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Conference Paper — Published Version

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Suggested Citation: Osmanbegović, Edin; Pirić, Nedžad (2025) : The Influence of Digital Infrastructure on the Connectivity in Bosnia and Herzegovina, In: Gadžo, Amra Klapić, Hidajet (Ed.): Regenerative and Digital Economy: Southeastern Europe's Path to Sustainable Competitiveness, University of Tuzla Faculty of Economics, Tuzla, pp. 215-227, <http://icei.ba/zbornik-radova/>

This Version is available at:

<https://hdl.handle.net/10419/343399>

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THE INFLUENCE OF DIGITAL INFRASTRUCTURE ON THE CONNECTIVITY IN BOSNIA AND HERZEGOVINA

ABSTRACT

This study explores the influence of digital infrastructure on household connectivity from the perspective of citizens in Bosnia and Herzegovina, responding to a notable gap in empirical research on digital inclusion at the national level. As digital technologies increasingly shape access to services and opportunities, understanding how citizens perceive public and private investment in ICT infrastructure becomes critical. Based on a representative sample of 1,547 citizens ($n = 171$), the study examines how perceptions of government and telecom operator investments, alongside the perceived accessibility of digital infrastructure, impact the extent of fixed and mobile internet usage within households. The findings reveal that citizens' confidence in institutional and corporate commitment to digital infrastructure development significantly correlates with higher levels of household connectivity. This underscores the importance of not only expanding access but also improving public trust in the digital ecosystem. The study highlights disparities in perceived infrastructure availability, indicating that equitable digital access remains a persistent challenge. These insights offer actionable recommendations for policymakers and telecom providers aiming to foster inclusive digital development, particularly in underserved regions of Bosnia and Herzegovina.

Keywords: digital infrastructure, internet connectivity.

JEL: L96, L86

1. INTRODUCTION

Digital infrastructure forms the foundational backbone through which digital connectivity is enabled, expanded, and sustained at individual, regional, and national levels. It encompasses the physical and organizational structures needed for the operation of information and communication technologies (ICT), including broadband networks, data centers, mobile networks, and related hardware and software systems. In the context of Bosnia and Herzegovina, digital infrastructure plays a critical role in shaping the patterns and quality of connectivity among citizens, businesses, and public institutions. While global digital transformation is accelerating, the disparities in digital infrastructure within Bosnia and Herzegovina highlight a crucial gap in ensuring equitable access to digital services, which, in turn, affects the ability of society to fully engage with and benefit from the digital economy.

Connectivity, understood as the ability to access and effectively use digital networks and services, is influenced not only by the presence of digital infrastructure but also by socio-economic, geographic, and institutional factors. Robust digital infrastructure can act as an enabler of connectivity by reducing barriers to Internet access and improving the quality of service, thereby fostering digital inclusion. Conversely, inadequate or unevenly distributed infrastructure perpetuates digital divides, restricting access to vital digital resources for large segments of the population, especially in rural and underserved areas of Bosnia and Herzegovina. Moreover, connectivity goes beyond mere access — it encompasses the capacity of users to engage meaningfully with digital platforms, which depends on factors such as affordability, digital skills, and relevant content.

The development and maintenance of digital infrastructure in Bosnia and Herzegovina are strongly influenced by policy frameworks, regulatory environments, and investment priorities set by governmental institutions and private sector actors. These institutional arrangements either stimulate or hinder the deployment of modern ICT infrastructure, affecting overall connectivity levels. For instance, regulatory bottlenecks or lack of coordination between different governing bodies can delay infrastructure projects or limit competition among service providers, impacting the affordability and quality of connectivity. Therefore, understanding the interplay between infrastructure development and institutional factors is crucial to devising effective strategies that enhance digital connectivity nationwide.

From a broader perspective, digital infrastructure is a key determinant of the digital economy's growth and sustainability. High-quality connectivity enabled by well-developed infrastructure allows businesses to operate more efficiently, innovate, and access new markets, thus fostering economic growth and social development. For citizens, improved connectivity facilitates access to education, healthcare, government services, and social participation, which are increasingly digital. However, the unequal distribution of digital infrastructure in Bosnia and Herzegovina raises concerns about social exclusion and economic disparity, underscoring the need for policies that prioritize inclusive infrastructure development.

The presented research examines the influence of digital infrastructure on connectivity patterns within Bosnia and Herzegovina, aiming to identify critical challenges and opportunities affecting citizens' digital engagement. The research starts with a literature review situating digital infrastructure and connectivity within global and regional frameworks, followed by a methodology section outlining the empirical approach for analyzing infrastructure availability and connectivity metrics. The results section presents findings on the current state and trends of digital infrastructure in Bosnia and Herzegovina and their impact on connectivity disparities. Finally, the study concludes with recommendations for fostering an inclusive and resilient digital infrastructure ecosystem that supports sustainable connectivity and digital economy growth.

2. LITERATURE REVIEW

Digital infrastructure represents the foundational technological framework that underpins modern connectivity systems, serving as the cornerstone for economic growth, social inclusion, and technological innovation. The relationship between digital infrastructure and connectivity has emerged as a critical area of research, particularly as nations worldwide recognize the transformative potential of robust digital ecosystems in driving economic development and societal advancement. The conceptual foundation for understanding digital infrastructure was established by KPMG (2020), which defined digital infrastructure as "an ecosystem of interconnected devices that exchange information with each other, including access to network connections, ICT devices, software and applications." This comprehensive definition highlighted the interconnected nature of digital systems and established the framework for subsequent research examining the relationship between infrastructure development and connectivity outcomes.

Some authors (Cavallo et al., 2022) investigated the resilience aspects of digital infrastructure during global disruptions, particularly focusing on the COVID-19 pandemic's impact on connectivity requirements. Research findings underscored how investments in digital infrastructure enhance business resilience and enable organizations to maintain connectivity during unprecedented challenges, thereby demonstrating the strategic importance of infrastructure development for sustained economic activity. A large number of authors emphasize the need for countries to invest in infrastructure, talent development and digital technology to improve their competitiveness in the global digital economy, highlighting the transformative potential of robust digital infrastructure in driving economic growth and innovation (Di et al., 2022).

The OECD (2022) contributed to the discourse by emphasizing coordinated approaches to infrastructure development, highlighting that countries effectively aligning infrastructure investment with digital skills development and policy reform tend to exhibit stronger digital economies and more inclusive growth patterns. This research established the importance of holistic infrastructure planning in achieving optimal connectivity outcomes. Research in 2023 focused significantly on the transition to next-generation connectivity technologies.

The ITU (2023) conducted comprehensive analysis on mobile broadband penetration as a critical driver of connectivity, particularly in regions with limited fixed infrastructure. The research demonstrated that while 4G networks transformed access in developing regions, the transition to 5G and fiber broadband remains essential for meeting the demands of data-intensive applications and future digital services.

The Cisco Annual Internet Report (2023) provided empirical evidence supporting the relationship between strategic fiber optic expansion and digital adoption rates. Their analysis showed that countries investing systematically in next-generation networks experience accelerated digital adoption and more effective closure of digital divides, reinforcing the causal relationship between infrastructure quality and connectivity accessibility. Different research concluded that connectivity improvements facilitated by advanced digital infrastructure are crucial for supporting economic growth, competitiveness, and bridging regional and enterprise-level disparities (Osei, 2024).

The World Economic Forum (2023) synthesized international research to emphasize coordinated approaches combining infrastructure investment, digital skills development, and policy reform. Their comprehensive analysis demonstrated that countries successfully aligning these components exhibit stronger digital economies and more inclusive growth patterns, reinforcing the systemic nature of infrastructure-connectivity relationships.

The World Bank (2024) established digital infrastructure as "the first pillar of the digital economy," emphasizing that affordable and fast internet availability is essential for inclusive digital participation. Their definition encompasses highly developed connectivity networks, including broadband internet, internet exchange points, and IoT-enabling devices, reinforcing the fundamental role of infrastructure in enabling connectivity. Other authors concluded that the rapid development of multiple technologies, including big data, the Internet of Things, and cloud computing, is driving the modern economy into a phase of digital evolution (Piepponen et al., 2022).

The OECD Digital Economy Report (2024) provided the most comprehensive recent analysis of broadband infrastructure's critical role in enabling digital connectivity and economic growth. This report emphasized that investments in broadband infrastructure are essential for providing fast internet access across urban and rural areas, enabling comprehensive digital service deployment. The OECD (2024) report also highlighted significant disparities in broadband access between urban and rural areas, suggesting that addressing these disparities is vital for ensuring equitable access to digital opportunities. Furthermore, the research identified 5G network deployment as transformative for mobile network infrastructure, promising higher internet speeds, reduced latency, and enhanced device connectivity capabilities essential for IoT growth.

As demonstrated throughout this review, the nexus between digital infrastructure and connectivity represents a fundamental determinant of national competitiveness, social equity, and technological sovereignty in an increasingly interconnected world. The empirical evidence consistently underscores that nations failing to adequately invest in robust digital infrastructure risk systemic exclusion from the global digital economy, perpetuating socioeconomic disparities and limiting their capacity for sustainable development. Conversely, countries that strategically prioritize infrastructure-connectivity optimization position themselves to harness the transformative potential of emerging technologies, foster innovation ecosystems, and achieve inclusive economic growth. This literature review thus affirms that understanding and optimizing the digital infrastructure-connectivity relationship is not merely an academic exercise, but an urgent societal imperative that demands continued scholarly attention, empirical investigation, and interdisciplinary collaboration to inform evidence-based policy frameworks and strategic investment decisions that will shape the digital future of nations and communities worldwide.

3. RESEARCH METHODOLOGY

As part of the primary research (field research), data were collected using the survey method, using a survey questionnaire as a technical means of data collection. The collection of primary data for this research is part of a wider research. Primary data was collected using the snowball method, which was partly done electronically using Google Forms a platform for online surveys, and partly by personally surveying respondents. In principle, the

main advantage of the snowball or multiple sample is the economic efficiency of the procedure, given that it is formed in such a way that the researcher, on a case-by-case basis, identifies the initial persons who have the studied trait, and then asks them to identify other respondents who also have the same. In other words, based on the information obtained from the initial respondents, the subsequent ones are identified, and so on, hence the metaphorical name of the "snowball" sample.

In the process of data collection, the answers of 1547 respondents were collected, based on which empirical research will be carried out for the needs of this part of the work. The survey questionnaire that was used in the research was designed in several parts, so, in addition to the categorical socio-demographic characteristics of the respondents in terms of territorial distribution, gender, and the number of household members, they are through segmented parts of the same, collected data on the perception of of public sector investment, telecom operators' investment and perceived accessibility of ICT infrastructure.

The survey questionnaire, except for the question about territorial affiliation, is structured in the form of closed-ended questions, whereby the respondents had the opportunity to evaluate their degree of agreement with certain statements through the offered answer form in the form of a five-point Likert response scale.

The methods that will be used in the presented scientific research work to investigate and present the results of scientific research are inductive and deductive, methods of analysis and synthesis, comparative methods, and statistical methods. During the research, the analysis of relevant scientific research and studies in the form of books, textbooks, magazines, official publications, websites, as well as other relevant literature will be carried out. The inductive method will be applied in the reverse direction - to derive general propositions from individual facts. The deductive method will be used to derive appropriate concrete assumptions and conclusions from general statements. These two methods will be used to explain established and discover new knowledge and new laws, as well as to prove established theses and test hypotheses and predict future events.

The method of analysis will enable the explanation of the problem and the subject of research by breaking it down into simpler parts and researching each part separately concerning other parts, which will enable the observation, discovery, and study of the scientific truth about mutual relationships. The synthesis method will be used to combine the obtained research results into a single unit in which these results are mutually related. The comparative method will be used to compare the same or related facts, phenomena, processes, and relationships, i.e. it will help to establish their similarities in behavior and intensity, as well as the differences between them. Following the usual research standards in the social sciences, the data obtained from the questionnaire will be processed using SPSS modern software package for statistical analysis. Bearing in mind that the research hypotheses were formulated in such a way as to test the influence (causality) of one variable on another, and not the connection (connection) between the defined variables, regression analysis was used in the paper. The method of description will be used to describe facts and their empirical confirmation but without scientific interpretation and explanation.

3.1. Research variables

The variables observed in the context of the empirical research are:

The independent variable relates to the digital infrastructure. A digital infrastructure refers to the foundational technological systems and components that enable digital communications, data processing, and online services. It encompasses both physical and virtual elements that support the digital economy and society.

The dependent variable is related to the connectivity as a determinant of digital economy. The connectivity is one of the main dimensions that evaluates the EU's fixed and mobile broadband infrastructure through indicators measuring availability, adoption, and affordability.

Indicators for measuring independent variables are the functions of the digital infrastructure, as follows:

- Perception of public sector investment: The extent to which citizens believe that local (municipal and

cantonal) and state-level government institutions are investing in the development of ICT infrastructure to support business digitalization and the expansion of e-business.

- Perception of telecom operators' investment: Citizens' views on whether state-owned and private telecommunications operators are actively investing in the development of information and communication infrastructure with the goal of advancing digitalization and improving everyday life for the population.
- Perceived accessibility of ICT infrastructure: The degree to which citizens perceive information and communication infrastructure (e.g., high-speed internet, mobile network coverage) as being equally accessible to all members of society.

Indicators for measuring dependent variables are the functions of the Connectivity, as follows:

- Number of fixed internet connection users in the household
- Number of active mobile devices with internet access in the household,

The planned research will be based on the application of scientific methods of secondary and primary research.

4. RESULTS AND DISCUSSION

Inspecting the results of the research, 63% of respondents reside in the territory of the Federation of Bosnia and Herzegovina, 32.45% of them in the territory of Republika Srpska, and 4.55% in Brčko District of Bosnia and Herzegovina. This distribution reflects the demographic and economic weight of each entity and suggests a representative sample aligned with national population structures.

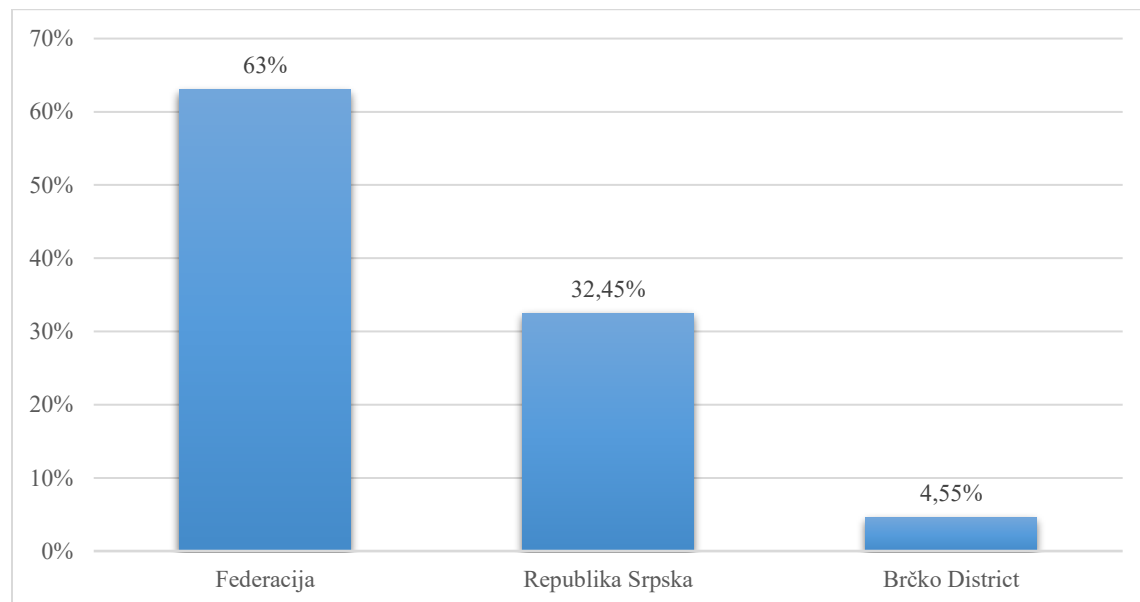


Fig.1. Respondent demographics based on entity

Source: Authors' research

If the location of the residence is considered according to whether it is an urban or rural environment, our research includes 78.98% of respondents who live in urban areas and 21.02% of respondents who live in rural areas.

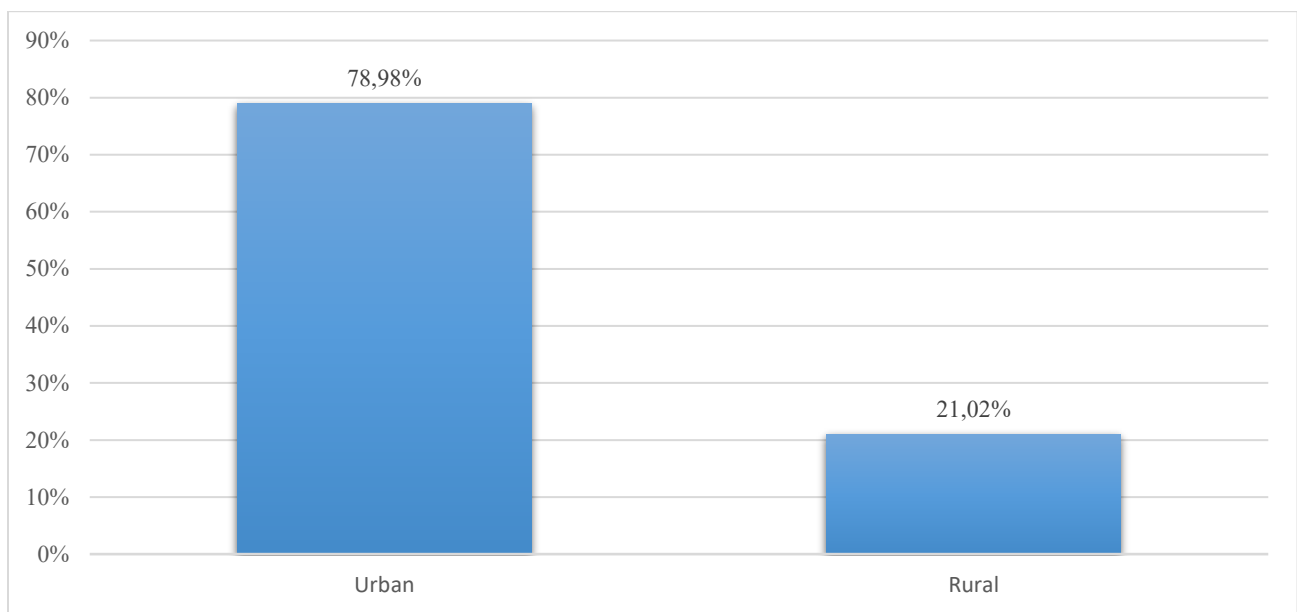


Fig. 2. Respondent demographics based on urban vs. Rural

Source: *Authors' research*

Gender representation among respondents is nearly balanced, with 51.09% identifying as male and 48.91% as female. This equitable distribution enhances the reliability of the findings by ensuring gender-inclusive perspectives on digital infrastructure and connectivity.

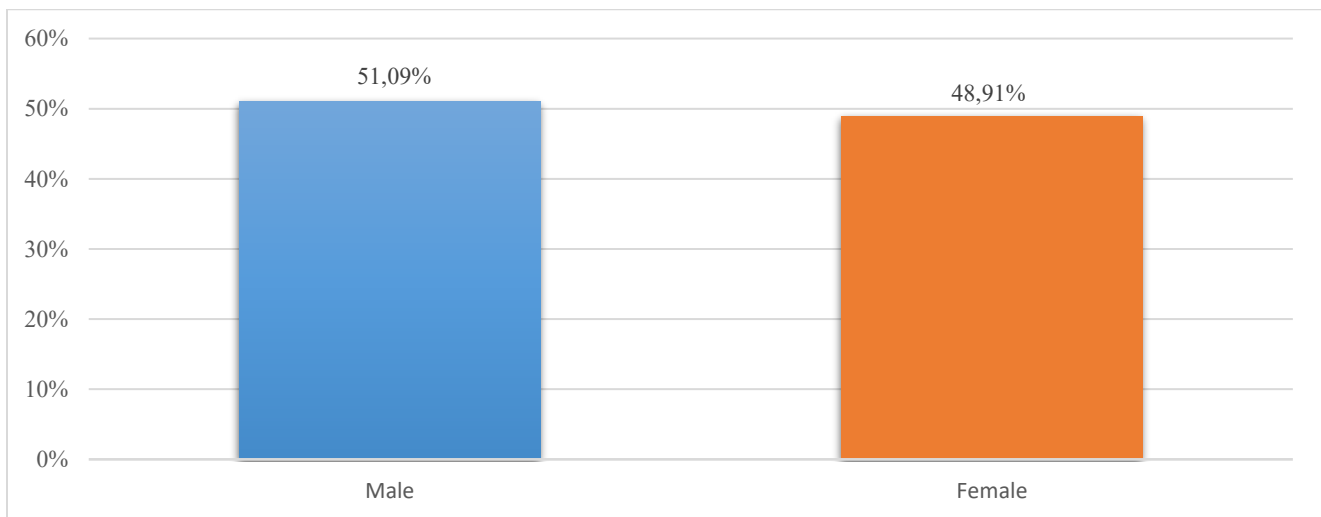


Fig. 3. Respondent demographics based on gender

Source: *Authors' research*

Results are presented with two dimensions of household digital access: fixed internet connections and mobile devices with internet access. The most common number of fixed connections per household is three (33.61%), followed by four (22.95%). For mobile devices, the highest frequency is also three (35.10%), followed by four (23.08%). These figures suggest a moderate to high level of digital penetration at the household level, with mobile connectivity slightly outpacing fixed-line access.

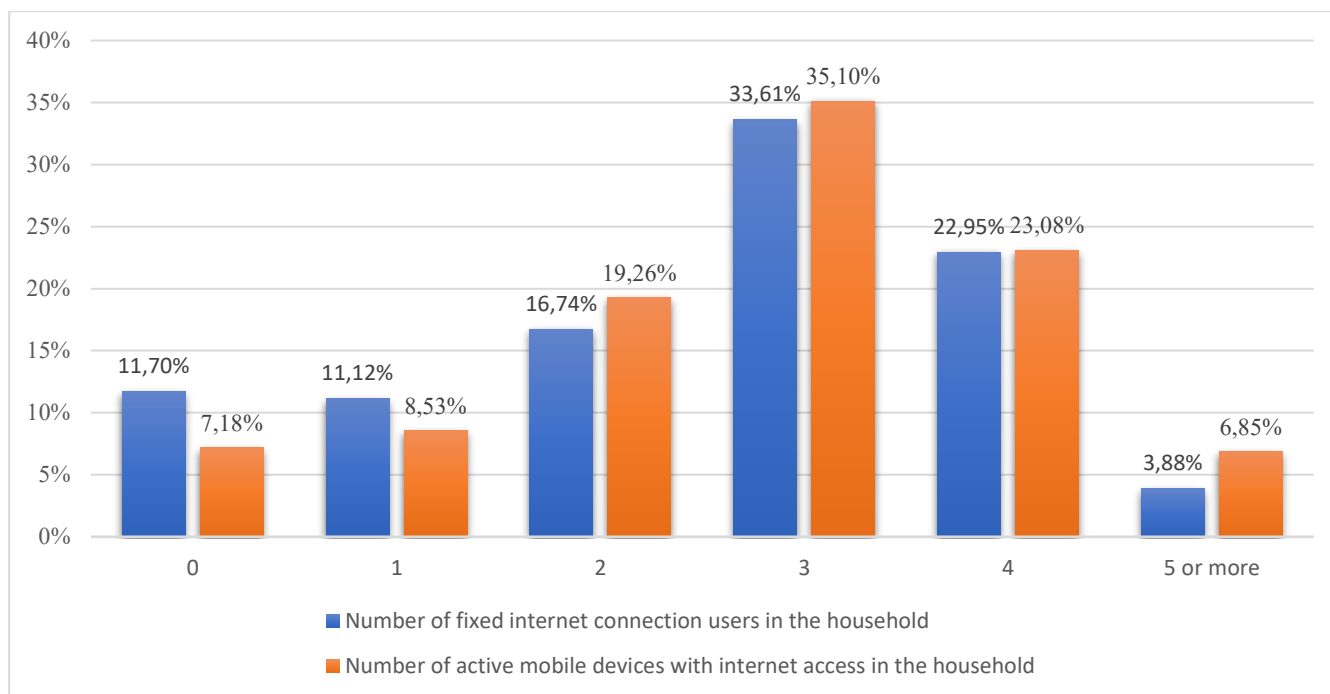


Fig. 4. Households connectivity in Bosnia and Herzegovina

Source: Authors' research

Respondents express skepticism regarding government investments in ICT infrastructure, with 39.24% strongly disagreeing and only 5.49% strongly agreeing. In contrast, perceptions of telecom operators are more favorable: 40.21% neither agree nor disagree, and 17.71% agree, indicating a more neutral or slightly positive view of private sector involvement. These results suggest a perceived gap in public sector commitment to digital development.

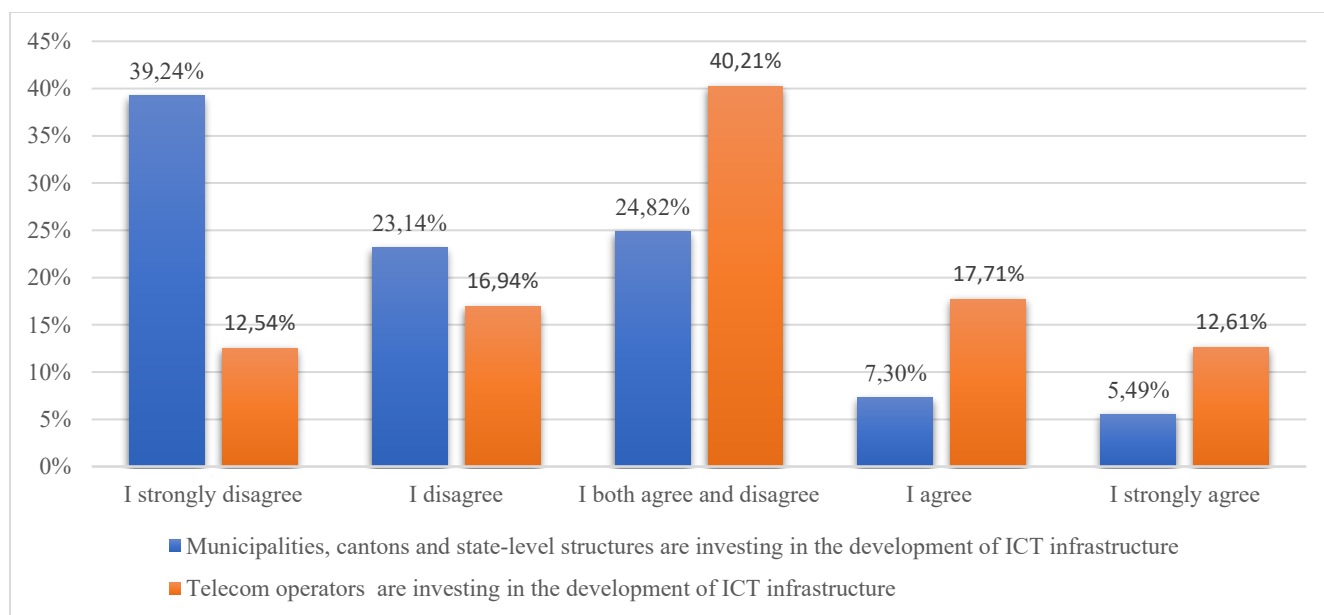


Fig. 5. Citizens perception on government and telecoms investments in ICT infrastructure

Source: Authors' research

The majority of respondents (40.85%) neither agree nor disagree that ICT infrastructure is equally accessible to all citizens. Only 13.38% strongly agree, while 12.15% strongly disagree. This ambivalence points to perceived inequalities in digital access, potentially influenced by geographic, socioeconomic, or infrastructural disparities.

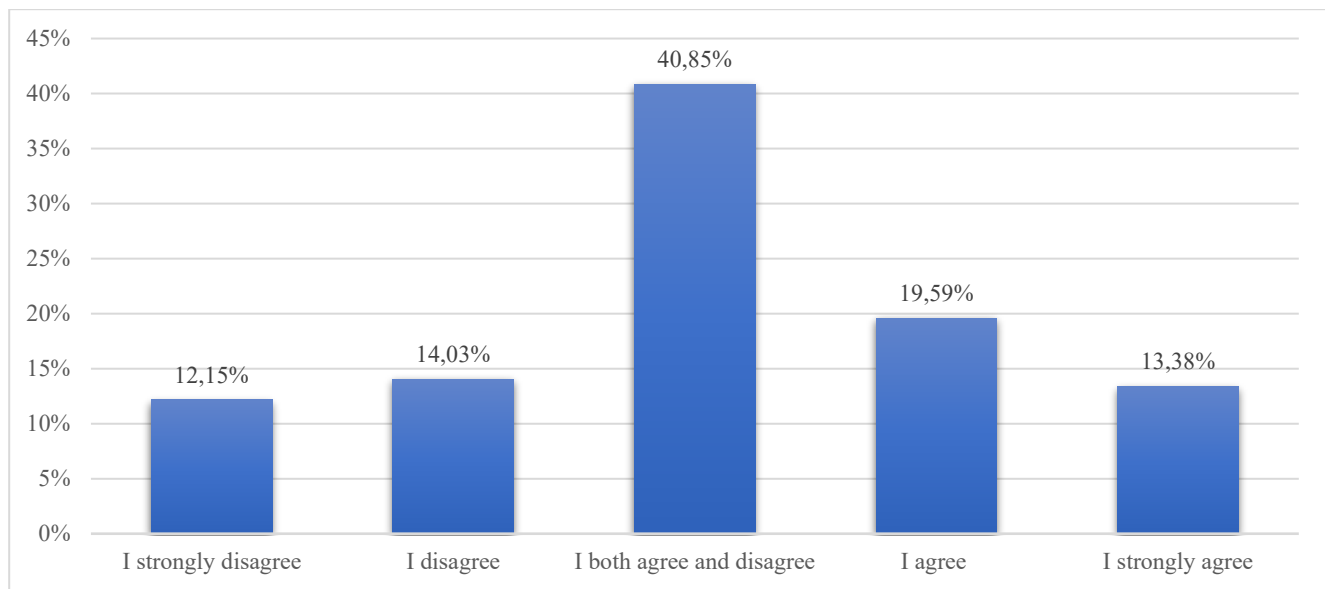


Fig. 6. Citizens perception on equally accessible of ICT infrastructure

Source: Authors' research

For the purposes of testing this working hypothesis, regression analysis was also used, and the most important part of the results is shown in Table 1, which represents an investigation of the impact of digital infrastructure on connectivity.

Table 1. Descriptive statistics on investment in information and communication infrastructure development

Statement	Average	Modus	Standard deviation
Municipalities, cantons and state-level structures are investing in the development of information and communication infrastructure with the aim of supporting digitalization and making citizens' lives easier.	2,17	1	1,183
Telecom operators (state and private) in our country are investing in the development of information and communication infrastructure with the aim of supporting digitalization and making citizens' lives easier.	3,01	3	1,162

Source: Authors' research

Respondents rate the equal accessibility of ICT infrastructure with an average score of 3.08 and a mode of 3, indicating a neutral stance. The standard deviation (1.163) reflects a wide range of opinions, reinforcing the notion of uneven access across different population segments, presented in Table 2.

Table 2. Descriptive statistics on ICT availability

Statement	Average	Modus	Standard deviation
The information and communication infrastructure (high-speed internet, mobile phone signal coverage, etc.) in our country is equally accessible to everyone.	3,08	3	1,163

Source: Authors' research

The regression model (Table 3.) reveals a statistically significant relationship between digital infrastructure and connectivity (Sig. = 0.000). The coefficient of determination ($R^2 = 0.081$) and the standardized Beta coefficient ($\beta = 0.284$) confirms a moderate positive effect, suggesting that improvements in infrastructure are associated with enhanced digital connectivity.

Table 3. Regression analysis: Impact of Digital Infrastructure on Connectivity

Summary of model ^b				ANOVA	Coefficients	
R	Coefficient of determination	Corrected coefficient of determination	Standard error of estimate	Sig.	Beta	Sig.
0,284 ^a	0,081	0,080	2,374	0,000	0,284	0,000
a. Predictor: DIGITAL INFRASTRUCTURE						
b. Dependent variable: CONNECTION						

Source: Authors' research

In summary, the results of this research clearly demonstrate that digital infrastructure development in Bosnia and Herzegovina faces significant challenges that directly impact connectivity accessibility and quality across different regions and demographic groups. The findings confirm that inadequate broadband coverage, and insufficient mobile network infrastructure are viewed as key barriers rather than enablers of comprehensive digital inclusion. These connectivity disparities reflect broader challenges in infrastructure investment coordination, policy implementation effectiveness, and regulatory framework harmonization, indicating that significant institutional and technical adjustments are required to improve the availability, reliability, and affordability of digital connectivity services tailored to the diverse needs of citizens, businesses, and public institutions throughout Bosnia and Herzegovina.

5. CONCLUSION

The integration of digital technologies into the socio-economic structure of Bosnia and Herzegovina is increasingly recognized as a strategic imperative for national development, competitiveness, and social inclusion. This study underscores the multifaceted nature of digital transformation, revealing that while foundational elements of digital infrastructure are present, their distribution, accessibility, and perceived effectiveness remain uneven and contested.

A key insight emerging from the analysis is the centrality of infrastructure quality in shaping digital connectivity. High-speed internet, reliable mobile networks, and widespread device penetration are essential enablers of digital engagement, yet their impact is contingent upon broader systemic factors. The perception of infrastructure investment, particularly by public institutions, suggests a disconnect between policy intentions and public experience. This gap may reflect limitations in implementation, communication, or responsiveness to local needs, and points to the necessity of more transparent, inclusive, and accountable governance in the digital domain.

Equally important is the role of private sector actors, particularly telecom providers, whose contributions to infrastructure development are viewed with greater neutrality or moderate approval. This indicates a potential for public-private partnerships to play a more dynamic role in accelerating digital access, provided they are guided by clear regulatory frameworks and aligned with public interest objectives.

The issue of equitable access remains a persistent challenge. Geographic disparities, socio-economic divides, and infrastructural limitations contribute to a digital landscape where not all citizens benefit equally from technological advancements. Addressing these disparities requires a holistic approach that combines infrastructure investment with digital literacy programs, affordability measures, and targeted support for marginalized communities. Digital inclusion must be understood not merely as a technical goal but as a social commitment to ensure that no individual or region is left behind in the digital age.

Furthermore, the findings suggest that connectivity is not solely a function of infrastructure availability but also of user engagement, institutional trust, and perceived relevance. As such, fostering a digitally empowered society demands more than technological deployment—it requires cultivating a culture of innovation, participation, and

adaptability. Education systems, local governments, and civil society organizations all have critical roles to play in nurturing digital competencies and promoting meaningful use of technology.

In conclusion, Bosnia and Herzegovina stands at a pivotal juncture in its digital evolution. The foundations are in place, but the path forward requires strategic coordination, inclusive policymaking, and sustained investment in both infrastructure and human capital. By embracing a comprehensive vision of digital development such as equity, transparency, and resilience, the country can harness the transformative potential of technology to drive economic growth, enhance public services, and strengthen democratic engagement.

This research reveals digital infrastructure as the cornerstone of Bosnia and Herzegovina's digital transformation, directly impacting both economic development and quality of life. Success requires a comprehensive approach: resolving current limitations, ensuring active participation from all stakeholders, and implementing robust monitoring mechanisms.

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