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## CATALYSING ECONOMIC GROWTH IN BALKAN COUNTRIES

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**Abstract:** In a world of speed and transformation from tangible to intangible, because of the Internet revolution and remarkable technological development and the subsequent prosperity and growth of individuals and companies. To upgrade developed countries, developing countries had taken serious steps towards the digitization of society and the economy. Serbia, for example, is a Balkan State that has strengthened the role of digitization in its governmental and commercial activities, as well as being one of the main indicators of GDP growth, as well as a crucial factor in the European Union's accession and enhanced market competitiveness. Like Serbia, most Balkan States have tended to embrace digitization in their activities aimed at bridging the digital divide between the Balkan States and the developed countries of the European Union, on the one hand, and at achieving the European Union's accession standards and conditions on the other. This paper provides a comparative analysis of the digital divide and the degree of the Balkan States' reliance on digitization in their organizations. It also aims to demonstrate the consistency of the Balkan States' trend towards digitization with EU countries through several factors: Embrace digitization in public services (digital government), enhance digital culture skills and knowledge among individuals, promote digital literacy, and stimulate the creation, promotion and financial and legal financing of digital platforms in accordance with funding packages, legal frameworks and regulations aimed at promoting digitization between the Balkans and developed countries .

**Keywords:** Balkan countries, digitization, information technology, economic development, internet.

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## Introduction

The Internet revolution and the dramatic development of technology have made most developed countries so digital that digitization has become a factor in countries' prosperity and progress. This standard has led many countries to take the developed countries' step to digitize their actions and organizations. The most prominent are the Balkan States, which have begun to take serious and rapid steps towards the knowledge and information economy and the digitization of the economy and society, such as the European Union's developed countries (Apostu et al., 2023) . As an example of the importance, effectiveness, and role of digitization in economic development, the Balkan States have reduced their rates of corruption and fiscal and fiscal leakage because of revitalizing methods for monitoring and digitizing trade and financial activities. as well as cooperation from regional and international partners, most notably the States of the European Union, in the exchange of digital expertise and resources (Ben Youssef et al., 2021) .

On the other hand, the courageous steps taken by the Balkan States towards political issues, Has stimulated economic and banking integration, as well as in the area of digital infrastructure and enhancement of individuals' digital knowledge and expertise and its conformity with European Union standards (Boshkov et al., 2023) , These steps could culminate in the digitization of the Balkan countries' trade and financial activities economic preparedness and a qualitative environment based on regional and international rules and cooperation, in order for the Balkan States to meet the conditions and criteria for their accession to the European Union (Huang, 2023) . The advent of the Internet revolution blended with remarkable technological advancements has turned most of the developed countries into digital powerhouses where digitization stands as a linchpin for both individual and collective progress (Karras, 2023) . This digital standard synonymous with prosperity now has instigated the domino effect as nations across the globe strive to emulate the success stories of their more digitized mature counterparts ("Digital transformation and economic cooperation," 2020) . Amongst this crop of aspirants, the Balkan States have seized the reins of change, embarking themselves towards the knowledge and information economy, mirroring on themselves the digital trajectories of the Western European developed nations of the European Union. Serbia, being positioned at the leading example within the Balkan region, indubitably has shown strong commitment toward digitalization (Žmuk and Mihajlović, 2018) . Serbia, not only positioning itself as a harbinger of GDP growth but to being a prominent player in the accession process of European Union, cannot do without digital technologies acquiring an essential part in strengthening



governmental and commercial activities. The embrace of digitization has become now a pivotal factor enhancing the market competitiveness and bridging the digital divide between Balkan States and their developed counterparts within EU (Vidas-Bubanja et al., 2019) . This fever for digitization in the Balkans goes beyond economic motive; its carriers critical implications vis-a-vis political cohesiveness, regional integration, and international collaboration (Gigauri et al., 2023) . Strategic steps, as these nations' digitalization initiatives are not solely primarily for economic benefits but toward achieving European Union accession standards providing for greater global competitiveness (Đorić, 2020) . The Balkan States recognized that the future of their political and economic developments lay in digital transformational power, therefore as a result, the strategic harnessed the digital to reduce corruption, fiscal leakage, and trade inefficiencies in their financial activities (Boshkov et al., 2023) . They hence attracted regional uptake for support and cooperation amongst regional and international partners most notably the European member states (Liao, 2023) . The inclusion of the Balkan States to the digital era involves multi-dimensional activities in terms of political, economic, and societal aspects (Avlijas, 2022) . Besides economic gains, these political and banking sectors brave steps towards integration attempts further reinforced digital infrastructures addition to the increasing of the digital literacy of their citizens (Government of Brčko District, Department of Public Safety, Brčko, Bosnia and Herzegovina et al., 2023) . In line with European Union standards, these efforts could result in digitizing trade and financial activities, creating a conducive environment for regional and international cooperation while meeting EU accession conditions stringently (Mitrovic, 2015) . But despite these commendable strides, the Balkan States face challenges in the implementation journey towards comprehensive digitization (Soreg and Bermudez-Gonzalez, 2021). The regulatory and political frameworks often exhibit signs of immaturity acting as obstacles for the full realizing of digital potential. Further, the absence of an enabling climate for digitization at both the individual and economic levels contribute to hurdles which therefore result in a weak presence of digitalization in the business and financial landscape of the Balkan States (Stoica and Bogoslov, 2017).

The paper will focus on the state of digitization in the Balkan States and their degree of inclusion in business, finance, and banking. The Balkan States are characterized by a weak presence of digitization in their companies and in their business and financial activities, owing, inter alia, to the immaturity of the regulatory and political framework and the lack of an enabling environment for the digitization of individuals and the economy. The paper's pursuit of the topic of digital transformation in the Balkan States is based on several considerations, most notably: the willingness of these States to digitize their organizations and businesses, and the appropriate political and economic climate in these States for digital transformation, appears to be an easy path towards digitization in the financial and business communities and will contribute to economic and social development. Establishing a unified digital market between the Balkans and developed countries through EU-compliant ICT policies in the Balkan States.



## Literature Review

Global tendencies in digitalization, imposing them on economic processes, transformed a phenomenon into a worldwide imperative but never failing to impact smaller countries, especially those of the Balkan peninsula (“Digital transformation and economic cooperation,” 2020) . The multi-dimension effect of digitalization on growth in the economy of the Balkan region in terms of education, government initiatives, global collaboration, and affectations both across and within distinct categories of economic activities is what this literature review involves (Žmuk and Mihajlović, 2018) . The digitization efforts of the Balkan countries are characterized by three significant traits, that is access to digital goods and services, equal opportunities participation in digital networks, as well as massive potential growth to the maximum through computing, big data analysis, and e-government services. The digital transformation (Zeković and Perić, 2023) , represented by the Internet revolution and cryptocurrencies, is deemed to have been initiated the global digitization. This classical to digital transition of transactions succeeded among developed countries, and now epitomizes a support for the massively developing nations such as those in the Balkans, through the introduction of efficient and low-priced digital business patterns (Vukmirović et al., 2021) . States have recognized digitization as essential for economic development, promotion of leading companies, boasting digital balance sheet, and fostering demand for innovation and leadership in business and finance (Vučeković et al., 2023) . This is in a bid to reduce the conventional infrastructure constraints and adapt in a changing working environment characterized by a growing switching from labour-based organizations to new venture driven culture and entrepreneurship amongst individuals. Digitization, therefore, is perceived to be inevitable for competitiveness, efficiency, and sustainability in the countries of the Balkan region (Vidas-Bubanja et al., 2023) . The literature review emphasis the significant role played by education in shaping people towards digitization and entrepreneurship with a concern of knowledge and skills in the digital world (Toska and Fetai, 2023) . This changes perception towards digitization where educational programs for instance ETT change the attitudes held. The review outlines developments in the Balkans where projects to foster digital literacy by training courses have inspired people taking up sophisticated technological skills (Toska and Fetai, 2023) . Balkan State governments have undertaken projects to digitize public services for easy accessibility and administrative process nimbleness (Soreg and Bermudez-Gonzalez, 2021) . The focus pertains to cybersecurity, anti-digital crime regulation, and laws that enhance the digital market through e-commerce, e-banking, and e-marketing (Butigan Vučaj, 2019) . The best path towards Balkan States joining EU involves full compliance for all countries on matters concerning EU regulations on digital knowledge and expertise (Avlijas, 2022) . Government interventions will aim at improving citizen standards of living through support towards digital adoption, having necessary policies created, as well as elimination of barriers towards



digitization (Apostu et al., 2023) . Packages on funding will incentivize services of different services of digitization in key sectors such as agriculture, services, and production. International collaborations facilitate the exchange of digital skills, knowledge, and expertise coupled with digital resource attraction (Vidas-Bubanja et al., 2023) . The review acknowledges that there exists differential support for digitization amongst Balkan States but underlined the value of overall support to digitization in improvement of GDP per capita and inspiring economic growth (Shimbov et al., 2016) . The balancing efforts towards digitization with EU standards pose challenges but are significant towards filling up the digital divide. Digital technology, smartphones, has contributed to reshaping the global economy in developing countries like Balkans (Ben Youssef et al., 2021) . According to the International Monetary Fund, digitization of the economy is bringing operations and activities in online forms welcoming telecommunications services, the Internet and modern communication means into economic and financial processes (Boshkov et al., 2023) . The main elements that drive the transformation of the digital economy are information technology, enterprises capable of providing their customers with digital products and services, as well as sectors of e-commerce, automation of government services, digitization in air travel, tourism, transport (Marti and Puertas, 2023) . Encouraging digital culture among employees and the population is deemed essential for success in the digital economy (Karras, 2023) . And in its entirety of the literature review together brings out multi-faceted efforts, challenges, and potential of digitization through the Balkan countries across education, government attempts, international collaboration, and transformative impact on diverse economic sectors (Marti and Puertas, 2023) . Firstly, Education Factor: Therefore, education stood an important stimulant towards integrating the digital environment across Balkan countries. Focusing on knowledge and expertise required for entrepreneurship along with digital engagements, educational programs like ETT were instrumental in changing the perceptions towards digitization (Avlijas, 2022). Government Initiatives and Regulatory Framework: Government initiatives attempting to facilitate digital literacy through training courses infuse technological skills sophisticated enough for the creation of a workforce more capable and armed with the needs of an economy rooted to digitization (Boshkov et al., 2023) . secondly, Governance-felt Initiatives: Balkan state governments have adopted programs to digitize the services, administration, and processes involved (“The impact of national intellectual capital on the economic growth in the South-Eastern European Countries,” 2018) . The key areas that should be accorded priority in this include cybersecurity and anti-digital crime regulation which should be the first to be adopted followed by the formulating of the laws to boost the digital market via e-commerce, e-banking, and e-marketing. In this regard, compliance of Balkan States with EU regulations on digital knowledge and expertise can be perceived to be a strategic pathway for the regional economies to align with international standards towards fostering economic growth (Vukmirović et al., 2021) . Thirdly, Impact on Economic Growth and GDP: Therefore, the literature



review from Balkan States acknowledges the differential support in this digitization but emphasizes the overall positive impact on economic growth (Boshkov et al., 2023; “The impact of national intellectual capital on the economic growth in the South-Eastern European Countries,” 2018; Toska and Fetai, 2023). Indeed, the improvement has been associated with the digital technological adoption to the GDP per capita thus stimulating the economic growth across different sectors (Ben Youssef et al., 2021). These efforts to bring up to EU's standards may be challenging although they are considered necessary in bridging digital divide and ensuring continued economic development (“Digital transformation and economic cooperation,” 2020). Fourthly, Digital Resource Attraction and International Collaboration: The paper highlights international collaborations as an important enabler of the transfer of digital skills, knowledge, and expertise. Collaboration enables Balkan countries to bring in digital resources from developed countries for use within local borders hence promoting innovation and creating a favourable atmosphere for digital businesses (Vidas-Bubanja et al., 2019). Smartphones, being the major enabler of digital technology in this era, serve as a strong transformational tool of not only daily activities but also global economy by reshaping the entire world. The developing countries such as those found in the Balkans have been placed to benefit significantly from this everything-is-paradigm (Žmuk and Mihajlović, 2018). Conclusively, dynamic landscape and impact in which digitalization is an evolving factor of economic growth in Balkan countries (Melović et al., 2020). The above areas of education, government initiatives, international collaboration as well as transformative effects on various economic sectors combine to form a remarkable highlight of the needed towards enhancing digitization for swifter and more significant economic development in the Balkan region.

Table 1. Summary of the review of the literature on fiscal councils, fiscal rules, and fiscal stability.

Authors	Title	Methodology	Sample	The Results
(Melović et al., 2020)	The impact of digital transformation and digital marketing on the brand promotion, positioning, and electronic business in Montenegro	SEM, ANOVA	172 companies	The paper will delve on how digital transformation in Montenegro shapes digital marketing in businesses zeroing in on promotion while light touching on brand positioning and development of electronic business. The usage of digital marketing is surveyed and analysed in 172 companies and main factors are highlighted with the strongest emphasis on time of implementation, managerial ability, perception of cost effectiveness, and measurement feasibility. The most frequently used tool is a social network with performance evaluator Google Analytics being chosen most often. Increased digital marketing adoption correlates with heightened promotional and branding effects.
(Marti and Puertas, 2023)	Analysis of European competitiveness based on its innovative capacity and digitalization level	TOPSIS, Prais-Winsten	EU	Using indices such as Global Innovation Index and Digital Economy and Society Index, this study ranked competitiveness of EU countries in terms of innovation and digitalization. It ranks economies from 2017 up to this year with Sweden remaining on the top position. What the analysis reveals is a gap between northern and southern Europe. The measures suggested to be taken are investing in wealth, employment, research, and infrastructure to improvement innovation and technology.
(Shimbo v et al., 2016)	International Production Networks and Economic Growth: The Case of the Western Balkan Countries	OLS	Western Balkan countries	Analysis of the Effect of International Production Networks (IPNs) on Economic Growth in the Western Balkans. Trading Patterns from 2002 until 2013 show that participation in IPNs can mould economic performance. The study suggests that trade attributable to production fragmentation has more positive impact than increased foreign demand, impacting on positive, growth rates in the region.
(Vidas-Bubanja et al., 2023)	Managing the reskilling revolution for the digital age: Case study: Western Balkan countries	OLS	EU	It emphasizes from changing facets within a shifting technology environment, COVID-19, and green developments. It analyses factors affecting skill changes from an influence by digital tech, youth employment, workforce education. The research analyses adult education in the Western Balkans drawing attention to an increasing awareness around the importance of digital and green skills in Serbian companies, though gaps in companies but also in personal upskilling's awareness.



(Zeković and Perić, 2023)	The relationship between working in the “gig” economy and perceived subjective well-being in Western Balkan countries	primary statistical method	471 freelancers	The paper looks at the well-being of freelancers in a digitalized and pandemic-driven increased remote work environment. It surveyed 471 Bulgarians in the field – as a consideration of various Balkan countries – and defined two primary factors being – work-related effects on personal life and economic/professional satisfaction. Economic satisfaction correlates with age, whereas higher education exhibits lower overall satisfaction. Insights are to support policy makers and businesses in tackling well-being within the changing gig economy.
(Hawach et al., 2023)	Internet capabilities and innovation in the Balkan countries: The role of foreign technology licensing	OLS	10 Balkan countries	This study looks at the impact of Internet capabilities on innovation within 10 Balkan countries over the period from 2007 to 2019 by examining their effect on product and process innovation. Foreign technology licensing has influenced positively and surprisingly these effects were not stepped up because of potential risks and benefits overlapping in region. These findings will enlarge knowledge on Internet capabilities and foreign technology licensing role for Balkan country development.
(Žmuk and Mihajlović, 2018)	Online booking for travel and accommodation influenced by economic and digital development level: Position of the Western Balkan countries within Europe	---	Eurostat data for 34 European, European Union (EU-28)	In this light, the current paper inspects the development indicators that influence internet use for travel in 34 European countries in 2017. More precisely, the paper outlines that there are extraordinarily strong positive correlations between GDPs per capita, tertiary education as well as digital competences and internet usage for travel. From the regression analysis, as being most impactful of all, digital skills are highlighted in a regression analysis. From k-means clustering round 1, indicators from the Western Balkans have among these indicators the lowest average among the three clusters.
(Vukmirović et al., 2021)	Foreign Direct Investments’ Impact on Economic Growth in Serbia	---	Serbia	This underestimates the importance of FDI in Serbia's economy, analysis herewith its relation to GDP, unemployment, and Global Competitive Index (GCI). Where a focus to FDI from China, Russia, EU there are projections for increases on GDP, FDI, competitive ranks, and declines on unemployment over next 5 years. These findings offer insights for future investment and policy directions, discussed theoretically and practically.





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(Avlijas, 2022)	how regional integration agreements can foster inclusive growth: lessons from exporting semes in the western Balkans	---	58 export-oriented SMEs	This touchstone study uses gravity model to analyse CEFTA's impact on the Western Balkans' spatial inequality and proposes measures for inclusive economic integration. Analysing interviews with SMEs in Bosnia & Herzegovina and Serbia, it focuses on their reliance on local resources beyond market expansion, calling for institutions fostering local cooperation to be used as stepping-stones to bolster regional integration.
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Source: Prepared by authors



## **Data and Methodology**

### ***Data***

The Digitalization Dataset, compiled until December 2022, in September 2023 by the Authors covers the following bellow indicators. It amalgamates data from various sources, including, IMF, WB, ITU and direct contacts with national authorities details the methodology. for 6 Balkan countries. In terms of variables, our sample incorporates several indicators:

the Individuals with ICT skills (ICTI), Full Time equivalent Telecommunication employees / number (FTTE), Annual investment in Telecommunication services million (AITS), ICT Regulator institutional structure (RICT), ICT price (PICT), digitalization skills (DS), Internet access (AI), Fixed broadband subscriptions (FBS), gross domestic products (GDP), Unemployment (UNEM), Inflation (INF), GDP per capita (GDPC), and Foreign direct investment net flows (FDIN). The data collection spans from 2018 to 2022, and a detailed presentation of the variables is available in Table 3, outlining the key aspects of the study's dataset

**Table 2. Variables sources.**

Variable	Code	Source	Definition	Reference
Individuals with ICT skills %	ICTI	<a href="#">ITU</a>	"ICT skills %" indicates the population percentage proficient in Information and Communication Technology (ICT), gauging digital literacy and technological competency among individuals.	(Mkiyes and Přivara, 2023)
Full Time equivalent Telecommunication employees	FTTE	<a href="#">ITU</a>	"Full-Time Equivalent Telecommunication Employees" is a metric reflecting total labour input in the telecom sector, combining full-time and part-time hours to standardize workforce reporting accurately.	(Mkiyes and Přivara, 2023)
Annual investment in Telecommunication services	AIT5	<a href="#">ITU</a>	"Annual Investment in Telecommunication Services (Million)" denotes the total yearly investment in the telecom sector, measured in millions of a specific currency, highlighting financial commitment within that period.	(Mkiyes and Přivara, 2023)
ICT Regulator institutional structure	RICT	<a href="#">ITU</a>	"ICT Regulator Institutional Structure" delineates the organizational setup and functions of an ICT regulatory authority, defining its departments' relationships and arrangements to ensure effective oversight and management within a district's ICT sector.	(Mkiyes and Přivara, 2023)
ICT price	PICT	<a href="#">ITU</a>	"ICT Price % from PPP" measures the cost of ICT products and services as a percentage of Purchasing Power Parity (PPP), which compares currency values based on their buying capacity for a range of goods and services.	(Mkiyes and Přivara, 2023)
Digitalization skills	DS	<a href="#">ITU</a>	"Digitalization Skills % Total Population" indicates the percentage of a population proficient in various digital competencies, covering computer literacy, software use, internet skills, and navigating digital platforms.	(Mkiyes and Přivara, 2023)
internet access	IA	<a href="#">ITU</a>	"Internet Access % Total Population" measures the percentage of a geographic area's population with internet connectivity, crucial for online activities, accessing information, and engaging with digital services.	(Mkiyes and Přivara, 2023)



Fixed broadband subscriptions	FBS	<a href="#">ITU</a>	"Fixed Broadband Subscriptions per 100 Persons" quantifies the number of fixed broadband connections per 100 individuals in a specific area, indicating the penetration and accessibility of wired internet services in that population.	(Mkiyes and Přivara, 2023)
GDP	GDP	<a href="#">IMF</a>	GDP at purchaser's prices accounts for all resident producers' value added, including product taxes minus subsidies. It is in current U.S. dollars, converted using official or alternative exchange rates for accuracy in a few countries.	(Toska and Fetai, 2023)
GDP per CAPITA	GDPC	<a href="#">IMF</a>	GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant local currency.	(Vučeković et al., 2023)
FDI	IFDI	<a href="#">IMF</a>	Net Foreign Direct Investment (FDI) represents the difference between inward and outward FDI flows, reflecting the net amount of investment foreign entities make in a country minus the investment made by domestic entities abroad.	(Shimbov et al., 2016)
Inflation	INF	<a href="#">IMF</a>	Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.	(Mitrovic, 2015)
Unemployment	UNEM	<a href="#">IMF</a>	Unemployment refers to the share of the labour force that is without work but available for and seeking employment. Definitions of labour force and unemployment differ by country.	("Digital transformation and economic cooperation," 2020)

Source: Prepared by authors



## *Models*

### Empirical methodology

Inspired by the existing literature, the effects of Individuals with ICT skills %, Full Time equivalent Telecommunication employees, Annual investment in Telecommunication services, ICT Regulator institutional structure, ICT price, Digitalization skills, internet access, fixed broadband subscriptions, GDP, GDP per CAPITA, FDI, Inflation, and Unemployment are formulated as follows (Eq.1):

$$XX_{it} = f(ICTI_{it}, FTTE_{it}, AITS_{it}, RICT_{it}, PICT_{it}, DD_{it}, \dots) \quad (\text{Eq.1})$$

The investigated variables XX as “ICTI, FTTE, AITSAITS, RICT, PICT, DS, IA, FBS” Digitalization rules, “GDP, GDPC, IFDI, INFINF, UNEM,” respectively. (Mkiyes, H., & Provera, A.2023) The proxy used for XX is the. The proxy used for XX is the level of Individuals with ICT skills %, Full Time equivalent Telecommunication employees, Annual investment in Telecommunication services, ICT Regulator institutional structure, ICT price, Digitalization skills, internet access, Fixed broadband subscriptions.

indices: GDP, GDP per CAPITA, FDI, Inflation, and Unemployment as a percentage from the indicator for the role of fiscal councils. FDI as next investment flow by the difference between FDI flowing % from GDP – FDI flow out % from GDP.

In this case, models such as O.L.S. built on the assumption of normal distribution may reveal biased estimates. This study utilised a novel estimation approach to overcome this issue, namely the M.M.Q.R. test that was first proposed in the study of Machado and Santos Silva (2019). Unlike earlier regression methods, M.M.Q.R. is used to estimate results through moment conditions that do not assume the presence of the moment function or make distribution assumptions. The M.M.Q.R. approach has superiority as it considers conditional heterogeneous covariance effects of the components of the endogenous explanatory variables. M.M.Q.R. shows the nexus among the variables through different quantiles. Hence, the distributional and heterogeneous effects are ascertained by the panel quantile regression model across quantiles (Dumitrescu and Hurlin, 2012). In addition, it reflects factual observations about the linkage between tested variables that consider the fixed effects of distribution heterogeneity. Hence, the testing model shows multiple conditions between tested variables in different conditional distributions that cannot be obtained using conventional regressions based on average factors estimates. However, it is essential to evaluate the tested variables at the conditional distribution within



conditional quantiles to delineate the distributive impact of the independent variable on the dependent variable in various quantile ranges (Dumitrescu and Hurlin, 2012). To estimate the conditional quantiles  $Qy(\tau|X)$  for the model of a location-scale variant, the equation (Eq.2) below is formulated:

$$Y_{it} = \alpha_{it} + X' \beta + (\delta_i + Z_{it} \gamma) \mu_{it} \tag{Eq.2}$$

where the probability,  $P \{ \delta_i + Z_{it} \gamma > 0 \} = 1$ .  $(\alpha, \beta', \delta_i, \gamma')$  are estimated parameters. The object  $i$  fixed is reflected by  $(\alpha_i, \delta_i')$ .  $i = 1, \dots, n$ , and  $Z$  is  $K$ -vector selected components of  $X$  that can be seen in a different format with  $l$  represented in Eq.3:

$$Z_l = Z_l(X), \quad l = 1, \dots, k \tag{Eq.3}$$

$X'$  is identically and independently disposed of for any stabilised  $i$  and independent through time ( $t$ ).  $\mu_{it}$  is identically and independently disposed within time ( $t$ ) and are orthogonal to  $X'$  and normalised to verify the present status in Machado and Santos Silva (2019) that amongst other variables do not indicate rigid exogeneity. Thus, equation (2) designates by Eq.4 stated below:

$$Q_y(\tau|X_{it}) = (\alpha_{it} + \delta_{iq}(r)) + X' \beta + Z_{it} \gamma' q(r) \tag{Eq.4}$$

In Eq.4, independent variables' vectors are indicated by  $X'$ , which in the current study are defined as the natural logarithms of FS.  $Q_y(\tau|X)$  reflects the quantile distribution of the response variable  $Y_{it}$  (FS) which is subject to the position of the independent variable  $X'$ .  $\alpha_{it}(r) = \alpha_{it} + \delta_{iq}(r)$  is the scalar coefficient, which is significant of the quantile  $-\tau$  fixed effect for individual  $i$ . The impact indicates no intercept change, unlike the typical fixed least-squares results. These parameters are fixed within time, whose heterogenous degrees are fitted to deviant the conditional distributional quantiles of the selected variables within the model. The  $\tau$ -the sample quantile is symbolised by  $q(\tau)$ , which is regarded by referencing the issue of optimisation (Eq.5):

$$\min_q \sum \sum_{it} \rho_c (R_{it} - (\delta_i + Z' \gamma) q) \tag{Eq.5}$$

In Eq.4,  $\rho_c(A) = (r - 1) AI \{A \leq 0\} + r AI \{A > 0\}$  denotes the check function. To confirm the cause-and-effect relationship among the inspected factors, another method of the test is utilised to examine the interconnection among the investigated



variables in heterogeneous panel information models. In this model, there are two dimensions: the causal link's heterogeneity and the employed regression model's heterogeneity. The hypothesis of non-homogeneous causality  $H_0$  is compared by two subclass options: The first one categorises the cause-and-effect interconnection among two variables, while the second subclass is constructed by two variables that have no relationship. (Dumitrescu and Hurlin, 2012) .

## Results and discussion

Digitalization has become a fundamental factor for Balkan countries regarding their economic stability and growth. Going from the historical changes to various stages of development, transitioning which these nations follow, modernization with help from digital integration has become a decisive condition for progress. Digitalization in the Balkans has invaded over sectors revolutionizing and showing new unexplored opportunities that were never thought of because of traditional industries. At the same time, it had contributed to efficiency enhancements, operations' streamlining, connectivity. Digitalization is an integral component of economic stability. However, digitization is making massive inroads into the workforce. The Balkan countries were traditionally dependent on some traditional industries and are looking at complete overhauling of labour dynamics. The demand for digital skills is humungous, which has created the requirement of upskilling and reskilling programs along with complete transformation of job profiles. This transition also points out how essential the role of education and training in preparing the workforce to the digital era giving them the ability to flexibly adapt with the new job markets.

Furthermore, digitalization has facilitated entrepreneurial opportunities especially within the tech domain. In the recent past, start-ups and tech-driven enterprises have been sprouting in the Balkans that deploy innovation to carve niches in the global market. Such a boom in entrepreneurial undertakings does not only spur economic growth but also situates the region as a melting pot for technological innovations. Other than constantly revolutionizing business dimensions, digitalization has a broader impact characterized by extending to governmental policies and public service delivery. E-governance initiatives have eased administrative processes making them transparent while also becoming efficient in the process of public services delivery. The application of the digital tools to governance improves accessibility, responsiveness with increasing the participation of the citizens giving a conducive environment for economic stability. However, challenges are still there in this digital journey. The regional economic growth potential calls for attention over infrastructure gaps, uneven digital literacy rates, and regulatory frameworks required to ensure equitable benefits of digitalization across the society. Bridging the digital divide and making a more inclusive digital ecosystem becomes crucial to



ensure the sustained economic stability in the region too. To that end, economic stability in the Balkans will continue to evolve further with future digitisation. Continuously embracing technological advancements, fostering innovation, addressing organisational disparities in terms of societal digital access and skills will narrow the gaps, thereby building an economically sustainable resilience. The Balkans can thus boost its economic foundation and become more integrated within the waves of digitalization that the world before it has so far experienced, ensuring lasting stability and growth with the transformative potential digitization has.

**Table .3. Descriptive Statistics**

variable	Obser	mean	max	min	Std.Dev
ICTI	30	20.986	55.300	1.700	14.410
FTTE	30	4913.267	1.4e+04	1127.0	4588.873
AITS	30	152.703	798.000	11.700	202.907
RICT	30	2.983	5.000	1.400	1.150
PICT	30	14.551	31.200	6.800	5.183
DS	30	53.131	77.000	8.600	24.511
IA	30	74.246	96.500	30.900	13.971
FBS	30	21.507	1.300	7.000	6.102
GDP	30	2.0e+10	6.4e+10	4.8e+09	1.7e+10
GDPC	30	1.6e+05	8.0e+05	082.207	2.7e+05
INF	30	3.973	12.241	0.062	3.426
UNEM	30	15.198	27.760	5.700	5.339
FDIN	30	5.711	13.468	1.399	2.988

Source: Collected by authors output of Stata.

The use of the Method of Moments Quantile Regression helps to better understand the possible impact of digitalization on economic stability along various blocks of the economy. This way, comprehensive examination can be carried out at least considering several quantiles of influence of digitalization on economic stability. To the scope, since the method captures the impacts at various places along the spectrum of stability, it provides insights on how digitalization influence not only the mean but as well the distribution of economic stability. This makes it possible to discover differences or disparities between sectors or over economic strata in the impact, that





is, whether the digitalization brings improvement in stability uniformly or differentially to locations or conditions, or to the entire economy. Such methodological approach enables a complete and granular assessment that is important to the policymakers and stakeholders who desire to seize opportunities rendered by digitalization in strengthening economic stability within variegated dimensions of the economy.

**Table 4. Normality test**

Variable	Skewness/Kurtosis		Shapiro–Wilk Test	
	Skewness	Kurtosis	Prob > Chi2	Prob > z
ICTI	0.537	2.613	0.4429	0.231
FTTE	1.034	2.543	0.0609	0.0762
AIT5	1.967	5.681	0.001 **	0.000 ***
RICT	0.560	2.218	0.3116	0.128
PICT	1.090	4.766	0.007**	0.001 **
DS	-0.675	1.698	0.111	0.076
IA	-1.822	6.500	0.001 **	0.000 ***
FBS	-0.656	2.874	0.3375	0.067
GDP	1.489	3.892	0.0024**	0.009 ***
GDPC	1.509	3.643	0.0024**	0.004**
INF	1.020	2.851	0.0026**	0.003**
UNEM	0.457	2.927	0.0731	0.087
FDIN	0.686	3.190	0.3019	0.752

Note: Number of observations for each variable is 30. \*\*\* and \*\* indicate statistical significance at 1% and 5% levels, respectively.

Source: Collected by authors output of Stata.

For normality tests, that is, the distribution of variables was tested by skewness/kurtosis and Shapiro–Wilk tests. These test results have been presented in Table 4. Further, from Table 4, it is quite evident that for PICT, IA, GDPC, with a p-value of 0 null hypotheses are rejected at 1% level of significance. In fact, the p-value for AITS, GDP, INF, UNEM, UNEM, FDIN' significance is 0.001 and technically rejects the null hypothesis at a 95% confident level. The findings are statistically significant and justify the rejection of the null hypothesis.

**Table 5. Cross-sectional dependence tests and stops homogeneity test (Pesaran, Yamagata, 2008).**

Statistic	p-Value
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ICTI	1.341	0.223
FTTE	5.984	0.091
AITS	2.009***	0.001**
RICT	1.763	0.654
PICT	1.094***	0.000***
DS	3.219	0.0982
IA	0.427***	0.000***
FBS	0.782	0.0651
GDP	-3.305***	0.001**
GDPC	-3.708*	0.000***
INF	-2.594**	0.009**
UNEM	-2.863***	0.004**
FDIN	-2.814**	0.005**

Note: + two-sided test. \*\*\* indicates statistical significance at 1% level. The null hypothesis is cross-sectional independence.

Source: Collected by authors output of Stata.

Moving to Table 5, the p-values for AITS, PICT, IA, GDP, GDPCGDPC, INF, UNEM, FDIN less than 0.05 with exception of that of the Budget Deficit p-value. This means that we reject the null hypothesis hence there is evidence of heterogeneity for all variances.

from table 6, a positive causality relation is there of FTTE, AITS, RICT and GDP for FTTE the relation is positive at all quantiles but for RICT there on individual quantiles the relation is negative this relation could be explained by In the context of Balkan countries, the correlation between Full-Time Equivalent (FTE) Telecommunication employees, annual investment in telecommunication services, ICT regulator institutional structure, and their positive influence on GDP is a fairly complex yet critical relationship underpinning economic growth and development. First, well, any considerable number of Full-Time Equivalent Telecommunication employees shows that the telecom sector has done well. A high skilled and substantial number of people in this area show that the industry has grown strong enough to invent, build innovations and lay down its infrastructures, setting the path clear for these results to come out. These employees therefore contribute not only towards services expansion in telecommunications but also towards technological advancements pivotal in enhancing productivity across all sectors of the economy. First, their experience and efforts do contribute to the effective use of



telecommunications resources that positively affect business functioning, delivery of public services, and overall economic efficiency. Second, the key role is played by the annual investment in telecommunication services. Higher investments in this sector usually indicate modernization, expansion and improving the infrastructure of telecommunication. Improvement of the infrastructure is a gateway to improved connectivity, more information accessibility and improved communication networks. This creates innovative activities, enables creation of new enterprises, and facilitates trade all adding immensely to economic growth. Even more, greater investments often attract the adoption of modern technologies and services that even boost economic activities and increase its competitive edge. Secondly, institutional structure of the ICT regulator is another key element. A well-structured ICT regulatory framework ensures open competition, consumers' interests protection, and industry expansion. A well-functioning regulator provides stability, standards that need to be adhered to and facilitates the technological advancements in place which permits an environment attractive for investment. A regulator whose policies and practices to promote innovation and fair market can invite foreign investors, can stimulate the indigenous entrepreneurship, and thus set the tune for overall progress of a country in the domain of telecommunications. Together these factors dovetailing to each other contribute to GDP in case to Balkan. A well-organized regulatory environment coupled with strong investments and equipped human resources in the form of a developed telecom sector becomes the catalyst for economic expansion. It allows innovation, opens doors for improved productivity in all the sectors, improved connectivity, and fostering an environment for economic activities to take place which will subsequently have a reflection on the GDP of those nations.

**Table 6. Panel quantile estimations (M.M.Q.R.) Proxy Variables on GDP**

Variables	Location	Scale	Q15	Q25	Q50	Q75
ICIT	0.001	0.003	0.002	0.005	0.008	0.008
FTTE	25.103***	-64.996	25.931***	25.646***	25.048***	24.513***
AITS	0.002**	83.76358	0.002	0.001	0.003**	0.004***
RICT	0.0010***	-0.004	-0.003*	-0.003**	-0.005***	-0.003***
PICT	0.002	0.004	0.001	0.001	0.001	0.002
DS	0.003	-0.002	-0.002	-0.004	-0.003	-0.001**
IA	-0.003	-0.001	0.001	7.851	-0.001	-0.002
FBS	0.001*	7.943	0.001	0.001	0.002	0.003
CONS	0.001	0.004	0.004	0.002	0.003	0.004



Note: \*, \*\*, \*\*\* means significance of the tested variables at 10%, 5%, 1% levels, respectively

Source: Collected by authors output of Stata.

According to table 7, a positive causality relation between AITS, RICT and GDP per capita for AITS the relation is positive in all quantiles but for RICT the relation on individual quantiles is negative this relation could be explained by In Balkan countries, the annual investment in telecommunication services and the institutional structure of the ICT regulator wield significant influence on the GDP per capita, shaping economic prosperity and individual wealth. Telecommunication services are among the main factors that significantly drive economic growth, and therefore GDP per capita in a country. Therefore, an increase in investments in telecommunication services ensures improved extensions as well as modernization of telecommunication infrastructures facilitating better connectivity, digitization reach and good coverage of communication network. These improvements have a snowballing effect to the different sectors of an economy. They breed innovations, efficiency in business operations, and foster rapid adaptation to emerging technologies. This cycle serves to boost productivity, support entrepreneurship, and open new economic opportunities that are positively affecting the GDP per capita. Besides, the coherence in an institutional structure of the ICT regulator contributes to the promotion of GDP per capita. A well-structured regulatory framework guarantees fair competition, consumer protection, and a favourable investment climate in the new trend in the communications technology industry. A transparent and well-functioning regulator begets confidence in investors, begets innovation and invitations foreign direct investments. This in turn creates employment, promotes economic growth and development of a competitive market which eventually leads to an increase in the GDP per capita final GDP per capita is determined collectively by all these factors in the interrelations in Balkan countries. An annual investment in a robust telecommunication sector is supported by a well-structured regulatory environment that guarantees increased economic activities, technological progressiveness, and enhanced productivity. These dynamics contribute overwhelmingly towards elevating the overall GDP per capita, thereby reflecting economic well-being and prosperity of the population within these nations.

**Table 7. Panel quantile estimations (M.M.Q.R.) Proxy Variables on GDP per Capita**

Variables	Location	Scale	Q15	Q25	Q50	Q75
ICIT	-3548.45	-527.565	-2753.755	-3120.699	-3815.359	-4069.854**



FTTE	3.394	5.355	-4.672	-0.947	6.104	8.687
AIT5	1054.029***	41.311	991.798*	1020.533**	1074.930***	1094.858***
RICT	-9.354***	1.239	-1.122*	-1.035**	-8.727***	-8.129***
PICT	1288.167	-1076.731	2910.093	2161.182	743.4214	224.0113
DS	728.301	558.119	-112.4176	275.777	1010.668	1279.902
IA	-1257.284	-347.2504	-734.206	-975.7328	-1432.967	-1600.479
FBS	15.768	-31.830	20.562	18.348	14.157	12.622
CONS	36.820	71.832	-71.383	-21.421	73.162	10.7814*

Note: \*, \*\*, \*\*\* means significance of the tested variables at 10%, 5%, 1% levels, respectively

Source: Collected by authors output of Stata.

As shown by table 8, there is a positive causality relation between FBS and GDP inflation the counsel relation shows by all quantiles but there is negative relation between RICT, DS and inflations this relation could be explained by the institutional structure of regulatory bodies and digitalisation skills have intertwined impacts over inflation rates in the Balkan countries. Insufficient or unclear regulatory bodies can serve as a barrier to market competition and inventive efficiency in the sector of telecommunications. In some cases, a low price of competition results in a higher charge of services and products that could escalate into cost-push inflation. Moreover, insufficient regulatory systems would dampen investments to modernize the infrastructure that would retard technological development and thereby impede the growth of productivity, thus indirectly stoking inflationary tendencies. On the other hand, a productive workforce who possesses sound competencies in digitalization indeed augments the level of productivity and efficiency in various economic sectors. Increased digital literacy and higher level of technological proficiency amongst workforce allow easy adoption of digital tools and innovations across various businesses hence the streamlining operation that leads to cost reduction. This efficiency often helps in mitigating the inflationary pressures as businesses can therefore maintain or lower prices due to improved productivity without letting that affect their profit margins. On the issue of fixed broadband subscriptions, the positive impacts which they have over inflation in Balkan countries are traceable from transformative effects that come by the increased connectivity. More subscriptions mean there is a broad access to high-speed internet needed for the facilitation of economic activities and efficiency across other industries. There is often increased use of digital technologies in automation, communication, and innovations associated with improved connectivity. This, in turn, drives productivity gains and cost efficiencies that may tame inflationary



pressures as businesses optimize operations and deliver goods and services more efficiently. so, institutional structure of regulators and digitalization skills play crucial role in shaping of inflationary pressures. An ineffective regulatory environment contributes to the incidence of inflation, a skilled work force, and improved connectivity via broadband subscriptions likely to counter the phenomenon by generating heightened levels of productivity, efficiency as well as innovativeness within the economy.

**Table 8. Panel quantile estimations (M.M.Q.R.) Proxy Variables on Inflation**

Variable	Location	Scale	Q15	Q25	Q50	Q75
ICIT	0.007	-0.028	0.047	0.037	0.002	-0.017
FTTE	0.001	0.002	0.003	0.005	0.004	0.003
AIT5	-0.005	-0.003	-0.001	-0.001	-0.006	-0.009
RICT	-3.372*	0.056	-3.450**	-3.430**	-3.361*	-3.323
PICT	-0.062	-0.094	0.066	0.034	-0.080	-0.144
DS	-0.203*	-0.022	-0.172**	-0.179**	-0.207*	-0.223
IA	-0.091	0.027	-0.129	-0.119*	-0.086	-0.067
FBS	1.514**	0.202	1.237**	1.306**	1.553**	1.689*
CONS	-0.351	-1.584	1.822	1.283	-0.650	-1.721

Note: \*, \*\*, \*\*\* means significance of the tested variables at 10%, 5%, 1% levels, respectively

Source: Collected by authors output of Stata.

according to table 9 is negative causal weak relationship between FTTE and the rate of unemployment this relationship explains specifically the last quantile which clearly explain the relation in Serbia this relation could be explained by that the influence of Full-Time Equivalent (FTE) Telecommunication employees on the unemployment rate can vary across Balkan countries. Taking into consideration Serbia, any increase in the number of FTE Telecommunication employees could be associated with an adverse impact on the level of unemployment. These distinct dynamics in the telecom sector of Serbia may materialize this scenario where an increase in skilled employee's implies growth in that sector or technological improvement. As telecom industry expands, it absorbs the available labour which might reduce the level of unemployment rate. However, this relationship may not hold uniformly across other Balkan countries. All these factors, as the size of telecommunications sector, presence of technological advancements, effective government policies and overall economic structure, would have a considerable variation across the nations. In some other Balkan countries employment dynamics



within the telecoms sector may not play a very overpowering role in changing the character of the unemployment rate. This could result from the relative importance of the sector in economy, pace at which diffusion of technologies is taking place or even other sectors with more key prevalent industries. While it may be different for the telecom sector in Serbia about reduction of unemployment owing to the rapid growth experience and increasing demand for skilled workforce, in other Balkan states this might not be the case considering complexities in their economies that make telecommunication employment less influential towards determining rate of unemployment. The relationship between telecom employment and unemployment rates is intricate, taking proportions in Balkan nations based on underlying economic structures, industry compositions and level of participation of the telecom industry in the general economy.

**Table 9. Panel quantile estimations (M.M.Q.R.) Proxy Variables on Unemployment rate**

Variables	Location	Scale	Q15	Q25	Q50	Q75
ICIT	0.077	-0.033	0.107	0.102	0.079	0.041
FTTE	-0.004*	-0.001	-0.001	-0.001	-0.001	-0.001**
AIT5	-0.007	0.001	-0.009	-0.008	-0.007	-0.006
RICT	-1.174	0.280	-1.425	-1.380	-1.192	-0.874
PICT	-0.205	0.115	-0.308	-0.290	-0.213	-0.082
DS	0.154	-0.032	0.183	0.178	0.156	0.120
IA	-0.169	-0.039	-0.134	-0.140	-0.167	-0.211*
FBS	-0.348	-0.007	-0.341	-0.342	-0.347	-0.356
CONS	35.523***	5.396	30.705*	31.560*	35.182***	41.295**

Note: \*, \*\*, \*\*\* means significance of the tested variables at 10%, 5%, 1% levels, respectively

Source: Collected by authors output of Stata.

as far as the table 10 comes, there can be noticed negative causal weak relationship between FTTE, DS, and FDIN rate this relationship could explain almost all quantiles except that of the highest ones but there is positive causal relation between AIT5 and FDIN this relation could be explained by The relationship between Full Time Equivalent (FTE) Telecommunication employees Digitalization skills and Foreign Direct Investment (FDI) in Balkan countries reflects a weak negative causal link across nearly all quantiles. Thus, differences in FTE Telecom employees or digitalization skills do not consistently and significantly impact FDI over levels or



segments of variation in the data. The weak negative causal relation observed between FTE Telecommunication employees, Digitalization skills and FDI is indicative of changes or growth in these functions that are not robustly related with higher FDI inflows. This could be attributed to a variety of reasons that included diversity of the factors driving FDI decisions and complex in nature beyond telecom labour or digital skills other stronger influences playing part in attracting foreign investments and the divergent economic situation prevailing within each quantile leading to differing response in investments. Contrarily, the positive causal relation between Annual Investment in Telecommunication Services and FDI implies greater growth related, reflective of foreign direct inflows with increased investments in telecom sector. Increased investments imply potential growth, improved infrastructures in place, and technological improvements deemed attractive to foreign investors looking for investment options in growing markets. This positive relationship portrays the significance of same factors for which investing telecommunication infrastructures are leading factor attracting foreign direct investments in the Balkan countries. Enhancing the telecommunications service environment usually bears foreign investors and therefore enhances FDI in countries specializing in dedicating resources towards the same. The contradictory strengths and directions of these relationships across quantiles highlight the property on the complex nature of factors influencing FDI. The association between telecom employment with digital skills and FDI seems weak and negative oriented as the positive association between annual telecom investments with FDI underpins cardinal role of telecom infrastructure investments for attracting foreign investment in Balkans.

**Table 10. Panel quantile estimations (M.M.Q.R.) Proxy Variables on Net flow FDI**

Variables	Location	Scale	Q15	Q25	Q50	Q75
ICIT	-0.046	0.001	-0.047	-0.047	-0.046	-0.044
FTTE	-0.001*	0.001	-0.001**	-0.001**	-0.001**	-0.001
AITS	0.015***	-0.001	0.018***	0.017***	0.016***	0.014*
RICT	0.881	0.281	0.519	0.596	0.803	1.099
PICT	0.067	-0.068	0.156	0.137	0.086	0.014
DS	-0.109**	0.021	-0.137***	-0.131***	-0.115**	-0.093
IA	-0.029	-0.009	-0.018	-0.020	-0.027	-0.036
FBS	0.453	0.026	0.419	0.426	0.446	0.474
CONS	1.342	0.942	0.131	0.389	1.082	2.075





Note: \*, \*\*, \*\*\* means significance of the tested variables at 10%, 5%, 1% levels, respectively

Source: Collected by authors output of Stata.

The relationships among some of the key economic indicators of Balkan countries with various attributes such as Full-Time Equivalent (FTE) Telecommunication employees, annual investment on telecommunication services, institutional structure of the ICT regulator, prices for ICT, and digitalization skills are multifaceted and interlinked. employees in FTE Telecommunication contribute much to the technological advancement and service provision. Therefore, their existence often shows a blooming telecom sector that enhances connectivity and technological innovation hence springing the GDP positively. Moreover, the enhanced investment in telecommunication services raise infrastructure and speed economic activities leading to an increase in Foreign Direct Investment (FDI). The improved infrastructure usually leads to improved connectivity that raises the level of GDP per capita. This institutional structure of these ICT regulators institutionalizes the efficiency and competitiveness of the telecom sector. A sound and efficient regulatory framework for business enhances investment that results in positive macroeconomic outcomes such as increased national GDP, FDI, and economic stability. Moreover, ICT prices can affect inflation rates, with higher prices potentially leading to cost-push inflation. Higher skills on the digitalization in the workforce will drive productivity, innovation, and efficiency across sectors thus directly impacting GDP, GDP per capita reducing rates of unemployment. However, it is whenever the skills do not align with what time to time the industry requires this can create a gap of skills where the economy can be highly affected. As such, enhancing the levels of digitalization is a goal towards achieving economic stability in Balkan countries. This may be simply achieved by increased investment in digital infrastructure, encouraging digital literacy programs, harmonizing education curricula with industry's needs as well as ensuring that the regulatory frameworks are supportive of technological advancements. Countries can also enhance their digital skills and infrastructure through which they are able to stimulate economic growth, attract FDI, reduce unemployment, containment of inflation. Additionally, there will be a requirement for collaborations among the governments, private sectors, and educational institutions. Putting in place policies that encourage innovation, research, and development in technology and enforcement of competitions and measures to protect consumers will create an enabling environment for the realization of economic stability, and growth in the Balkans.



## Conclusion:

The study found that the impact of digitization on macroeconomic variables such as unemployment, GDP and economic growth had a significant positive impact in the countries where the study was conducted, namely the Balkan States. The study revealed that digitization indicators played a role in developing digital society and improving macroeconomic indicators. It also revealed a difference in digitization indicators by period studied and methods used to detect effects among the Balkan States. However, most Balkan States agreed on the need to promote digitization and technological development in trade and finance that would enhance economic development and GDP, as well as reducing national and political barriers to digitization and the single digital market between Balkan States and developed countries in Europe. The study also stressed "the importance of digitization indicators for social and economic well-being gross domestic product (GDP), which can be expressed as GDP per capita, Reducing unemployment by promoting digital literacy and creating new technology-based jobs for the unemployed economic growth through the creation of added value for the economy on the basis of trade and extraterritorial work using the ways of technology and digitization. The studies, which have been carried out regarding the effect of digitalization on the growth of economy in the Balkan countries, taking the main independent variables as Full-Time Equivalent Telecommunication employees, annual investment on telecommunication services, ICT regulator institutional structure, ICT price, and skills on digitalization and dependent variables such as GDP, GDP per capita, FDI (Foreign Direct Investment), inflation, and unemployment during the period from year 2018 to financial year 2022, has led to enlightening insights. From the complexity and interaction of these variables, the three factors that have been found as being significant influencers of economic growth within the Balkan region are: Full-Time Equivalent Telecommunication employees, annual investment in telecommunication services, and the ICT regulators' institutional structure. Presented with strong positive correlations with GDP, GDP per capita, and FDI are: Full-Time Equivalent Telecommunication employees, annual investment in telecommunication services, and the institutional structure of ICT regulators. Full-time equivalent employees in the telecommunication sector are representative of a huge workforce in that industry hence an indicator of robustness since this industry serves to promote technological development, improved infrastructure, and connection. This factor consistently showed positive relationships with the economic growth indicators like GDP and FDI. Similarly, more annual investment in telecommunication services has depicted strong positive relationships with the economic growth metrics. The said investments represent modernization, expanded infrastructure and technological innovation contributing a significant share to GDP with foreign direct investment



attracted. The role that has further emerged determining importance is regarding the decided question of ICT regulators and their institutional structure. A transparent, efficient regulatory framework positively influences the way economic growth facilitates an environment for investment, innovation as well as technological advancement. Notably, the institutional setup has told volumes of impacts on GDP and FDI in Balkan countries thus evidenced that regulatory policies have shaped the telecom sector efficiency and competitiveness. However, among the positive noted correlations earlier, a contrasting trend was visible being as the relationship between independent variables and inflation. The study uncovered a negative association between these factors and inflation rates in Balkan countries. While further investigations better warrant the reasons behind this negative relationship, what is indicated through the correlation is that even though there are factors leading to increased pressures of inflationary such as increase in telecom employment, higher investment of countries involved in telecommunications, and an effective regulatory framework may not necessarily be substantial within the period of study. In conclusion, the study points towards substantive influence of factors related to digitalisation - telecom employment, investment, and regulatory structure - over economic growth in Balkan countries. These findings underscore the need to develop a skilled telecom workforce, giving incentive for investment in infrastructure and making sure strong regulatory frameworks exist to spur economic growth as well as to attract foreign direct investment. However, the observed negative association between these factors and inflation opens avenues for deeper exploration and nuanced policy considerations on how to achieve sustained economic stability of the SADC region.

## References:

- Apostu, S.A., Panait, M., Vasile, V., Sharma, G.D., Vasile, R., 2023. FINTECHS and financial inclusion—Balkan experience: Digital perspectives on financial markets. *Electron. J. Inf. Syst. Dev. Ctries.* 89, e12257. <https://doi.org/10.1002/isd2.12257>
- Avlijas, S., 2022. HOW REGIONAL INTEGRATION AGREEMENTS CAN FOSTER INCLUSIVE GROWTH: LESSONS FROM EXPORTING SMES IN THE WESTERN BALKANS. *Econ. Ann.* 67, 67–93. <https://doi.org/10.2298/EKA2235067A>
- Ben Youssef, A., Boubaker, S., Dedaj, B., Carabregu-Vokshi, M., 2021. Digitalization of the economy and entrepreneurship intention. *Technol.*



- Forecast. Soc. Change 164, 120043.  
<https://doi.org/10.1016/j.techfore.2020.120043>
- Boshkov, T., Josevski, D., Miteva, N., 2023. FINANCIAL DIGITALIZATION AND ECONOMIC GROWTH: RECENT DEVELOPMENTS IN BANKS AND FINTECH. pp. 15–25. <https://doi.org/10.46763/YFNTS2361015b>
- Butigan Vučaj, T., 2019. EUROPEANA for us: transforming the Western Balkan with culture. *Bosniaca* 55–59. <https://doi.org/10.37083/bosn.2019.24.55>
- Digital transformation and economic cooperation: The case of Western Balkan countries, 2020. . *Zb. Rad. Ekon. Fak. U Rijeci Časopis Za Ekon. Teor. Praksu* Proceedings Rij. Fac. Econ. J. Econ. Bus. 38. <https://doi.org/10.18045/zbefri.2020.2.697>
- Đorić, Ž., 2020. Digital economy: Basic aspects and the case of Serbia. *Ekon. Pogl.* 22, 73–96. <https://doi.org/10.5937/EkoPog2002073Q>
- Dumitrescu, E.-I., Hurlin, C., 2012. Testing for Granger non-causality in heterogeneous panels. *Econ. Model.* 29, 1450–1460. <https://doi.org/10.1016/j.econmod.2012.02.014>
- Gigauri, I., Janjua, L.R., Panait, M., Puime Guillen, F., 2023. Exploring The Nexus Between Financial Inclusion, Poverty, Digitalization And Sustainable Development Goal. Presented at the 3rd International Conference Global Ethics -Key of Sustainability (GEKoS), pp. 63–81. <https://doi.org/10.18662/lumproc/gekos2022/06>
- Government of Brčko District, Department of Public Safety, Brčko, Bosnia and Herzegovina, Puška, A., Štilić, A., Academy of Applied Studies Belgrade, The College of Tourism, Belgrade, Serbia, Stojanović, I., College of Business Administration, American University in the Emirates, Dubai International Academic City, Dubai, United Arab Emirates, 2023. Approach for multi-criteria ranking of Balkan countries based on the index of economic freedom. *J. Decis. Anal. Intell. Comput.* 3, 1–14. <https://doi.org/10.31181/jdaic10017022023p>
- Hawach, F., Zhang, C., Acharjee, S., Nicolas-Sans, R., 2023. Internet capabilities and innovation in the BALKAN countries: The role of foreign technology licensing. *Electron. J. Inf. Syst. Dev. Ctries.* 89, e12242. <https://doi.org/10.1002/isd2.12242>
- Huang, P., 2023. Internet financial forecasting and digital economy development by using machine learning algorithm in the new consumption environment. *Soft Comput.* 27, 10285–10296. <https://doi.org/10.1007/s00500-023-08309-3>
- Karras, D., 2023. On state of the art research trends in albania regarding digitalization. *Automation and sustainable development. CRJ* 20–39. <https://doi.org/10.59380/crj.v1i1.2753>



- Liao, W., 2023. How does the digital economy affect the development of the green economy? Evidence from Chinese cities. PLOS ONE 18, e0289826. <https://doi.org/10.1371/journal.pone.0289826>
- Marti, L., Puertas, R., 2023. Analysis of European competitiveness based on its innovative capacity and digitalization level. Technol. Soc. 72, 102206. <https://doi.org/10.1016/j.techsoc.2023.102206>
- Melović, B., Jocović, M., Dabić, M., Vulić, T.B., Dudic, B., 2020. The impact of digital transformation and digital marketing on the brand promotion, positioning and electronic business in Montenegro. Technol. Soc. 63, 101425. <https://doi.org/10.1016/j.techsoc.2020.101425>
- Mitrovic, D., 2015. Broadband adoption, digital divide, and the global economic competitiveness of Western Balkan countries. Econ. Ann. 60, 95–115. <https://doi.org/10.2298/EKA1507095M>
- Mkiyes, H., Příklad, A., 2023. Digitalization in Balkan Countries. <https://doi.org/10.5281/ZENODO.10130143>
- Shimbov, B., Alguacil, M., Suárez, C., 2016. International Production Networks and Economic Growth: The Case of the Western Balkan Countries. East. Eur. Econ. 54, 49–70. <https://doi.org/10.1080/00128775.2015.1112749>
- Soreg, K., Bermudez-Gonzalez, G., 2021. Measuring the Socioeconomic Development of Selected Balkan Countries and Hungary: A Comparative Analysis for Sustainable Growth. Sustainability 13, 736. <https://doi.org/10.3390/su13020736>
- Stoica, E.A., Bogoslov, I.A., 2017. A Comprehensive Analysis Regarding DESI Country Progress for Romania Relative to the European Average Trend. Balk. Reg. Conf. Eng. Bus. Educ. 2, 258–266. <https://doi.org/10.1515/cplbu-2017-0034>
- The impact of national intellectual capital on the economic growth in the South-Eastern European Countries, 2018. . Zb. Rad. Ekon. Fak. U Rijeci Časopis Za Ekon. Teor. Praksu Proceedings Rij. Fac. Econ. J. Econ. Bus. 36. <https://doi.org/10.18045/zbefri.2018.2.777>
- Toska, A., Fetai, B., 2023. The Impact of E-Commerce on the Economic Growth of the Western Balkan Countries: A Panel Data Analysis. Int. J. Sustain. Dev. Plan. 18, 935–941. <https://doi.org/10.18280/ijstdp.180329>
- Vidas-Bubanja, M., Bogetić, S., Bešić, C., Kalinić, Z., Bubanja, I., 2023. Managing the reskilling revolution for the digital age: Case study: Western Balkan countries. J. Eng. Manag. Compet. 13, 37–52. <https://doi.org/10.5937/JEMC2301037V>
- Vidas-Bubanja, M., Bogetić, S., Bubanja, I., 2019. International standards: An important component of a successful digital transformation of the national



- economy. *J. Eng. Manag. Compet.* 9, 72–81.  
<https://doi.org/10.5937/JEMC1901072V>
- Vučeković, M., Avlijaš, G., Marković, M.R., Radulović, D., Dragojević, A., Marković, D., 2023. The relationship between working in the “gig” economy and perceived subjective well-being in Western Balkan countries. *Front. Psychol.* 14, 1180532. <https://doi.org/10.3389/fpsyg.2023.1180532>
- Vukmirović, V., Kostić-Stanković, M., Pavlović, D., Ateljević, J., Bjelica, D., Radonić, M., Sekulić, D., 2021. Foreign Direct Investments’ Impact on Economic Growth in Serbia. *J. Balk. East. Stud.* 23, 122–143.  
<https://doi.org/10.1080/19448953.2020.1818028>
- Zeković, S., Perić, A., 2023. Regional Industrial Policy in the Western Balkans: Neither Specialization nor Spatialization? *East. Eur. Econ.* 1–26.  
<https://doi.org/10.1080/00128775.2023.2178936>
- Žmuk, B., Mihajlović, I., 2018. Online booking for travel and accommodation influenced by economic and digital development level: Position of the Western Balkan countries within Europe. *Croat. Rev. Econ. Bus. Soc. Stat.* 4, 86–98. <https://doi.org/10.2478/crebss-2018-0016>



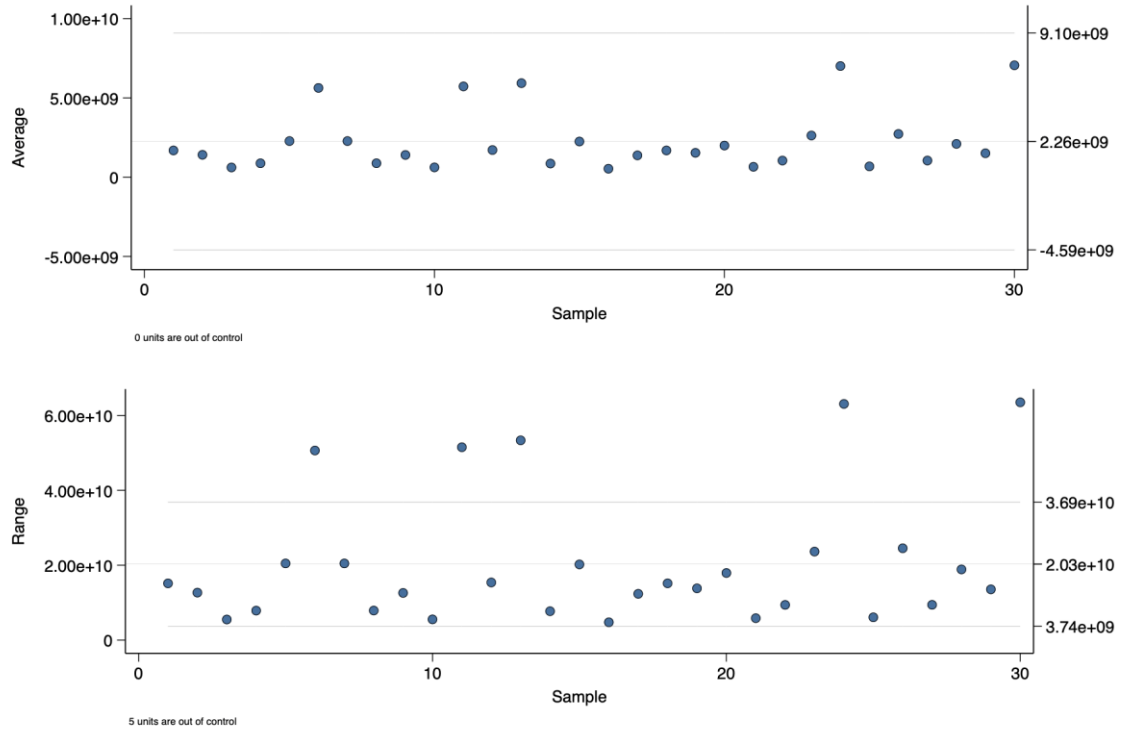
## Appendices



Graphs by Y

**Fig.1. Panel quantile estimations (M.M.Q.R.)**

Source: Collected by authors output of Stata.



**Fig.2.Filled data**

Source: Collected by authors output of Stata.

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