

ICT AND ECONOMIC GROWTH: EVIDENCE FROM CROSS-COUNTRY GROWTH MODELING

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ABSTRACT

The goal of this study is to explore the ICT-growth nexus in the framework of digital economy and innovation as a driver of economic growth across countries and regions. Using data for more than 170 countries over the period 1990-2019, we find that ICT index has positive impact on GDP growth overall. On the other hand, we also find that Internet users, mobile phone users and internet servers have inverted U-shaped association with GDP growth. The results suggest that innovative activities proxied by ICT and digitalization are instrumental for economic growth in the long run.

CCS CONCEPTS

• ICT, innovation, GDP growth, digitalization;

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1 INTRODUCTION

The ICT development has significantly increased since 1990's. For example, the share of world's population using Internet has increased from 0% in 1990 to 50% in 2020. The size of international digital economy is currently estimated at 11.5 trillion USD according to the Oxford Economics (2020). Therefore, it is important to assess whether rise of ICT has been a source of economic growth across nations. If so, what are the estimates and how these findings can be used by policymakers.

The goal of this research is to explore the relationship between ICT development and its measures on GDP growth across countries over the period 1990-2019. This research is novel for a number of reasons. First, we capture 171 countries from all income groups making our sample as large as possible. Second, our time period accounts for different economic crisis such as Asian crisis and

global financial crisis. Therefore, we take into account the impact of macroeconomic turbulences in the ICT-growth nexus.

Using fixed effects regression estimator, we find that overall ICT index is positive and significant in the cross-country growth regression. In particular, a standard deviation increase in the ICT index is associated with one percentage point increase in GDP growth rates. We also find that ICT sub-components are have non-linear (inverted U-shaped) relationship with GDP growth. For example, the turning point for the Internet users is 30% of population. The results are robust for a number of checks.

2 LITERATURE REVIEW

Nibel (2018) explores the relationship between ICT and economic growth in a sample of 59 nations over the period 1995-2010, using panel regression estimators. The findings of the study show that overall ICT development is important predictor of economic growth. The study also highlights that significant effect of ICT is robust across countries with different levels of economic development. The author highlights the need for further ICT investment to maintain stable rates of GDP growth. Stanley et al. (2018) relies on meta-regression method to investigate the effect of ICT on economic growth based on a sample of 59 published papers. In contrast to Nibel (2018), the study shows that various ICT proxies have different effects on GDP. Moreover, these effects are also conditional on the level of economic development. The study shows that effect of mobile phones penetration has much higher economic impact on GDP growth.

Majeed and Ayub (2018) relies on a larger sample of countries (N=149) over the period 1980- 2015 to explore the links between ICT and economic growth. The study uses different statistical method such as mean regression estimators, pooled, instrumental variable regression and generalized method of moments to robustly explore this relationship. The results show that ICT matters for economic growth. Moreover, empirical modeling shows that telecommunications and e-government have stronger impact on GDP growth. Aghaei and Rezagholizadeh (2017) focus on OIC nations while exploring the links between ICT and GDP growth. Using dynamic panel data estimators for the years 1990-2014, the authors show that ICT investments have positive impact on GDP growth rates. Therefore, the major policy conclusion is that more incentives should be made to promote investment in the ICT sector.

Albiman and Sulong (2017) suggest that there may be non-linear links between ICT and economic growth in Sub-Saharan Africa. Using data for 27 countries over the period 1990-2014, the study finds that only Internet development has positive impact across all

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Table 1: Summary Statistics

Variable	Description	Mean	Std. Dev.	Min	Max
y	GDP growth, % Source: World Bank	3.56	5.71	-64.05	149.97
GDP per capita	GDP per capita adjusted for PPP Source: World Bank	9.11	1.17	6.08	11.99
ICT index	ICT index Source: Word Bank, authors Estimates	0.00	1.31	-2.79	12.79
Investment	Gross fixed capital formation as % of GDP Source: World Bank	22.75	7.08	-2.42	93.55
Trade	Trade openness as % of GDP Source: World Bank	81.41	52.30	0.02	860.80
FDI	FDI as % of GDP Source: World Bank	7.02	51.27	-58.32	1846.60
Education	Education Index Source: UN	0.58	0.19	0.08	0.95
Government	General government final consumption expenditure as % of GDP Source: World Bank	16.29	7.92	0.91	147.73

income groups, while the effect of other ICT indicators is mixed depending on the level of economic development. Cortés and Navarro (2011) extend related research by exploring the effects of ICT on economic growth and human capital in 27 EU countries. The results suggest that information society is an essential aspect of economic growth in EU.

Saidi and Omri (2018) explore the relationship between ICT and economic growth in high income nations over the period 1990-2015. The study uses cointegration, unit root, vector error correction model as key methods. The results show unidirectional causality between mobile users and economic growth, and bi-directional between internet users and GDP growth. Vu (2011) explores the impact of ICT penetration on economic growth for the years 1996-2005 accounting for other antecedents of economic development. The author with the aid of GMM estimator documents that Internet has stronger impact on economic growth compared to mobile phone and personal computers penetration. Fernández-Portillo et al. (2020) relies on partial least squares estimator to assess the relationship between digital economy and economic growth of OECD countries. The results show that e-governance and e-commerce are important sources of economic growth.

A number of studies are devoted for single country analysis. For example, Jalava and Pohjola (2008) explore the roles of electricity and ICT in explaining GDP growth of Finland over the years 1990-2004. The effect of ICT at least three-fold stronger compared to energy consumption. The study pinpoints that innovation and digitalization are crucial tools to promote economic growth in region. Wang (1999) discusses the importance of ICT in the context of strategy for economic development of Taiwan based on IT sector development. The analysis based on the years 1983-1999 shows that adoption and penetration of ICT technologies by the population and companies leads to increase in economic growth.

3 DATA AND METHODOLOGY

The dependent variable in this study is GDP growth rate from the World Bank. In our sample GDP growth rates for the period 1990-2018 range from minus 64% to 150% with an average rate of 3.56%. The main independent variable in our study is ICT development index which was estimated with the help of principal component analysis from Internet users, mobile phone users and number of secured internet servers. The index scores estimated from the Stata range from - 2.79 to 12.79.

The econometric model exploring the relationship between ICT and economic growth can be expressed in the following general form:

$$y = \alpha + \beta * ICT + \gamma X + \epsilon \quad (1)$$

where y is GDP growth rate, ICT is our ICT development index, X is the vector of control variables, ϵ is an error term, α , β and γ are parameters to be estimated. As the vector of control variables, we include investment rate as % of GDP, trade as % of GDP, FDI as % of GDP, government consumption as % of GDP and education index. Table 1 presents descriptive statistics for the main variables. We estimate Eq. 1) using fixed effects regression estimator to take into account time invariant variables and reduce omitted variable bias.

4 RESULTS AND DISCUSSION

The main results are reported in Table 2. Column 1 offers the parameters assessing the ICT- growth nexus controlling only for the convergence effect by including lagged GDP per capita. As expected, GDP per capita is negative and significant, while ICT index has positive effect on GDP growth. The results suggest that there is convergence across nations. Quantitatively, a standard deviation increase in the ICT index is associated with one percentage points increase in GDP growth rates. We include other drivers of economic growth in column 2: investment, FDI, government size, education and trade. GDP growth increases in countries that have greater

Table 2: Main results

	I	II
GDP per capita	-17.1095 (14.11)***	-15.5263 (11.82)***
ICT	0.8319 (3.92)***	0.8716 (3.80)***
Investment		0.2022 (9.02)***
Trade		0.0460 (6.21)***
FDI		0.0037 (0.47)
Education		12.6921 (2.34)**
Government size		-0.1952 (5.05)***
Constant	163.3932 (14.42)***	134.4041 (11.50)***
R ²	0.13	0.20
N	1,900	1,388

* p<0.1; ** p<0.05; *** p<0.01

trade openness. In a similar vein, national investment rate is important to promote economic growth, as the coefficient is positive and significant at the 1% level. The positive effect of education (a proxy for human capital) on GDP growth is confirmed in our study. In line with Roy (2009), we find that government size has negative influence on GDP growth rates. With regards to our main variable of interest, ICT is again positive and significant. The results in Table 2 suggest that ICT development is important factor of economic growth even after accounting for other growth channels.

At the same time, it is important to assess the non-linear effects of ICT as suggested by extant research (Ali, 2020). Therefore, test separate non-linear effect of Internet users, mobile phone users and number of secured servers on GDP growth in Table 3. We find that all three variables have non-linear (inverted U-shaped) relationship with economic progress. For example, the turning point for the Internet is 30%. This implies that internet penetration has positive effect on economic growth until the share of population using Internet has reached 30%. Once Internet penetration exceeds this threshold further ICT development hampers economic growth. Overall, our findings confirm presence of 'leapfrogging' effect. Countries with underdeveloped ICT infrastructure may benefit from ICT development.

5 CONCLUSION

The goal of this study is to explore the relationship between ICT development and GDP growth rates in a sample of 172 nations over the period 1990-2018. The result from fixed effects regression modeling suggest that overall ICT development index is important predictor of economic growth. The disaggregated findings show that Internet users, mobile phones penetration and secured server number has inverted U-shaped relationship with GDP growth rates.

Thus, our results offer a number of policy implications. First, we provide evidence for the 'leapfrogging' effect of ICT on economic growth. Countries with poor ICT quality may significantly benefit from digitalization. Therefore, policymakers need to offer more stimulus for the adoption of ICT technologies by population and private sector. These technologies may be low interest business loans, grants and subsidies for the communities and tax cuts for companies shifting to digital sector. Our results also suggest that innovative activities as proxied by digital economy and ICT development are important drivers of economic growth for developing countries such as Uzbekistan.

REFERENCES

- [1] Aghaei, M., & Rezagholizadeh, M. (2017). The impact of information and communication technology (ICT) on economic growth in the OIC Countries. *Economic and Environmental Studies*, 17(2 (42)), 257-278.
- [2] Albiman, M. M., & Sulong, Z. (2017). The linear and non-linear impacts of ICT on economic growth, of disaggregate income groups within SSA region. *Telecommunications Policy*, 41(7-8), 555-572.
- [3] Ali, M. S. B. (2020). Does ICT promote democracy similarly in developed and developing countries? A linear and nonlinear panel threshold framework. *Telematics and Informatics*, 50, 101382.
- [4] Cortés, E. A., & Navarro, J. L. A. (2011). Do ICT influence economic growth and human development in European Union countries?. *International Advances in Economic Research*, 17(1), 28-44.
- [5] 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.
- [6] Jalava, J., & Pohjola, M. (2008). The roles of electricity and ICT in economic growth: Case Finland. *Explorations in Economic history*, 45(3), 270-287.
- [7] Majeed, M. T., & Ayub, T. (2018). Information and communication technology (ICT) and economic growth nexus: A comparative global analysis. *Pakistan Journal of Commerce and Social Sciences (PJCSS)*, 12(2), 443-476.
- [8] Niebel, T. (2018). ICT and economic growth—Comparing developing, emerging and developed countries. *World Development*, 104, 197-211.
- [9] Oxford Economics (2020). Digital Spillover: Measuring the true impact of the digital economy. <https://d2rpq8wtqka5kg.cloudfront.net/391958/open20170913102600.pdf>

Table 3: Non-linear effects of ICT on economic growth

	I	II	III
GDP per capita	-5.9326 (12.96)***	-6.1049 (13.29)***	-11.3091 (11.15)***
Internet	0.0304 (2.68)***		
Internet squared	-0.0499 (4.34)***		
Investment	0.1656 (12.08)***	0.1756 (12.88)***	0.1982 (9.79)***
Trade	0.0303 (8.29)***	0.0242 (6.53)***	0.0469 (6.98)***
FDI	-0.0031 (0.72)	-0.0023 (0.48)	0.0067 (0.90)
Education	12.2233 (6.34)***	11.5909 (5.47)***	11.3025 (2.49)**
Government	-0.1609 (6.77)***	-0.2014 (8.58)***	-0.1721 (4.89)***
Mobile		0.0273 (4.71)***	
Mobile squared		-0.0184 (5.78)***	
Servers			0.0000 (3.82)***
Servers squared			-0.0000 (2.84)***
Constant	47.2409 (12.19)***	49.3740 (12.41)***	95.5061 (11.58)***
R2	0.11	0.11	0.19
N	3,746	4,141	1,559

* p<0.1; ** p<0.05; *** p<0.01

- [10] Roy, A. G. (2009). Evidence on economic growth and government size. *Applied Economics*, 41(5), 607- 614.
- [11] Saidi, K., & Mongi, C. (2018). The effect of education, R&D and ICT on economic growth in high income countries. *Economics Bulletin*, 38(2), 810-825.
- [12] Stanley, T. D., Doucouliagos, H., & Steel, P. (2018). Does ICT generate economic growth? A meta-regression analysis. *Journal of Economic Surveys*, 32(3), 705-726.

- [13] Vu, K. M. (2011). ICT as a source of economic growth in the information age: Empirical evidence from the 1996–2005 period. *Telecommunications Policy*, 35(4), 357-372.
- [14] Wang, E. H. H. (1999). ICT and economic development in Taiwan: analysis of the evidence. *Telecommunications Policy*, 23(3-4), 235-243.