Abbreviation
Dependent Variable	
GDP per capita (current US$)	GDP
Independent Variables	
EU or Non-EU	EUorNonEU
Fixed-broadband subscriptions (per 100 people)	FBBS
Fixed telephone subscriptions (per 100 people)	FTS
Individuals using the internet (% of population)	IUI
Mobile cellular subscriptions (per 100 people)	MCS
Labor force participation rate, total (% of total population ages 15+) (national estimate)	LFPR
Unemployment, total (% of total labor force) (national estimate)	UNEMT

Foreign direct investment, net inflows (% of GDP)	FDI
Research and development expenditure (% Of GDP)	RADE

Source: Authors' own work

Results

With an overall summary for the whole sample put through Stata, the total number of observations, the mean, standard deviation, minimum, and maximum were found. Table 8 below shows us the summary results.

Table 8: Summary table for the whole sample

Variable Name	Observations	Mean	Standard Deviation	Minimum	Maximum
GDP	114	7896.696	6977.66	622.7421	27501.81
FBBS	97	10.75014	9.00952	.0001967	29.48918
FTS	110	27.58787	12.25895	4.879359	51.39031
IUI	108	40.07963	24.46873	.1140973	79.74998
MCS	110	83.06203	35.97816	.5696524	134.3387
LFPR	96	52.27397	6.717641	34.45	63.0214
RADE	87	.7683506	.6451594	.01611	2.5801
UNEMT	93	15.00016	6.316501	4.3706	31.1099
FDI	114	4.634263	2.826477	-.6905618	13.1017

Source: Authors' own work

From the summary results, there are multiple outputs that help shape the dataset without having every value from 2000-2018 for all 6 countries in the study present. The mean shows us an average estimated value for each individual indicator. The standard deviation shows us how much variation there is from the mean and the calculations can aid in further analysis of the spread of data points. What is important to note from the summary of results is the true number of observations taking into account missing values. The true number of observations is relatively low in order to compute highly accurate results however, the study was not halted due to a lack of data available. This motivated us even more to keep pushing forward as in the future, similar studies can be done based on the methodology used here and there should be enough data to go by to ensure the highest level of precision in terms of results.

Following the computation of the summary for the whole sample, the correlations were run. These results were divided based on the predefined categories: EU and non-EU countries. The significant correlations for the EU countries category are shown in Table 9 below and are denoted with an *.

Table 9: Correlation results for EU category

Variable Name	GDP	FBBS	FTS	IUI	MCS	LFPR	RADE	UNEMT	FDI
GDP	1.0000								
FBBS	**0.6258***	1.0000							
FTS	**0.7100***	0.2485	1.0000						
IUI	**0.7250***	**0.9294***	0.4147	1.0000					
MCS	0.4509	**0.5734***	0.2532	**0.5482***	1.0000				
LFPR	-0.3155	-0.3556	-0.1852	-0.2428	0.1784	1.0000			
RADE	**0.7311***	0.3611	**0.7085***	**0.5217***	0.4280	0.2388	1.0000		
UNEMT	0.0498	0.2258	0.1742	0.1386	-0.0932	**-0.7197***	-0.3324	1.0000	
FDI	-0.1336	**-0.6155***	0.0840	-0.4766	-0.4181	0.3207	0.0867	-0.2795	1.0000

Source: Authors' own work

From the correlation results for the EU category, it was found that the following ICT factors had a significant relationship with GDP: FBBS, FTS, IUI, and RADE. One indicator we would like to emphasize from these correlation results is the strong relationship between RADE with GDP, FTS, and IUI. RADE and R&D overall are key in digitalization and moving towards ICT implementation which in turn not only impacts a country's GDP, but a multitude of factors ranging from socio-economic factors to growth of knowledge through education to a betterment of the quality of life for the country's respective citizens. It is surprising to see that MCS had a less significant relationship with GDP as EU countries because wireless communications are already implemented in the EU countries.

Following the computation of the correlation results for the EU category, the same process was conducted for the non-EU category. The significant correlations for the category non-EU countries are shown in Table 10 below and are denoted with an *.

Table 10: Correlation results for non-EU category

Variable Name	GDP	FBBS	FTS	IUI	MCS	LFPR	RADE	UNEMT	FDI
GDP	1.0000								

FBBS	**0.6250***	1.0000							
FTS	0.2744	-0.3587	1.0000						
IUI	**0.6243***	**0.9852***	-0.3507	1.0000					
MCS	0.4167	**0.7767***	-0.3423	**0.7482***	1.0000				
LFPR	**0.7838***	0.2246	0.4116	0.2533	0.0445	1.0000			
RADE	**0.8005***	0.4290	0.0439	0.4525	0.1569	**0.7624***	1.0000		
UNEMT	**-0.6065***	0.0758	-0.4990	0.0779	0.1115	-0.8398*	**-0.5522***	1.0000	
FDI	**-0.5300***	-0.4394	-0.1646	-0.4849	-0.1191	-0.4360	**0.5187***	0.1722	1.0000

Source: Authors' own work

It was found that the following ICT factors had a significant relationship with GDP based off the correlation results: FBBS, IUI, and RADE. These results coincide with those in Table 9 however, it wasn't surprising to see that FTS and MCS had a below average relationship with GDP as non-EU countries are behind on implementing the newest technologies as well as having internet access throughout the entirety of the countries.

Lastly, a regression model was utilized for data analysis to show the true significance between if ICTs have a positive effect on GDP or not. The regression results for the category EU countries are shown in Table 11 below.

Table 11: Regression results for the EU countries category

Source	**Ss**	**df**	**MS**	Number of obs = 33 F(8,20) = 49.53 Prob > F = 0.0000 R-squared = 0.9429 Adj R-squared = 0.9238 Root MSE = 1567.7		
Model	973806352	8	121725794			
Residual	58985941.2	24	2457747.55			
Total	1.0328e+09	32	32274759.2			
GDP	**Coef.**	**SE**	**t**	**P > | t |**	**[95% CI]**	
FBBS	323.0803	186.323	1.73	0.096	-61.47151	707.632
IUI	2.834088	112.4454	0.03	0.980	-229.2418	234.91
FTS	412.1348	79.05057	5.21	0.000	248.9824	575.2871
MCS	30.00573	33.06499	0.91	0.373	-38.23704	98.24851

LFPR	-65.60885	228.8828	-0.29	0.777	-537.9997	406.782
RADE	3998.431	858.2145	4.66	0.000	2227.163	5769.698
UNEMT	-417.7469	175.4945	-2.38	0.026	-779.9498	-55.54412
FDI	93.31301	169.0196	0.55	0.586	-255.5263	442.1524
_cons	-6752.961	12890.64	-0.52	0.605	-33357.93	19852.01

Source: Authors' own work

Both the R-squared and adjusted R-squared values for the EU countries regression output are high, meaning that the variables used fit the model. The regression results for EU countries show that FTS ($p < .01$), FBBS ($p < .10$), and RADE ($p < .01$) are significant as expected. FTS, FBBS, and RADE were significant in the correlation analysis as well (reference Table 9). The coefficients for IUI, and MCS are positive but are shown to be statistically not significant according to the p| values. The model is not perfect but it still explains the level of GDP influenced by our independent variables.

The regression results for the category non-EU countries are shown below in Table 12.

Table 12: Regression results for non-EU category

Source	**Ss**	**df**	**MS**	Number of obs = 29 F(8, 20) = 18.08 Prob > F = 0.0000 R-squared = 0.8785 Adj R-squared = 0.8299 Root MSE = 471.96		
Model	32213003.5	8	4026625.44			
Residual	4454857.66	20	222742.883			
Total	36667861.2	28	1309566.47			
GDP	**Coef.**	**SE**	**t**	**P > | t |**	**[95% CI]**	
FBBS	-37.11346	55.34126	-0.67	0.510	-152.5533	78.32639
IUI	30.47441	18.55934	1.64	0.116	-8.239689	69.1885
FTS	15.7433	30.50554	0.52	0.611	-47.89014	79.37673
MCS	14.79007	6.979528	2.12	0.047	.2310259	29.34911
LFPR	-127.7896	30.44618	-4.20	0.000	-191.2992	-64.27994
RADE	1700.371	686.5662	2.48	0.022	268.2194	3132.523
UNEMT	-43.6577	28.43021	-1.54	0.140	-102.9621	15.64667

FDI	55.31684	41.22751	1.34	0.195	-30.68225	141.3159
_cons	8384.991	1819.501	4.61	0.000	4589.579	12180.4

Source: Authors' own work

Both the R-squared and adjusted R-squared values for the non-EU regression output are high, meaning that the variables used fit the model. However, the results for the non-EU countries have obvious differences from the ones for the EU countries, which is understandable considering the development of EU countries versus non-EU countries in other aspects such as political, social, education, and economic. The regression results show that MCS ($p < .05$) and RADE ($p < .05$) are significant. The coefficients for IUI and FTS are positive but are shown to be statistically not significant according to the p values and the coefficient for FBBS is negative, but not statistically significant.

Conclusions

A cross-reference analysis of ICT data ranging from 2000-2018 for Albania, Armenia, Bosnia and Herzegovina, Croatia, Serbia, and Slovenia was conducted based on location, size, similar historical backgrounds, among other factors. Armenia, a small yet prosperous country when looking at the data, is more developed now and is still developing on vast scales because IT infrastructure was developed within the country. The results show the significance of a few of the ICT variables. This is due to the small sample size and time limitation for data collection for other variables, such as education. A few major variables were included in comparison to the ICT variables. The findings show that the use of ICTs do in fact have a positive impact on the growth of a country's GDP. Fixed telephone subscriptions, fixed broadband subscriptions, as well as R&D investment show significant positive impact on the economy of EU countries. Mobile cellular subscriptions and R&D investment as well show significant positive impact on the economy of non-EU countries. Overall, a consensus was reached that R&D is a factor that on both sides positively impacts GDP and this is something that should be implemented in every country. It is notable that fixed broadband subscriptions and fixed telephone subscriptions are not statistically significant for non-EU countries, but it has merit as developing countries are directly implementing wireless technologies without investing much on wired connections.

Although some of the results were surprising as they do not show statistically significant coefficients, there are other factors that should be taken into account for further research and discussion. In order to get more meaningful results, a larger data set is needed consisting of a longer time frame and more variables which is something that can be considered for further studies. It is important to note that data prior to 2000 will be difficult to find, if available, due to the lack of data for the countries, particularly in Southern Europe, via public databanks. Missing variables also need to be taken into account although the data will be difficult to find, if available. The main goal of this study was to further emphasize and stress the importance of ICTs not only for a country's economy, but for a country's value and quality of life for its citizens. Developing countries need to invest more in R&D practices as well as start creating ways for the total population to have access to internet and telephone connections, whether they are wired or not. For future research, policies should be drafted and implemented within local, national, and international governments as there is a dire need for the inclusion of ICTs in all aspects of life. We

are currently in a digital age and the world is advancing faster than we know it. ICTs have changed the world and will continue to change the world for the better.

References

AIMS. (n.d.). *Information and Communication Technologies (ICT)*. Food and Agriculture Organization of the United States. Retrieved from http://aims.fao.org/information-and-communication-technologies-ict

Archibugi, D., & Pietrobelli, C. (2003). The globalisation of technology and its implications for developing countries: Windows of opportunity or further burden?. *Technological forecasting and social change*, *70*(9), 861-883.

Bahrini, R., & Qaffas, A. A. (2019). Impact of information and communication technology on economic growth: Evidence from developing countries. *Economies*, *7*(1), 21.

Bucar, M., Stare, M., & Jaklic, A. (2006). eStrategy and ICT investment in Slovenia. *BLED 2006 Proceedings*, 19.

Čutura, S., & SELAK, G. (2017). *The ICT sector in Croatia*. Belgium Embassy – Economic office, Belgium.

Cvetkovic, S. (2001). *Development Study for Information Technology in Bosnia & Herzegovina*. Deutschen Gesellschaft für Technische Zusammenarbeit, Germany.

Digital Innovation Profile Bosnia and Herzegovina (2018). *ICT centric innovation ecosystem snapshot. National Expert Assesment.* ITU. Retrieved from https://www.itu.int/en/ITU-D/Innovation/Documents/Publications/eBAT_Brochure%E2%80%93DIP%20BosniaH_431106_.pdf

European Training Foundation (2020). Digital Factsheet 2020. *Digital Skills and Online Learning in Armenia.* Retrieved from https://www.etf.europa.eu/sites/default/files/2021-03/digital_factsheet_armenia_0.pdf

Evangelista, R., Guerrieri, P., & Meliciani, V. (2014). The economic impact of digital technologies in Europe. *Economics of Innovation and new technology*, *23*(8), 802-824.

Feldstein, M. S. (2017). *Why is growth better in the United States than in other industrial countries* (No. w23221). National Bureau of Economic Research.

Fernández-Portillo, A., Almodóvar-González, M., & Hernández-Mogollón, R. (2020). Impact of ICT development on economic growth. A study of OECD European union countries. *Technology in Society*, *63*, 101420.

Hovhannisyan, H., & Chobanyan, A. (2018). Economy Impacts of ICT Industry: Case of Armenia. *Marketing and Management of Innovations*, *3*, 260-267.

ICT Centric Innovation Ecosystem (2016). *Country Review Albania. Telecommunication Development Sector.* ITU. Retrieved from https://www.itu.int/en/ITU-D/Innovation/Documents/Publications/Albania%20Country%20Review%20Innovation%20June%202016.pdf

ICT Sector in Serbia (2015). *Serbia – General Economic Overview.* Office of the commercial attache – Embassy of Belgium.

Jalava, J., & Pohjola, M. (2002). Economic growth in the new economy: Evidence from advanced economies. *Information Economics and policy*, *14*(2), 189-210.

Johnson, J. (2021). *Internet usage in the United States – Statistics & Facts.* Statista. Retrieved from https://www.statista.com/topics/2237/internet-usage-in-the-united-states/#dossierSummary.

Keček, D., Žajdela Hrustek, N., & Dušak, V. (2016). Analysis of multiplier effects of ICT sectors–a Croatian case. *Croatian Operational Research Review*, *7*(1), 129-145.

Kleibrink, A., Radovanovic, N., Kroll, H., Horvat, D., Kutlaca, D., & Zivkovic, L. (2018). The potential of ICT in Serbia: An emerging industry in the European context. *Luxembourg: Publications Office of the European Union*.

Kordha Tolica, E., Sevrani, K., & Gorica, K. (2015). *Information society development through ICT market strategies.*

Madden, G., & Savage, S. J. (1998). CEE telecommunications investment and economic growth. *Information Economics and Policy*, *10*(2), 173-195.

Martinovic, M., Pozega, Z., & Pudic, D. (2014). Use of ICT sector in order to improve and develop competitiveness of Eastern Croatian economy. *Economy of eastern Croatia yesterday, today, tommorow*, *3*, 84-96.

Massa, I. (2015). Technological change in developing countries: Trade-offs between economic, social, and environmental sustainability. *United Nations University-Maastricht Economic and Social Research Institute on Innovation and Technology (MERIT)*.

Matijević, & Šolaja. (2020). *ICT in Serbia at a glance*. Vojvodina ICT Cluster.

OECD. (2020). *OECD Economic Surveys: Slovenia*.

Prodani, R., Bushati, J., & Andersons, A. (2018) AN ASSESSMENT OF IMPACT OF INFORMATION AND COMMUNICATION TECHNOLOGY IN ENTERPRIZES OF KORÇA REGION IN ALBANIA. *DAUGAVPILS UNIVERSITATES SOCIALO ZINATNU FAKULTATES STARPTAUTISKO ZINATNISKO KONFEREN» U RAKSTU KRAJUMS*, 71.

Schwab, K. (2019). *The Global Competitiveness Report 2019*. World Economic Forum.

SEVRANI, K., & BAHITI, R. (2013, June). ICT in small and medium enterprises (Case of Albania). *International Conference on Balkan Studies.*

Sharafat, A., & Lehr, W. H. (2017). ICT-centric economic growth, innovation and job creation. *ITU, Geneva*.

Vreese, G. D. E. (2017). *Latest figures on ICT sector worldwide and its R&D investment*. EU Science Hub - European Commission.

Waverman, L., Meschi, M., & Fuss, M. (2005). The impact of telecoms on economic growth in developing countries. *The Vodafone policy paper series*, *2*(03), 10-24.

The World Bank. (2020). *Realizing Armenia's High-Tech Potential.* Washington DC.

The World Bank. (2021). *Individuals using the Internet (% of population) – Qatar.* Retrieved from https://data.worldbank.org/indicator/IT.NET.USER.ZS?locations=QA.