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The role of information and communication technologies in regional development

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1. Introduction

ICT is "the use of any computers, storage facilities, networks and other physical devices, infrastructure and processes to create, process, store, protect and exchange all forms of electronic data" (Search Data Center, 2019)

There is evidence that ICTs have an impact on economic growth, as well as that they are its result (Toader et al., 2018)

ICTs are seen as tools for “releasing the creative potential and knowledge embodied in people” (World Bank, 2018)

The purpose of this part of the study is to prove that certain components of ICT have a positive impact on economic development and growth.

We want to show that the impact of ICT on economic growth does not occur immediately, but it exists and plays an important role in the development of economic systems

Theoretical background

The existence of a positive relationship between investment in ICT and economic growth was shown on the basis of 27 Central and Eastern European countries (Madden and Savage, 1998). For that period of the study (1990-1995), investments in the development of telephone lines had the greatest return.

The use of data from 10 Latin American countries (1975-2003) showed the presence of a significant positive impact of ICT on economic growth (Veeramacheneni et al., 2007)

A study conducted in 18 Arab countries (for 1995-2013) showed that the development of ICT has a positive impact on economic growth (other indicators of the model were the rate of population growth, gross accumulation of fixed capital and the degree of openness of trade) (Hodrab et al., 2016)

An analysis of data from 34 OECD countries (1968-2013) showed that the number of Internet users has a positive impact on the annual economic growth rates per capita (Sezer and Abasiz, 2016)

The study of the impact of ICT infrastructure on GDP per capita and economic growth in the European Union countries (from 2000 to 2017) showed a positive impact of the number of subscriptions to mobile cellular communications and broadband Internet connection. (Toader et al., 2018)

The introduction of ICT has greatly influenced and modified the economic structure, contributed to the development of highly qualified industries and increased productivity (in some countries) ((Silva and Teixeira. 2011)

Yusuf, Y. T. (2021). *The Impact of Information and Communication Technology on Income Level and Economic Growth: Evidence from African Countries*

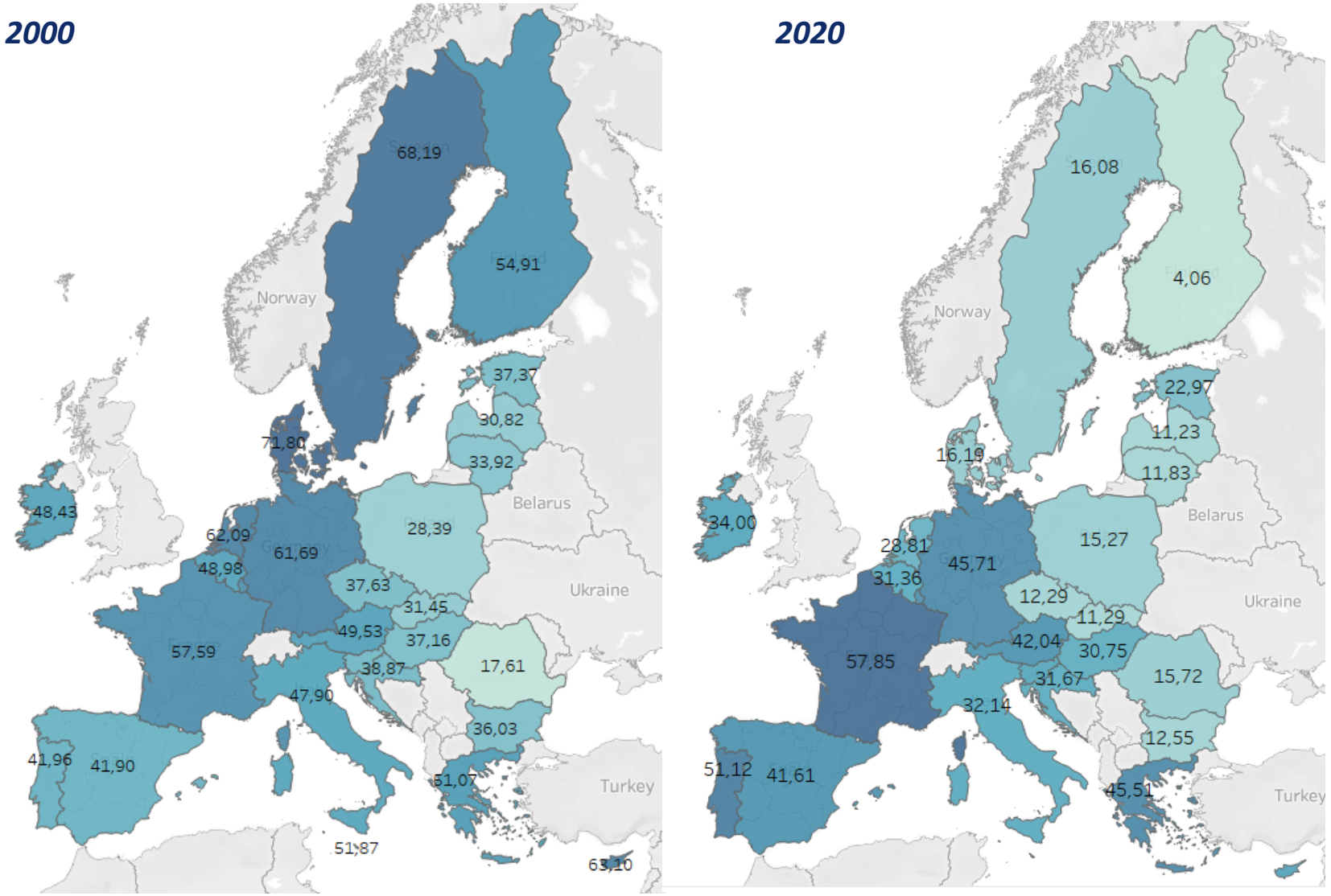
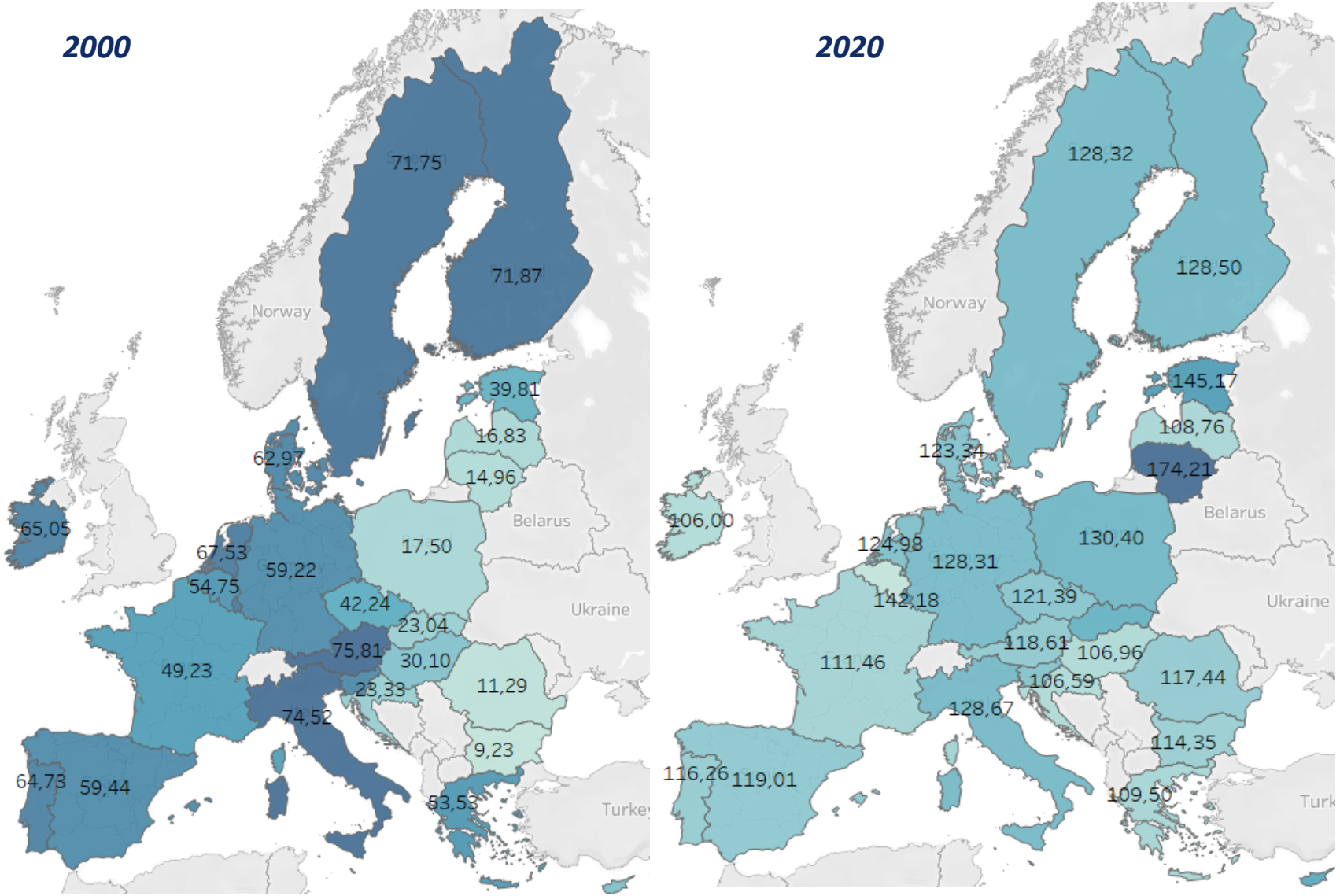


Fig.1. The number of fixed telephone subscriptions per 100 inhabitants in the countries of the European Union in 2000 and 2020

Fig.2. The number of mobile cellular subscription per 100 inhabitants in the countries of the European Union in 2000 and 2020



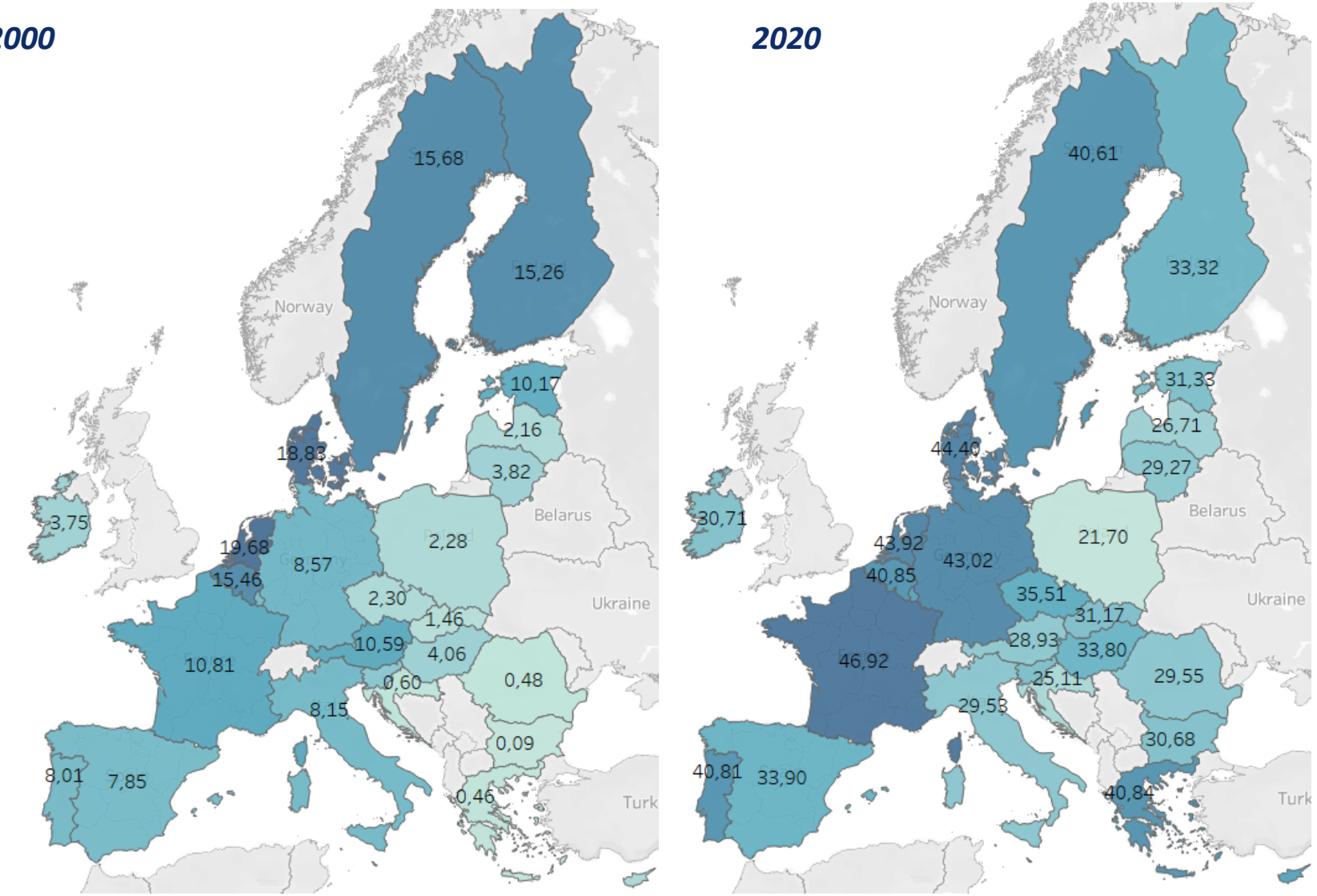
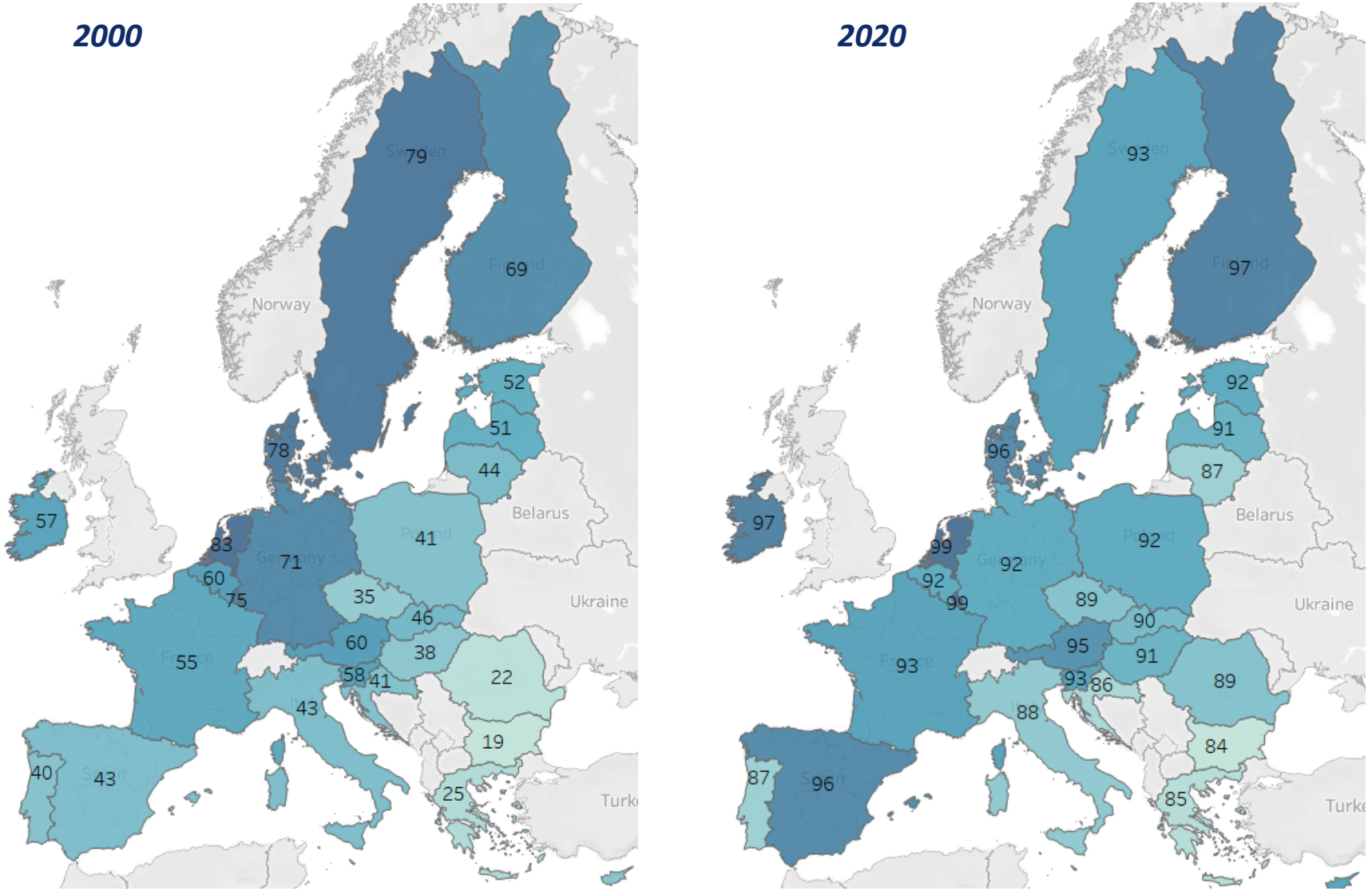


Fig.3. The number of fixed broadband subscription per 100 inhabitants in the countries of the European Union in 2000 and 2020

Fig.4. Internet users as percentage of population in the countries of the European Union in 2000 and 2020



Static approach to assessing the impact of ICT on economic development (stage 1)

An increase in the explanatory variables leads to a one-time increase in production per capita - the indicator moves from point A to a higher value - point B. If there is a decrease in the explanatory variable, then the AC trajectory is fulfilled - production per capita decreases one time. Let us note that in both the first and second cases the position B or C achieved is preserved in the future.

Compiled by the author according to Dornbusch, R., Fischer, S., & Startz, R. (2011). Macroeconomics (eleventh). *New York, NY, 10020;* Yusuf, Y. T. (2021). *The Impact of Information and Communication Technology on Income Level and Economic Growth: Evidence from African Countries* (Doctoral dissertation, Kwara State University (Nigeria)).

(a) Impact on the level of production per capita (Stage 1)

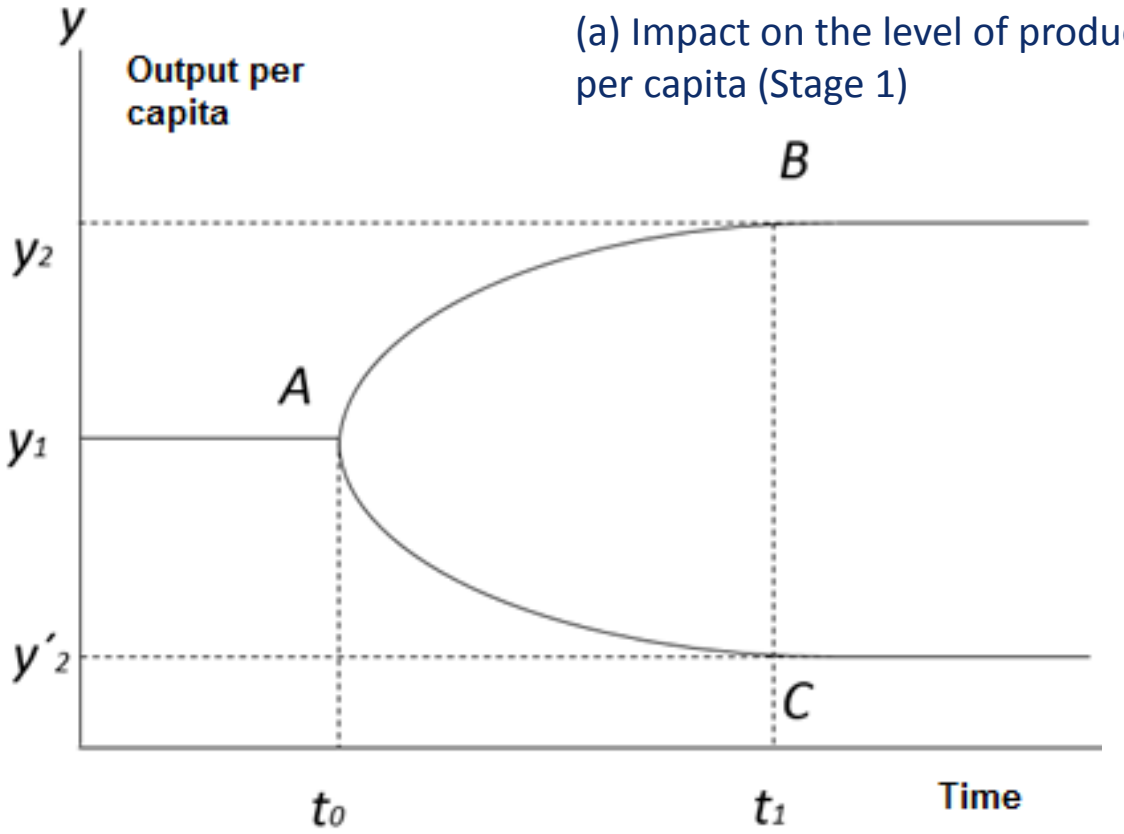


Fig.1. Effect of changes in explanatory variables on (a) per capita output and then on (b) economic growth

Static approach to assessing the impact of ICT on economic development (stage 2)

The corresponding effects on economic growth are shown in (b). An increase in the explanatory variable leads to a one-time increase in output per capita, while a decrease leads to a decrease, respectively. But when the effect is aimed at increasing the level of output per capita (not economic growth), this effect is short-lived, and in the long run the level of economic growth returns to the initial position.

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(b) The relevant impact on economic growth (Stage 2)

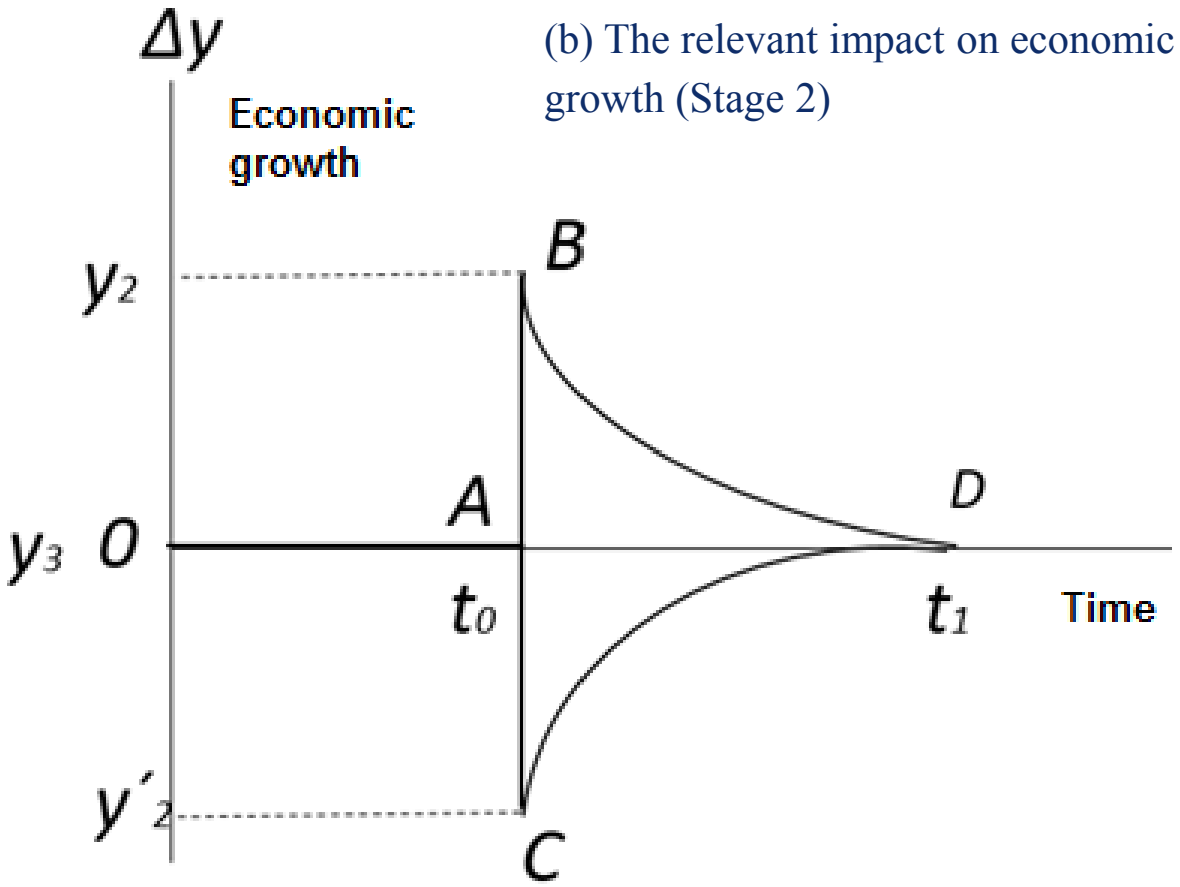
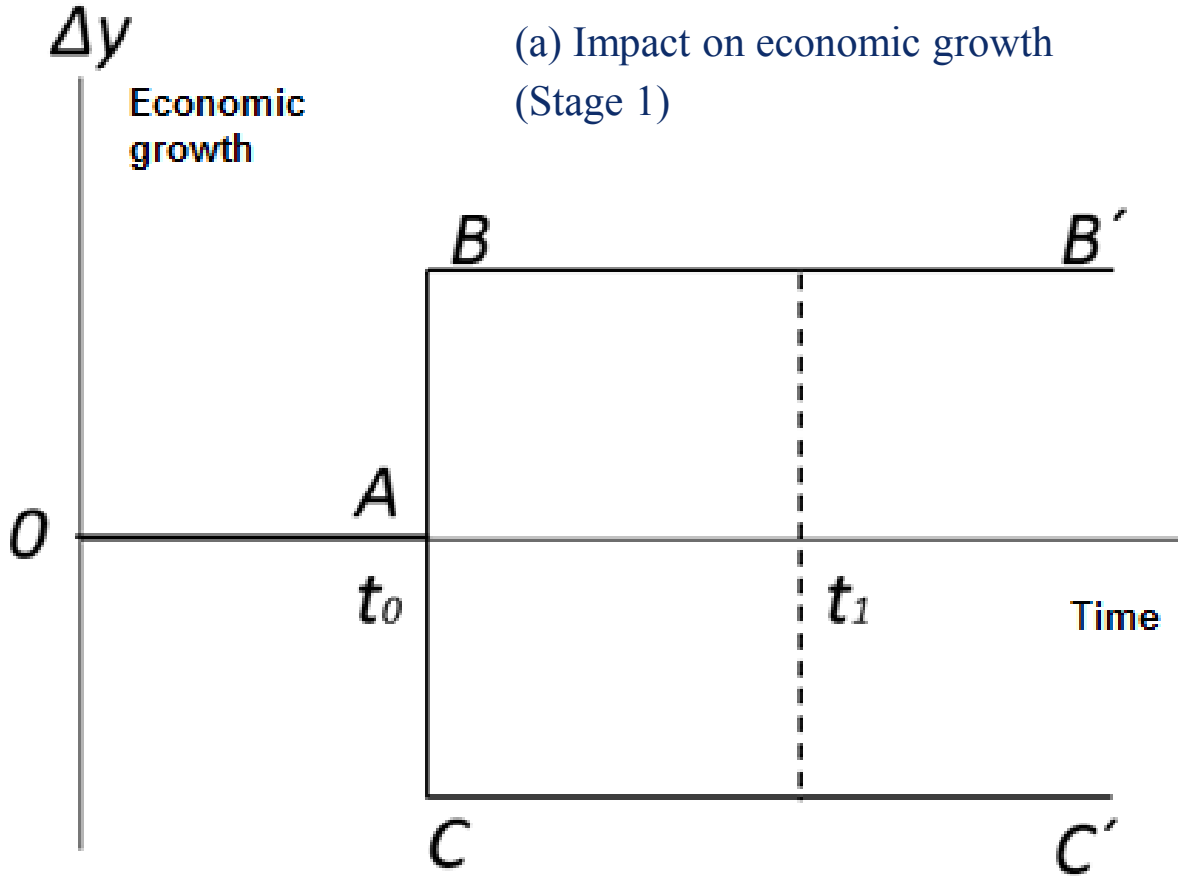


Fig.1. Effect of changes in explanatory variables on (a) per capita output and then on (b) economic growth



(a) Impact on economic growth (Stage 1)

Fig 2. Effect of changes in explanatory variables on (a) economic growth and then on (b) per capita output

Dynamic approach to assessing the impact of ICT on economic growth (stage 1)

If there is an effect on economic growth, a change in the explanatory variable will cause the rate of economic growth to rise or fall, and it will remain at the same level over time.

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(b) The corresponding effect on the level of production per capita (Stage 2)

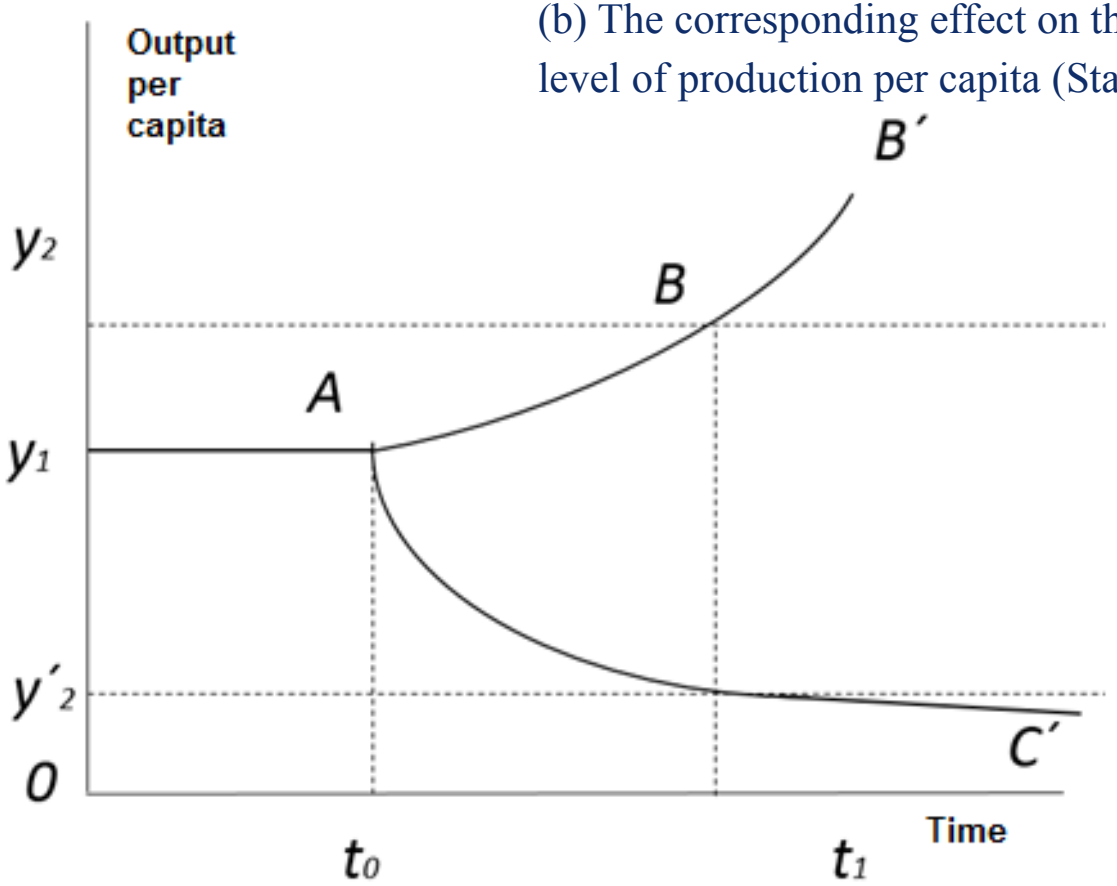

Fig 2. Effect of changes in explanatory variables on (a) economic growth and then on (b) per capita output

Dynamic approach to assessing the impact of ICT on economic growth (stage 2)

A sustained growth rate at a higher point (above zero) will result in a constant and exponential increase in output. A decrease in the rate of economic growth will lead to a monotonic decrease in output, but not to zero.

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Static approach to assessing the impact of ICT on economic development

$$Y = AF(K, L), \quad (1)$$

where ***Y***- output, ***A*** – technological progress, ***K*** – capital, ***L*** - labor

$$Y = AK^{\alpha}L^{1-\alpha} \quad (2)$$

where ***α*** - elasticity of output by capital

$$lnY = lnA + \alpha lnK + (1-\alpha)lnL \quad (3)$$

To get variables per capita, divide by L:

$$ln\left(\frac{Y}{L}\right) = lnA + \alpha ln\left(\frac{K}{L}\right) + (1-\alpha)ln\left(\frac{L}{L}\right) = lnA + \alpha ln\left(\frac{K}{L}\right) + (1-\alpha)ln1 =$$

$$lnA + \alpha ln\left(\frac{K}{L}\right) \quad (4)$$

Let

$$y \equiv \frac{Y}{L} \quad (5) \qquad \textbf{and} \qquad k \equiv \frac{K}{L} \quad (6)$$

where ***y*** – labor productivity, ***k*** – capital per capita. Then

$$ln(y) = \alpha ln(k) + lnA \quad (7)$$

Dynamic approach to assessing the impact of ICT on economic growth

$$Y = AF(K, L), \quad (1)$$

where ***Y***- output, ***A*** – technological progress, ***K*** – capital, ***L*** – labor

…

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$$\frac{\Delta y}{y} = \alpha \frac{\Delta k}{k} + \frac{\Delta A}{A} \quad (16)$$

Linear panel data-based equations

$$lnA = \beta_1 + \beta_2 lnICT + \beta_3 lnINV + \beta_4 lnGOV + \\ + \beta_5 lnEXP + \beta_6 lnINFL + \varepsilon \quad (17)$$

$$\frac{\Delta A}{A} = \beta_1 + \beta_2 lnICT + \beta_3 lnINV + \beta_4 lnGOV + \\ + \beta_5 lnEXP + \beta_6 INFL + \varepsilon \quad (18)$$

where ***ICT*** as ***FTS*** – fixed telephone subscriptions per 100 inhabitants;
MCS – mobile cellular subscription per 100 inhabitants;
FBS – fixed broadband subscription per 100 inhabitants;
IU – internet users as percentage of population;
INV – gross fixed capital formation as a ratio of GDP;
$\frac{\Delta A}{A}$ – economic growth;
A – real income per capita;
INFL – inflation rate;
GOV – general government final consumption expenditure ratio;
EXP – export of goods and services ratio (to GDP)

Table 1. Regression results, economic development, countries EU, 1960-2020

Variables	ln_FTS	ln_MCS	ln_FBS	ln_IU
Time	1960-2020	1980-2020	1998-2020	1990-2020
const	4,145*** (0,908)	6,694*** (1,073)	4,510*** (0,659)	6,509*** (1,097)
ICT	0,763*** (0,148)	0,075*** (0,018)	0,19*** (0,03)	0,063* (0,035)
ln_GovExp	0,683** (0,286)	0,762*** (0,268)	1,317*** (0,193)	0,808*** (0,289)
ln_EXP	0,305*** (0,088)	0,249*** (0,082)	0,326*** (0,045)	0,284*** (0,065)
ln_infl	-0,024*** (0,038)	-0,322*** (0,055)	-0,127** (0,047)	-0,33** (0,062)
Number of observations	1002	803	496	721
R^2	0,455	0,295	0,287	0,282
Standard model error	0,811	0,844	0,769	0,879

ICT as ***FTS*** – fixed telephone subscriptions per 100 inhabitants;
MCS – mobile cellular subscription per 100 inhabitants;
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INV – gross fixed capital formation as a ratio of GDP;
INFL – inflation rate;
GOV – general government final consumption expenditure ratio;
EXP – Export of goods and services ratio (to GDP)

Source: Author's computation, 2022. Explanatory Note: ***, ** and * indicate significance at the 1%, 5% and 10% level.

Variable ***ln_INV*** in all four models is not statistically significant, so it was removed from the table.

Conclusions 1 (for economic development)

1) the development of fixed telephony had a positive and significant impact on GDP per capita between 1960 and 2020;

2) the positive impact of mobile telephony was more pronounced in the period since 1980;

3) the number of fixed broadband subscribers had a positive impact on economic development since 1998;

4) the share of Internet users in the total population had a positive effect on the economy in the period since 1990;

5) cumulatively, the impact of ICT indicators on GDP per capita occurred from different starting periods, but persisted until 2020;

6) government spending, like exports, had a positive impact on economic development in the short term;

7) inflation, which is expected to be negative for economic development;

8) the impact of gross fixed capital formation in all static models is insignificant.

Table 2. Regression results, economic growth, countries EU, 1960-2020

Variables	ln_FTS	ln_MCS	ln_FBS	ln_IU
Time	1975-2020	1980-2001	1998-2020	1991-2006
const		2,000* (1,004)		
ICT	lag (3) 0,182** (0,066)	lag (1) 0,062* (0,036)	lag (5) 0,113*** (0,035) lag (6) -0,139*** (0,032)	lag (3) 0,060* (0,035)
ln_INV	0,933*** (0,167)	0,442* (0,223)	1,359*** (0,233)	0,872*** (0,284)
ln_GovExp	-1,209*** (0,177)	-1,179*** (0,334)	-1,455*** (0,220)	-0,978*** (0,3)
ln_EXP	0,273*** (0,057)	0,313*** (0,065)	0,27*** (0,083)	0,316*** (0,066)
Number of observations	803	267	319	285
R^2	0,623	0,149	0,649	0,693
Standard model error	0,830	0,741	0,745	0,792

Source: Author's computation, 2022. Explanatory Note: ***, ** and * indicate significance at the 1%, 5% and 10% level.

Variable *ln_infl* in all four models is not statistically significant, so it was removed from the table.

ICT as ***FTS*** – fixed telephone subscriptions per 100 inhabitants;
MCS – mobile cellular subscription per 100 inhabitants;
FBS – fixed broadband subscription per 100 inhabitants;
IU – internet users as percentage of population

INV – gross fixed capital formation as a ratio of GDP;
INFL – inflation rate;
GOV – general government final consumption expenditure ratio;
EXP – Export of goods and services ratio (to GDP)

Conclusions 2 (for economic growth)

1) the fixed telephone network has a positive effect on economic growth since 1975 (not since 1960, as in the impact on economic development) and with a lag of 3 years;

2) mobile telephone has a positive effect on economic growth with a lag of 1 year and in the 1980-2001 period (in the static analysis, the period to 2020);

3) the positive impact of fixed broadband can be traced to 1998 (as in the static analysis), but with a lag of 5 years;

4) the share of Internet users in the total population has a positive and statistically significant impact on economic growth between 1991 and 2006, with a lag of 3 years;

5) gross fixed capital formation has a significant and positive impact on economic growth;

6) exports have a positive impact in both groups of models;

7) in dynamic models, government spending has a negative impact on economic growth, indicating that it is an instrument of short-term impact on the economy;

8) the inflation indicator was excluded from the models due to statistical insignificance.

Conclusion

Why did we decide to conduct this study?

The ICT technologies discussed in this presentation are the results of yesterday's decisions.

Today, issues of the implementation of 5G technologies are being raised all over the world.

If we do not show that each ICT technology has a positive impact not only on economic development, but also on economic growth (which is not obvious without in-depth analysis), this may negatively affect policy decision-making in the future.