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Original Scientific Article

The Economic Impact of Internet Usage in Balkan Countries

Albina Hysaj[1]

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Abstract: *This paper attempts to analyze the impact of internet usage on economic growth in nine Balkan countries, namely Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia, Croatia, Bulgaria, Greece, and Romania, from 2010 until 2022 by incorporating several control variables such as foreign direct investment, governmental expenditures, net exports, and labor. Through a cross-sectional panel data analysis, the results indicate that internet usage, foreign direct investment, and labor have a statistically significant positive effect on economic growth. However, other variables such as governmental expenditures and net exports have a statistically significant negative effect on economic growth. The findings of this paper hold important implications for policymakers: enhancing digital connectivity and investing in ICT infrastructure, alongside supporting complementary growth factors, can substantially contribute to fostering economic growth in the region.*

Keywords: *Internet usage; Economic growth; Balkan countries; Panel data analysis*

JEL Classification: O47, O33

✉ ahysaj@epoka.edu.al
[1] Faculty of Economics and Administrative Sciences, Epoka University, Rruga Tiranë-Rinas, Km 12, 1039, Tirana, Albania

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1. INTRODUCTION

The internet is one of the most significant innovations of the twentieth century. Considering the role of the internet as a communication network, its implications in technology, commerce, and information flow are indisputable. There exist several theoretical and empirical models that link the development of the internet with economic growth. Endogenous growth models emphasize the role of human capital, knowledge, and innovation in technology as leading forces of long-term economic growth (Novales et al., 2009), through different channels such as lowering information costs, increasing the efficiency of the market, and optimizing resource allocation (Brookes & Wahhaj, 2001; Țurcan et al., 2023; Wang et al., 2022).

Moreover, several empirical studies subjecting different regions worldwide confirm the significant contribution of the internet to economic growth. Czernich et al. (2011), who investigate the impact of broadband penetration on economic growth in OECD countries from 1996-2007, find that a 10-percentage point increase in broadband penetration would contribute to an annual 0.9-1.5 percentage point increase in per capita growth. A later study for Latin America indicates that for the period 2010-2018, the increase in broadband connections has a significant positive effect on the economic growth of the region (Alderete, 2022). Furthermore, studies for Asia and ASEAN countries confirm the existence of a positive impact of broadband penetration on economic growth (Alam et al., 2019; Camba & Camba, Jr., 2020).

Even though there is a growing body of literature confirming a significant positive effect of internet usage on economic growth, there is a lack of evidence regarding the Balkan countries. The Balkan region represents a particularly important case study since it is mostly dominated by transitional economies with rapid development, which show a significant digitalization process as a necessity to fulfil the criteria for EU integration.

Balkan economies have several structural characteristics as well. The informal economy, supported by a high level of corruption, is still a significant challenge for Balkan countries (Mungiu-Pippidi, 2015). Moreover, due to continuous high migration rates, the Balkan countries are still heavily reliant on remittances (Jushi et al., 2021; Ziberi & Alili, 2021). At the same time, the economy is mostly dominated by sectors such as construction and tourism that are not directly related to the digitization process. Considering all those challenges in Balkan countries, the question is raised while the usage of the internet has a significant effect on economic growth in the region. Analyzing the impact of internet usage in Balkan countries has a particular academic and policy significance, with a special emphasis on enriching the literature of information communication technology by offering insights from the region and enabling policymakers to support their decisions with empirical analysis.

This study's purpose is to inspect the influence of internet usage on economic growth in Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia, Croatia, Bulgaria, Greece, and Romania for the period from 2010 to 2022, through a panel data analysis. The following section is a brief literature review of the relevant studies, which is followed by an explanation of the method and methodology used to capture the relationship between the variables used. Additionally, the findings and the conclusions are discussed.

2. LITERATURE REVIEW

An increasing number of studies investigate the impact of the internet on economic growth or other macroeconomic variables. Salahuddin and Gow (2016) analyze the short-run and long-run

relationship of internet usage, trade openness, and economic development on economic growth in South Africa from 1991 to 2013. The authors find a positive long-run relationship between internet usage, economic development, and economic growth. Moreover, the findings indicate that internet usage and economic development Granger-cause economic growth, marking significant implications for policymakers. Also, Haini (2022), who investigates the impact of the internet on economic growth in Southeast Asian countries from 1999 until 2017, finds that the internet has a positive impact on economic growth. By using a fixed-effects method of moment quantile regressions, the author finds that the effect of the internet is stronger for developed countries compared to developing countries.

Appiah-Otoo and Song (2021) conduct very inclusive research regarding the impact of internet usage on economic growth. The authors compose the ICT index by using variables such as mobile, internet, and fixed broadband use, and make a comparison of the ICT index on economic growth in 123 low-, medium, and high-income economies from 2002 until 2017. The findings of their study reveal that in all groups, the ICT Index positively affects economic growth, but it seems to be more beneficial in low-income countries. Similarly, Bhattacharya and Ghosh (2020) analyze the influence that internet usage has on economic growth for the period 2002-2011 in 39 middle- and low-income countries by using a panel data regression. The authors find that there is a significant and positive impact of the internet on economic growth in middle-and low-income countries, even though this impact is shadowed by the financial crises.

Li (2019) applies dynamic panel data to analyse the impact of the internet on economic growth in the Belt and Road Region for the period between 1996 and 2014. The author finds that there is a positive effect of the internet on economic growth. Moreover, the findings reveal that the effects are stronger when the level of development is higher. However, the impact of the internet on economic growth is strongly related to several macroeconomic factors, such as capital, labour, technological development, international trade, the level of economic development, and the economic structure of the country. The study implies that joint efforts towards internet development in the region would contribute to a higher impact on economic growth.

Choi and Hoon Yi (2009) investigate the influence of the internet on economic growth in 207 economies for the period 1991-2000 by using the internet user ratio as an explanatory variable, accompanied by several control variables such as investment ratio, government consumption ratio, and inflation. The authors find that the internet has a positive and significant impact on economic growth in the countries analyzed. Bahrini and Qaffas (2019) also investigate the impact of ICT on economic growth in MENA and Sub-Saharan countries from 2007-2016 by using several indicators of internet usage, such as fixed and mobile phones, internet usage, and broadband adoption. The findings reveal that mobile phones, internet usage, and broadband adoption have a significant positive impact in all countries.

The study of Noh and Yoo (2008) is particularly significant as it investigates the impact of internet adoption and income inequality on economic growth in 60 countries from 1995 to 2002 using panel data. The findings reveal that the effect of internet adoption on economic growth becomes negative in countries with high income inequality, as the digital divide limits the growth-enhancing benefits of internet adoption.

Based on the review of the literature, most of the studies support a positive relationship between internet usage and economic growth. However, the empirical evidence comes from Asian, African, and OECD countries. Given the economic specifics of the Balkan countries and considering

that there is no study investigating the relationship between internet usage and economic growth in Balkan countries, this study aims to fill this gap. The main hypothesis of this study is:

Hypothesis One: There is a statistically significant positive relationship between internet usage and the GDP Growth rate in Balkan countries.

3. METHODOLOGY

This study uses balanced panel data analysis to investigate the relationship between internet usage and economic growth in nine Balkan economies, such as Albania, Bosnia and Herzegovina, Montenegro, North Macedonia, Serbia, Croatia, Bulgaria, Greece and Romania, from 2010 until 2022. The dependent variable is the GDP growth rate as a proxy for economic growth. The explanatory variable is individuals using the internet as a percentage of the population. Moreover, other variables such as foreign direct investments, government expenditures, labor force participation, and net exports are used as control variables. All the data used are retrieved from the World Bank Database.

The general model is shown in equation 1:

$$GDP\ Growth_{it} = \beta_0 + \beta_1 \text{INTERNETUSERS}_{it} + \beta_2 \text{GOVEXP}_{it} + \\ + \beta_3 \text{NETEXP}_{it} \beta_4 \text{FDI}_{it} + \beta_5 \text{LABOR}_{it} + \mu_{it} \quad (1)$$

where,

- **GDP Growth** (GDP Growth_{it}) – dependent variable, GDP Growth Rate (%).
- **Internet users** ($\text{INTERNETUSERS}_{it}$)- independent variable, individuals using the Internet (% of population)
- **Governmental Expenditures** (GOVEXP_{it}) – independent variable, final consumption expenditure (% of GDP)
- **Net Exports** (NETEXP_{it}) – independent variable, net exports of goods and services (% of GDP)
- **Foreign Direct Investments** (FDI_{it}) – independent variable, foreign direct investment, net inflows (% of GDP)
- **Labor** (LABOR_{i}) – independent variable, labor force participation rate, total (% of total population ages 15-64)
- β_0 – intercept
- $\beta_1, \beta_2, \beta_3, \beta_4, \beta_5$ – coefficients of the independent variables.
- μ_{it} – error term, capturing all unobserved factors affecting GDP growth.
- i – cross-sectional unit (country).
- t – time period (year).

Several tests are conducted to ensure that the OLS estimation is unbiased. Initially, a multicollinearity test is performed to ensure that there is no correlation among independent variables that would affect their impact on the dependent variable. Table 1 shows that all correlation coefficients are below 0.8, indicating no evidence of severe multicollinearity among the independent variables.

The stationarity of the variables is evaluated by using the Phillips-Perron estimation. The results shown in Table 2 indicate that GDP, foreign direct investment, internet users, and labor are stationary at the level, while other variables, such as governmental expenditures and net exports, are stationary at the first difference. All the following estimations will be based on those results.

Table 1. Correlation matrix

	FDI	GOV_EXP	INTERNET_USERS	LABOR	NET_EXP
FDI	1.00				
GOV_EXP	0.33	1.00			
INTERNET_USERS	0.15	0.20	1.00		
LABOR	0.06	-0.17	0.08	1.00	
NET_EXP	-0.54	-0.77	-0.11	0.11	1.00

Source: Authors' calculation using E-Views 10

Table 2. Series stationarity estimation

Variable	Philips-Perron	Level Prob	Philips-Perron	1st Diff Prob
GDP	93.82	0.00		
FDI	51.78	0.00		
GOV EXP	15.87	0.60	91.14	0.00
INTERNET_USERS	85.70	0.00		
LABOR	93.43	0.00		
NET_EXP	18.95	0.39	96.71	0.00

Source: Authors' calculation using E-Views 10

The Hausman test is utilized to determine whether the Fixed or Random Effect model is more appropriate. The results indicate a chi-square statistic of 5.84 with 5 degrees of freedom and a probability value of 0.32. Since the p-value is above the 5% significance level, the null hypothesis cannot be rejected, implying that the Random Effect Model is more appropriate for the analysis.

Heteroskedasticity is tested by regressing the squared residuals on GDP and GDP^2. The results shown in Table 4 show that GDP^2 has a positive and significant effect. Also, the F-statistic shows that the regression is significant as well, meaning that the variance of the residuals is not constant and heteroscedasticity is present.

Table 3. Hausman Test

Test Summary	Chi-Sq. Stat	Chi-Sq. d.f.	Prob.
Cross-section random	5.84	5	0.32

Source: Authors' calculation using E-Views 10

Table 4. Heteroskedasticity – Breusch-Pagan Test.

Dependent Variable: RESID01^2				
Variable	**Coeff**	**Std. Error**	**t-Stat**	**Prob.**
C	4.473	1.475	3.033	0.003
GDP	0.121	0.286	0.423	0.674
GDP^2	0.127	0.033	3.857	0.000
F-statistic	7.504	**Prob(F-statistic)**		0.00

Source: Authors' calculation using E-Views 10

The results of the LM test for serial correlation are shown in Table 5. Neither of the coefficients of lagged residuals is significant. Moreover, the probability value of the F-statistic suggests that the model is not significant. The results reveal that the model does not suffer from serial correlation.

One of the key assumptions of OLS estimation is the zero conditional mean assumption, which indicates that the error term is not correlated with the explanatory variables. As shown in Table 6,

the coefficient of correlation between the residuals and other variables is almost zero. Moreover, the mean value of residuals is zero (1.54E-16), indicating that the zero conditional mean assumption is satisfied.

Table 5. LM Test for Serial Correlation.

Dependent Variable: RESID01				
Variable	**Coeff**	**Std. Error**	**t-Stat**	**Prob.**
RESID01(-1)	0.148	0.104	1.418	0.159
RESID01(-2)	0.149	0.115	1.291	0.2
F-statistic	1.449	**Durbin-Watson stat**		2.073
Prob(F-statistic)	0.197			

Source: Authors' calculation using E-Views 10

Table 6. Correlation matrix of residuals

	FDI	**D_GOV_EXP**	**D_NET_EXP**	**INTERNET_USERS**	**LABOR**
RESID01	-9.88E-17	5.04E-16	2.35E-16	5.37E-17	2.54E-16

Source: Authors' calculation using E-Views 10

4. RESULTS

Based on the Hausman test, the Random Effect Model is the most appropriate. In order to correct for heteroskedasticity, the White diagonal method is used, and the estimation output is shown in Table 7.

Table 7. Estimation output

Dependent Variable: GDP				
Method: Panel EGLS (Cross-section random effects)				
White diagonal standard errors & covariance (d.f. corrected)				
Variable	**Coeff**	**Std. Error**	**t-Stat**	**Prob.**
C	0.0319	0.720	0.044	0.964
FDI	0.341	0.111	3.069	0.002
INTERNET_USERS	0.097	0.026	3.700	0.000
LABOR	0.326	0.128	2.549	0.012
D_GOV_EXP	-1.351	0.167	-8.045	0
D_NET_EXP	-0.322	0.148	-2.173	0.032
	Weighted Statistics			
R-sqrd	0.605	**Adj R-sqrd**		0.585
F-stat	31.28	**Prob(F-statistic)**		0

Source: Authors' calculation using E-Views 10

Table 7 presents the results of the Panel Estimated Generalized Least Squares (EGLS) estimator with cross-section random effects, using White diagonal heteroskedasticity-consistent standard errors and covariance matrix (d.f. corrected) to account for heteroskedasticity. The model is estimated using feasible generalized least squares (FGLS), with weighted statistics obtained from the EGLS transformation. The model explains approximately 60.5% of the variation in GDP growth ($R^2 = 0.605$), and the F-statistic indicates that the model is jointly significant.

Among the explanatory variables, internet users, foreign direct investment, and labour have positive and statistically significant effects on GDP growth, indicating that higher internet penetration, investment, and labour input contribute to economic growth. In contrast, government

expenditure growth and net export growth are negatively associated with GDP growth, suggesting that increases in these factors may exert short-term adverse effects on output.

The findings reveal that a one-unit increase in internet users is associated with a 0.097 percentage-point increase in the GDP growth rate. This suggests that higher internet penetration contributes to increased economic growth, possibly due to increased business productivity that comes from innovation and digitalization. Regarding the effect of foreign direct investments, a one-unit increase in FDI is associated with a 0.341 percentage point increase in the GDP growth rate. Also, a one-unit increase in labor is associated with a 0.326 percentage point increase in the GDP growth rate. These findings align with the endogenous growth theory, which determines technological progress, knowledge, investment, and efficient labor as the determinants of growth. On the other hand, a one-unit increase in net export is associated with a 0.323 percentage point decrease in the GDP growth rate. The findings indicate that increased net exports do not necessarily promote economic growth. Xi Wan et al. (2022), which investigates 130 developing countries, find that export-oriented policies may lead to deindustrialization, which reduces the contribution of the manufacturing sector to economic growth, particularly in developing and lower-income countries.

Regarding government expenditures, a one-unit increase in the government expenditure growth is associated with a 1.351 percentage point decrease in the GDP growth rate. The negative coefficient on government expenditure growth is consistent with the findings of Delgado (2023), who examined the relationship between public expenditure and economic growth in European Union countries during 2004–2019. The study found that total public expenditure has a statistically significant negative effect on economic growth, suggesting that higher levels of public spending do not necessarily translate into stronger economic performance, as they are aimed at increasing the well-being of the citizens.

The findings align with several studies that have explored the relationship between internet usage and economic growth. Choi and Hoon Yi (2009) concluded that the internet promoted economic growth from 1990 until 2000, utilizing cross-country panel data. Similarly, Czernich et al. (2011) reported that broadband infrastructure positively affects economic growth in OECD countries. However, it's noteworthy that some studies have observed a negative or mixed impact. For instance, Saidi et al. (2017) found that internet usage affects electricity consumption in the long run, which may indirectly influence economic growth.

Overall, the results highlight the importance of digital adoption, investment, and labour in promoting economic growth, while fiscal and trade factors may have complex short-term effects in the studied countries.

To assess the robustness of the findings, the model was re-estimated using a Fixed-Effects estimator with White-diagonal heteroskedasticity-consistent standard errors. The results, reported in Appendix A (Table A1), are consistent with the Random Effects model. Internet usage remained positively and statistically significantly associated with GDP growth, while the signs and significance of the remaining explanatory variables were unchanged. These findings confirm the robustness of the main results to an alternative panel estimation approach.

5. CONCLUSION

This study has investigated the role of internet users on economic growth in Balkan countries from 2010 until 2022, through a panel data approach by utilizing several controlling variables such as foreign direct investment, governmental expenditures, labour, and net exports. The results

indicate that internet usage, foreign direct investment, and labour have a significant positive effect on economic growth. On the other hand, governmental expenses and net exports negatively affect economic growth.

The findings of the study have significant implications. First, the positive effect of the internet on fostering economic growth emphasizes the role of connectivity in economic development. Investing in ICT infrastructure would contribute to boosting economic growth. Second, the positive effect of labor and foreign direct investment emphasizes that maintaining a good climate for investment and focusing on increased participation in the labor market are crucial for economic growth. Third, the negative impact of governmental expenditures and net exports suggests inefficiencies in public spending and trade. The right policies in public spending and diversification of exports may contribute to economic growth.

In conclusion, the study provides empirical evidence that internet usage plays a vital role in promoting economic growth in Balkan countries, reinforcing the importance of digital strategies as part of broader economic development policies. Strengthening ICT infrastructure, supporting investment, and enhancing labour market efficiency, while addressing structural inefficiencies in fiscal and trade sectors, can jointly create a more sustainable growth trajectory for the region.

This study has several limitations that should be acknowledged. Although the Random Effects model provides reliable estimates, endogeneity may still be present, as higher economic growth may also encourage more investment in digital infrastructure, while other unobserved factors could influence both internet use and economic growth. Future research could address these limitations by using alternative econometric approaches and broader measures of digitalization.

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APPENDIX A.

Table A1. Fixed effect model

Dependent Variable: GDP				
Method: Panel EGLS (Cross-section fixed effects)				
White diagonal standard errors & covariance (d.f. corrected)				
Variable	**Coeff**	**Std. Error**	**t-Stat**	**Prob.**
C	-0.957	0.731	-1.310	0.193
FDI	0.553	0.160	3.468	0.001
INTERNET_USERS	0.100	0.023	4.289	0.000
LABOR	0.288	0.131	2.203	0.030
D_GOV_EXP	-1.378	0.163	-8.479	0.000
D_NET_EXP	-0.332	0.146	-2.266	0.026
	Weighted Statistics			
R-sqrd	0.658	**Adj R-sqrd**		0.611
F-stat	13.93	**Prob(F-statistic)**		0