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DIFFERENT COUNTRIES, DIFFERENT OUTCOMES: MULTIPLICATIVE EFFECTS OF BROADBAND INVESTMENTS IN WESTERN BALKAN COUNTRIES

Abstract

The paper aims to determine in what way different structures of economies may contribute to discrepancies in the short-term economic effects of broadband investments. The paper uses the input-output methodology to explore the multiplicative impact of broadband investments in six Western Balkan countries. The multiplicative effects of broadband investments on gross value added, employment, imports and tax revenues are calculated, which in turn can affect the investment propensity and condition appropriate policy responses. The results reveal significant economic benefits, including increased output, job creation, and government revenue, underscoring the importance of supportive government policies and regulatory frameworks.

Keywords: firm entry, digitally intensive sectors, broadband speed, digital transformation, Croatia, spatial spillovers.

1.   INTRODUCTION

Broadband (BB) investments are widely recognized as an economic growth and social development catalyst. In the Western Balkan countries, the transformative potential of broadband infrastructure is particularly significant

given the region's economic underdevelopment compared to other parts of Europe. Broadband investments in the Western Balkans can address regional disparities and promote inclusive growth, ensuring that all segments of society benefit from digital advancements (International Bank for Reconstruction and Development [IBRD] and World Bank [WB], 2017). This is supported by Qiang (2010), who emphasizes that the growth effect of broadband is significant and more substantial in developing countries than in developed ones, making investments in broadband networks an essential component of development strategies in these regions. In addition, broadband access contributes to social inclusion and improves the quality of life by connecting underserved and rural communities to essential services (Reddick, Enriquez, Harris & Sharma, 2020). The value of broadband investment in each Western Balkan economy depends on several factors, including the current condition of broadband infrastructure, geographical and geological factors, population density, the distribution of households in urban and rural areas, and economic factors such as equipment prices and broadband service affordability (Katz, Vaterlaus, Zehnhäusern & Suter, 2010).

This paper aims to explore the multiplicative effects of broadband investments in six Western Balkan countries—Croatia, Albania, Bosnia and Herzegovina, Serbia, Montenegro, and North Macedonia—by applying an input-output methodology. These effects include the impacts on gross value added, employment, imports, and tax revenues, which are important for shaping appropriate policy responses. Our analysis uses input-output tables to estimate broadband investments' direct, indirect, and induced impact, highlighting the most beneficial sectors and the overall economic implications. In other words, this paper examines how the economic structures of different countries contribute to discrepancies in the short-term economic effects of broadband investments. The results of our analysis reveal significant economic benefits, including increased output, job creation, and government revenue. In addition, our findings show that future investments in different technologies will influence the value chain of domestic producers and the diffusion pattern of direct, indirect, and induced effects across economic sectors. For instance, investments in fiber technologies (e.g. FTTC, FTTP/FTTH/FTTB) significantly benefit the production of cables and construction services. In contrast wireless broadband investments primarily boost the production of sophisticated transmission devices. Our results also confirm that deploying broadband infrastructure in areas where the relative cost per user is high can be unattractive to private investors unless subsidized by public funds. Since these investments positively affect economic activity, the resulting increase in government revenues from taxes and contributions can serve as an additional source of financing for unprofitable projects. Therefore, by understanding these multiplicative effects, policymakers and stakeholders can better assess the economic impact of broadband infrastructure and design strategies and policies to maximize its benefits. Policymakers in the Western Balkans should focus on creating a conducive environment for these investments by reducing bureaucratic hurdles and providing financial incentives, especially in less attractive areas.

The contribution of this paper can be observed in three significant dimensions. Firstly, it provides empirical evidence to inform effective policy and investment strategies in the Western Balkans, showcasing the substantial economic benefits of broadband infrastructure and advocating for increased public and private investment. Secondly, it enriches the limited body of literature on the Western Balkans by identifying the sectors that benefit most from broadband investments. Lastly, it employs input-output tables as a robust methodology for assessing the economic impact of broadband investments, offering a replicable approach that can be applied in other regions to evaluate similar investments.

The rest of the paper is organized as follows: After the introduction, a comprehensive literature review is provided in Section 2. Section 3 details the data and methodology used in our analysis, followed by Section 4, which presents the main findings. Finally, section 5 summarizes the key findings and concludes.

2. LITERATURE REVIEW

Broadband investments radically impact countries' economic growth and social development. This literature review explores the multiplicative effects of broadband investments, focusing on their impact on GDP growth (Qiang, 2010; Czernich, Falck, Kretschmer & Woessmann, 2011; Katz & Koutroumpis, 2013; Rohman & Bohlin, 2013; Minges, 2016; Koutroumpis, 2019; Briglauer, Dürr & Gugler, 2021), productivity (Lehr, Osorio, Gillett & Sirbu, 2006; Kretschmner, 2012; Mack & Faggian, 2013; Edquist, 2022), employment (Crandall, Lehr & Litan, 2007; Atasoy, 2013; Balsmeier & Wörter, 2019) and regional economic disparities (Rohman, 2013; Haller & Lyons, 2015). The following text systematically reviews the key papers and studies relevant to this research.

By employing a simultaneous equations model on 22 OECD countries, a study by Koutroumpis (2009) reveals increasing returns on broadband telecommunications investments, consistent with persistent network effects. In particular, the study shows that the impact of broadband penetration on GDP growth ranges from 0.26% to 0.85% for each 10-point increase in penetration. Evidence indicates a critical mass phenomenon at the 30% level, where half of the population has broadband access. Similarly, Czernich et al. (2011) analyzed a panel of OECD countries and found that broadband penetration significantly increases GDP growth. Specifically, they observed that the initial introduction of broadband correlates with a 2.7-3.9% increase in GDP per capita. Furthermore, they found that a subsequent 10 percentage point increase in broadband penetration results in a 0.9-1.5 percentage point growth in GDP per capita, highlighting the substantial economic benefits of widespread broadband adoption.

Our study methodologically leans more on Katz et al. (2010), who used input-output tables to distinguish between direct, indirect, and induced employment and production effects of network construction. An investment of approximately 36 billion euros in the short-term induces 33.4 billion euros in gross

value added. Network externalities in the ten-year period after investment contribute an additional 137.5 billion euros, resulting in a total increase of 170.9 billion euros in GDP, equivalent to 0.60% GDP growth in Germany. According to the study, network construction is expected to create 968,000 incremental jobs, with 541,000 from network construction (total employment along the supply chain estimated by the input-output model) and 427,000 jobs from enhanced innovation and new business creation in the long term. The type I multiplier of the Broadband network construction for the German economy has been estimated to be 1.45, while the type II multiplier is 1.93, meaning that total economic effects are almost double compared to the initial effects recorded by suppliers of broadband investment. If only short-term effects are accounted for, an investment valued at 100 million euros induces 93 million GVA and 1.5 thousand jobs. Industries mainly benefitting from BB investments are construction, electronics equipment manufacturing and telecommunications. Rohman & Bohlin (2013) analyzed the effect of broadband speed on economic growth in 34 OECD countries from 2008 to 2010 and found that doubling broadband speed contributes to a 0.3% increase in GDP growth compared to the base year. Additionally, the study shows that the impact is more pronounced for countries with lower previous economic growth. A more recent study by Koutroumpis (2019) confirms that while broadband adoption does enhance economic output across OECD countries, the gains exhibit diminishing returns. The research identifies a speed threshold that rises over time, beyond which further speed improvements no longer boost productivity. The study results suggest that policymakers should adopt a balanced approach to designing broadband policies, combining both coverage and quality to maximize impact.

Crandall et al. (2007) report the positive impact of broadband on employment across various industries in the United States during the early stages of broadband development. They show that for every percentage point increase in broadband penetration, employment is projected to increase by 0.2 to 0.3 percent per year, translating to about 300,000 jobs at the national level. Atasoy (2013) finds that accessing broadband services in the United States is associated with an approximately 1.8 percentage point increase in the employment rate, with even more significant effects observed in rural and isolated areas. The introduction of high-speed internet facilitates remote working schemes, reduces transaction costs, and provides firms access to larger markets and skilled labor, thereby boosting overall productivity (IBRD and World Bank, 2017). During the COVID-19 pandemic, the importance of broadband became more evident as it enabled remote working, learning, and telemedicine. Moreover, the countries with better broadband infrastructure were able to mitigate some of the economic and social disruptions caused by the pandemic (ITU, 2021).

Gruber et al. (2014) report that the overall future benefits of high-performance broadband technologies outweigh the investment costs for the European Union as a whole and for most individual member states. The study recognizes that private sector investment is limited, as investors can only partially capture these benefits, suggesting a rationale for public sector subsidies to support high-speed broadband infrastructure build-out.

Rehman & Nunziante (2023) used the Törnqvist and Malmquist index and found the positive impact of the digital economy on total factor productivity at the regional level. The development of digital technology based on the BB network also improves innovation efficiency and competitiveness (Wang & Cen, 2022). Kretschmer (2012) provides evidence of the ICT industry's positive impact on productivity, which is increasing over time. The study suggests that public-private partnerships can effectively deploy broadband infrastructure in economically less attractive areas. Public investment is particularly important in rural areas since urban areas, with better infrastructure, typically benefit more from broadband investments than rural areas. One of the significant impacts of broadband investments is the reduction of regional economic disparities. In 2023, 81% of urban dwellers worldwide use the Internet, compared to only 50% of rural residents. The urban-rural gap varies significantly across income groups. In high-income countries, the gap is almost bridged with a ratio of 1.1. In contrast, in low-income countries, only 17% of rural residents use the Internet, making urban residents nearly three times more likely to be online. This highlights a pronounced digital divide in rural areas across income groups. The Internet use gap between urban areas of low- and high-income countries is 48 percentage points, while the gap between rural areas is 71 percentage points (International Telecommunication Union [ITU], 2023). Targeted investments in rural broadband infrastructure can help bridge this gap, providing rural communities with economic opportunities similar to those of their urban counterparts. More balanced regional development and reduced migration from rural to urban areas are essential considerations for the Western Balkan countries in our sample. Broadband infrastructure could serve as a critical vehicle to achieve these goals, according to the literature more oriented on the digital divide and geographical disparities (LaRose, Gregg, Strover, Straubhaar & Carpenter, 2007; Aldashev & Batkeyev, 2021).

Research on broadband's impacts within the Western Balkans remains limited, with existing studies only beginning to explore various dimensions (Mitrović, 2015; Ibrahimi & Fetai, 2022; Drilo, Stojčić & Vizek, 2022). Mitrović (2015) used a set of indices to measure the digital divide in the region, revealing significant disparities that underscore the importance of targeted infrastructure investments. Ibrahimi & Fetai (2022) examined the economic impact of ICT on Western Balkan countries from 2000 to 2019, finding that selected ICT variables positively influenced GDP growth across the region. Still, the econometric results are not robust and depend on the model specification and selection of specific indicators. Our research quantifies the impact of broadband infrastructure on specific economic metrics, such as employment, tax revenue, and value-added across various sectors. The bibliometric analyses by Savastano et al. (2024) and Sajter (2024) confirm that digital economy research in this area is underdeveloped. Savastano et al. (2024) provide a global perspective on digital economy trends and research gaps by focusing on the leading journals, while Sajter (2024) focused on Croatian publications. Of relevance to our study, Drilo et al. (2022) found that improvements in digital infrastructure led to increased firm entry in digitally intensive sectors within Croatia, one of the countries included in our analysis. They

showed a 10% increase in broadband speed corresponded with a 0.68% rise in new digitally intensive firms. Although our research does not directly examine firm entry, the findings from Drilo et al. (2022) offer valuable insights into the potential impacts of broadband infrastructure on firm performance within the region.

3.   METHODOLOGY AND DATA SOURCES

3.1.   Data

This paper includes a sample of six Western Balkan economies - Croatia, Albania, Bosnia and Herzegovina, Serbia, Montenegro, and North Macedonia. We selected the economies based on the geographical criteria and the ownership structure of the leading national telecom providers. We conducted a survey to collect and estimate the data about the costs and structure of broadband investments. At least one major telecommunications company for each Western Balkan economy completed the survey. Companies were asked to estimate investment value per new final user for a typical project in a Western Balkan economy they operate and to distribute these costs to the major investment items. A typical project is defined as large enough (with more than 10,000 potential users), and it represents a typical investment in the local market regarding the structure of users (urban/rural) and the prevailing status of current telecommunications infrastructure. Additionally, the survey asked for the distribution of domestic and import contents for individual components of broadband investment. Some companies have pointed out the problem of selecting a representative project. Private telecommunications companies are concerned about project profitability and primarily invest in projects that ensure a return in a shorter period. Most private investments are oriented toward urban areas with high population density, ensuring lower costs per user. Therefore, actual costs per final user in future periods could be higher than reported for a typical project conducted by a private company if full broadband coverage is to be realized. Uncovered areas (so-called "white" areas or spots) usually cover less populated rural areas, and costs per user could be many times higher than those incurred in a typical private investor project. The financial viability of investments in those areas could be ensured only if supported by government funds. Instead of typical project data, telecommunications companies operating in Croatia and Serbia (and LTE technology in Montenegro) estimated the average costs per user representative for the entire territory, including geographical areas where high costs of broadband infrastructure could discourage private investment.

Based on the results for six Western Balkan economies (Table 1), we found that the costs of broadband deployment in most of them are lower, on average than in developed economies, as seen in previous studies (Katz et al., 2010). Costs of investments based on wireline technology are generally higher than costs of mobile broadband infrastructure.

Table 1

Approximate values of investments per final user, in euro

	Investment value per final user	Broadband technology	Reference data
Albania	40	Mobile	Typical project
Bosnia and Herzegovina	140	Mobile	Typical project
Croatia	2100	Greenfield (fiber optic cables)	A stratified sample including total territory
Croatia	380	Brownfield (copper)	A stratified sample including the total territory
North Macedonia	290	Fiber	Typical project
Montenegro (based on active users)	490	Fiber	Typical project
Montenegro (based on potential users)	175	Fiber	Typical project
Montenegro (LTE)	3500	Mobile	A stratified sample including the total territory
Serbia	2500	Mobile	A stratified sample including the total territory

Source: Western Balkan telecommunication companies survey (designed and conducted by authors).

Survey data, similar to the findings of the previous studies for developed economies, identify the following sectors (according to the standard CPA classification, which is used in officially published IO tables[1]) as the leading suppliers of equipment and services incorporated in broadband infrastructure: Computer, electronic, and optical products (including transmission network equipment) - CPA_C26; Electrical equipment (including fiber optic cables) - CPA_C27; Constructions and construction works - CPA_F; Telecommunications services (including implementation costs borne by the investor) - CPA_J61.

Those sectors are expected to be active as the leading suppliers in broadband network development. A Leontief inverse matrix based on national input-output tables estimates the multiplicative effects of broadband investments. Input-output tables are available for four Wester Balkan economies: Albania, Croatia, North Macedonia, and Slovenia, while the average multipliers (in combination with economy-specific data on productivity and price differentials) were used for other economies.

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[1] Statistical classification of products by industries can be found at http://ec.europa.eu/eurostat/statistics-explained/index.php/Glossary:Statistical_classification_of_products_by_activity_(CPA).

3.2.   Methodological approach

The effects of investments in broadband infrastructure on the Western Balkan economies are estimated by the input-output (IO) method. The advantage of the input-output method over other approaches is that it focuses on the spread of the backward effects of the initial increase in final demand on the economic activity of all companies in the value-added chain of a specific industry. Effects analysis in the input-output approach usually includes value-added, employment, imports and tax revenues generated along the supply chain of BB investment (e.g., Katz et al., 2010; Koutroumpis, 2019). Unfortunately, due to rigid assumptions about fixed technological coefficients, the input-output method is inappropriate for evaluating additional economic effects, such as productivity growth and improved competitiveness. Investments in a telecommunications network certainly enable technological innovation, an increase in productivity, export competitiveness, and overall development, as measured by GDP per inhabitant. Effects related to technological changes and increases in efficiency can be better captured by using econometric methods (Drilo et al., 2022; Wang & Cen, 2022) or the application of the Törnqvist or Malmquist index related to the decomposition of the economic growth (Rehman & Nunziante, 2023).

The IO model presents flows of goods and services between economic sectors and examines the effects of final demand on output, gross value added (GVA) and employment. The IO model is a relatively old method and has been broadly explained in the previous economic literature (Leontief, 1986; Miller & Blair, 2009; ten Rea, 2006). Therefore, this methodological part presents only a short overview of the IO model.

If X_i is the total output of the sector i, X_{ij} represents sales of intermediary inputs by sector i to sector j, and Y_i represents the final demand for products delivered by the sector i, then the total output of an economic sector i equals to:

$$X_i = \sum_{J=1}^{n} X_{ij} + Y_i \, , i = 1, \dots, n, \tag{1}$$

The equation (1) can be written as:

$$X_i = \sum_{J=1}^{n} a_{ij} X_j + Y_i \, , i = 1, \dots, n, \tag{2}$$

where $a_{ij} = \frac{x_{ij}}{X_j}$ is a technical coefficient defined as a ratio of a product from a sector i that is required by the sector j to produce one unit of its product. The system of equations (2) in matrix form can be written as:

$$X = AX + Y, \tag{3}$$

where $A = \begin{bmatrix} a_{11} & \cdots & a_{1n} \\ \vdots & \ddots & \vdots \\ a_{n1} & \cdots & a_{nn} \end{bmatrix}$ is a $n \times n$ matrix of technical coefficients.

If the matrix $I - A$ is non-singular and a positive definite matrix, where I is an $n \times n$ identity matrix, the solution to the system (3) is:

$$X = (I - A)^{-1} Y. \tag{4}$$

Matrix $(I - A)^{-1}$ is called the Leontief inverse matrix, also known as a multiplier matrix. If final demand Y is exogenously given, by Equation (4), the total production of all economic sectors can be calculated. An element l_{ij} of the Leontief inverse matrix represents the sector i's output, which is required, directly and indirectly, per one unit of final demand from the sector j.

IO analysis quantifies direct, indirect, and induced effects of each economy sector to the overall economy. The final demand effects on output, GVA, and employment are estimated via multipliers. There are two types of multipliers, type I multipliers, and type II multipliers, which differ according to the form of the IO model. IO model, in which the final personal consumption is considered an exogenous variable, type I multiplier includes direct and indirect effects. Type I multiplier is calculated from the Leontief inverse matrix $(I - A)^{-1}$. A closed IO model is an IO model in which at least one component of the final demand, usually personal consumption, is considered endogenous. For the type II multiplier calculation, the matrix $(I - \bar{A})^{-1}$ is used, where the matrix $\bar{A}$ is obtained by expanding the technology matrix A with one more row, presenting the compensation of employees' coefficients, and one more column, representing household consumption coefficients. Type II multipliers include direct, indirect, and induced effects (McLennan, 2006). To calculate GVA, the Leontief inverse matrix is to be pre-multiplied with GVA coefficients (vector v where v_i represents a share of value added in the output of the relevant sector). The same approach is applied to calculate employment effects where an employment coefficients vector is used.

Some authors argue that type I multipliers underestimate the total impact because the household sector is excluded from the calculation, while type II multipliers could overestimate the total effects (Grady & Muller, 1988; Miller & Blair, 2009). Thus, the exact impact is usually located in the middle of the interval in which the type I multiplier is lower, and the type II multiplier is its upper limit of total effects.

Broadband investments positively contribute to the Western Balkan economies by increasing the final demand for goods and services incorporated in the broadband infrastructure. Direct effects are related to increases in revenues and employment of those companies that directly supply the telecommunications industry with investment goods: producers of optical cables and electronic components, construction and other companies supplying inputs required to develop broadband infrastructure. Companies that supply the telecom industry require various components, energy, and other intermediate inputs to deploy a broadband infrastructure.[2] Positive stimulus of additional demand, therefore, is not limited to the direct suppliers of broadband equipment but spills over to many other industries that are part of the respective value chain and thus linked to telecom firms

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[2] Producers of optical cables require metal and plastic inputs, energy and various services incorporated in their output. Construction companies engaged for laying cables in wrenches need construction materials, oil derivatives used by machinery and many other intermediate goods and services. Multiplicative effects are spreading out to the rest of the economy in many steps: producers of intermediate inputs also need goods and services to be incorporated in their products.

and their suppliers. The respective effects on revenues and employment are labeled as indirect effects. An increase in revenues along the value chain of broadband infrastructure induces demand for new jobs and increases wages and salaries. A proportion of the increased income will be re-spent on final goods and services by households. Increased activity in companies that produce personal goods and services, including the activity of their suppliers, is classified as induced effects. Spillover effects are presented in Figure 1.
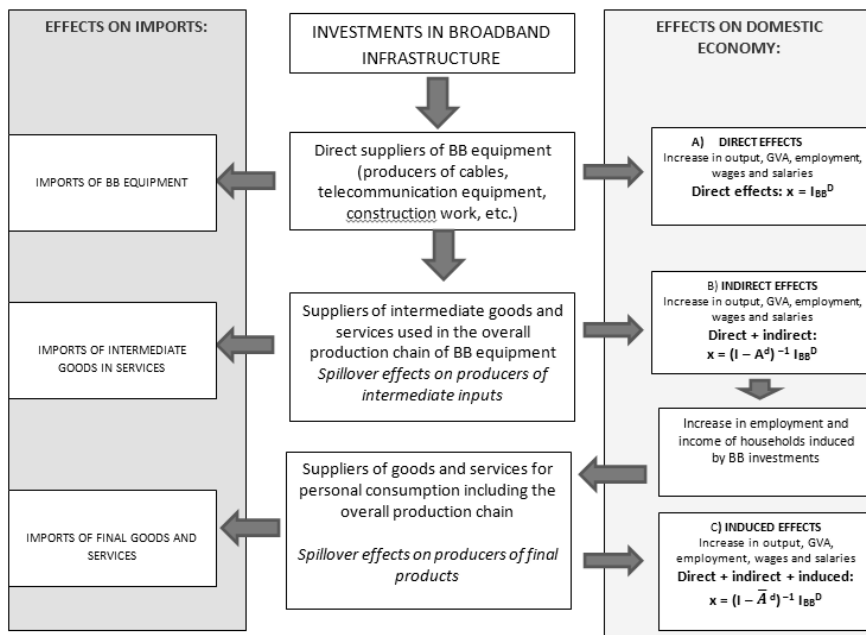

Figure 1 Spillover of direct, indirect and induced effects of broadband investments

*Source: Authors' systematization based on Miller and Blair (2009).*

The simple or type I multiplier (Miller & Blair, 2009) includes direct and indirect effects (marked as A and B in Figure 1). Besides the direct and indirect effects, the total or type II multiplier includes effects of induced personal consumption (marked as C in Figure 1). Total effects are estimated by the application of the standard IO model (equation 4) in which broadband investments delivered by domestic companies (I_{BB}^D in Figure 1) is treated as an increase in final demand.

4.   RESULTS

Output multipliers present the ratios of total output created in an economy to the value of a broadband project direct suppliers deliver to investors. A higher multiplier generally indicates intensive integration and cooperation between

domestic producers. At the same time, lower multiplicative effects could stem from the high import dependence of producers of broadband equipment where part of multiplicative effects is transferred abroad.

The type I multiplier of broadband investments (ratio of direct and indirect effects to direct effects) in Western Balkan economies ranges from 1.36 to 1.73 (Figure 2). This means that each euro received by a domestic direct broadband infrastructure supplier indirectly induces additional output from other domestic producers included in the value chain, estimated to range between 36 cents in North Macedonia and 73 cents in Croatia and Slovenia. Type I multiplier is the lowest for North Macedonia and Albania because of high import dependency, especially regarding components incorporated in mobile networks. A more favourable technological structure and the existence of domestic suppliers capable of delivering sophisticated equipment resulted in the highest multipliers estimated for Croatia and Slovenia. If the effects of induced personal consumption (type II multiplier) are included, the total output caused by broadband investment is expected to be in the range of 1.65 (North Macedonia) to 2.32 (Croatia) times higher than the initial value of broadband investment delivered by a domestic producer. Multipliers for all WB economies, except Macedonia and Albania) are estimated to be higher than found before for Germany (Katz et al., 2010). It is probably a consequence of the higher share of construction in the value of BB investment in the WB region (especially in brownfield projects and fibre technology) compared to projects based on high-tech electronic components supplied by global producers active in highly competitive international markets, which are dominant in developed economies.
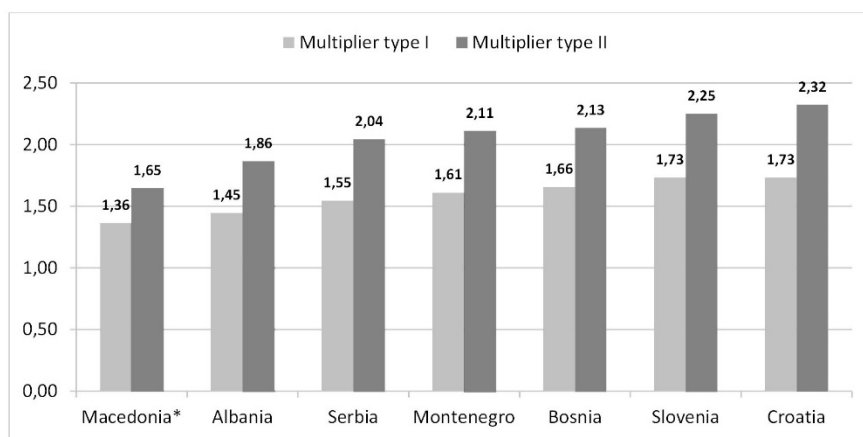
Note: *North Macedonia

Figure 2 Broadband investment multipliers

Source: Authors' calculations.

To compare multiplicative effects estimated for individual Western Balkan economies, the investment structure derived from the survey of telecommunication companies is scaled up to a common nominator: a value of 100 million euros invested in each of Western Balkan economies. It should be highlighted that multipliers are active only for part of the investments delivered by domestic companies and total effects depend on the share of services provided by domestic and foreign producers. According to the survey data, domestic firms directly supply investments in Croatia, Albania, and Serbia. In other Western Balkan economies, foreign companies usually supply a certain proportion of equipment, reducing the potential for spillover effects to other domestic companies.

The total GVA induced by the comparable value of broadband investments is estimated to be the highest in Croatia, Serbia, Albania, and Slovenia (Table 2 and Figure 3). In Croatia and Slovenia, it results from higher multipliers coupled with a dominant share of domestic contractors. On the other hand, in Albania and Serbia, multipliers are estimated to be low, but a significant part of investments is expected to be directly contracted to domestic companies. As a result, higher GVA effects are expected in those economies as opposed to Bosnia and Herzegovina and Montenegro, where multipliers are high, but so is the share of direct import. In North Macedonia's case, low multipliers and a high share of direct import resulted in the lowest GVA effects. A high share of direct imports prevents more abundant positive impulses spread widely over domestic producers in Montenegro, Bosnia and Herzegovina, and North Macedonia, where total GVA induced is estimated to be only 40–60 per cent of the initial investment value. If compared to the estimates of the relative impact of BB investments for the more developed economies (for example, Germany as estimated in Katz et al., 2010), it can be concluded that in the WB region, a significant proportion of positive economic effects have been transferred abroad because of underdeveloped domestic production of high-tech products required by BB projects. Only in Croatia is the share of induced GVA relative to initial broadband investment value (95.5%) higher than estimated for Germany (93%).
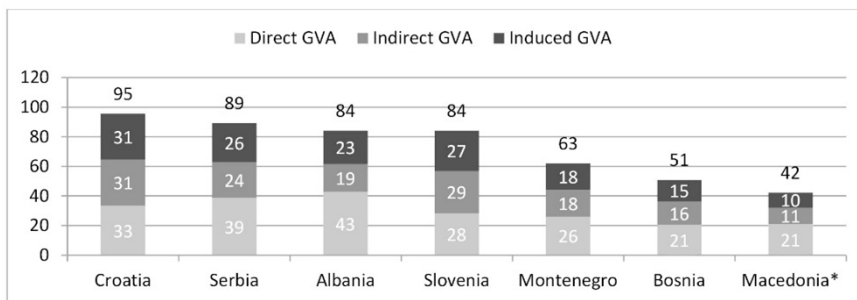
Table 2

Effects of broadband investments of 100 million euro

	Albania	Bosnia and Herzegovina	Croatia	North Macedonia	Montenegro	Serbia	Slovenia*
Output, in 000 EUR							
Direct	100,000	57,747	100,000	67,328	69,104	100,000	100,000
Indirect	44,569	37,934	73,121	24,476	42,153	54,586	73,304
Induced	41,839	27,558	59,004	18,997	34,632	49,644	51,444
Total	186,408	123,239	232,125	110,800	145,890	204,230	224,748
GVA, in 000 EUR							
Direct	42,728	20,540	33,264	20,968	26,401	38,662	28,232
Indirect	18,766	15,674	31,335	11,126	17,960	24,076	28,645
Induced	22,660	14,628	30,885	10,149	18,397	26,375	27,258
Total	84,154	50,842	95,485	42,243	62,758	89,112	84,134
Employment in FTE							
Direct	5,317	1,534	1,541	2,343	1,706	3,703	982
Indirect	1,347	818	1,215	727	836	1,626	824
Induced	3,270	1,011	1,093	849	1,173	2,456	701
Total	9,934	3,363	3,849	3,919	3,715	7,785	2,507
Imports, in 000 EUR							
Direct	0	42,253	0	32,672	30,896	0	0
Indirect	24,752	18,888	33,836	33,773	21,729	33,202	41,842
Induced	4,436	3,287	6,237	3,152	4,136	5,919	6,107
Total	29,188	64,429	40,073	69,598	56,761	39,121	47,949
Memo item	Estimate of total government revenues induced, in million EUR						
Government revenues induced	23,1	26,7	46,8	15,0	30,6	47,4	42,0

Note: *Estimates for Slovenia are based on the same structure of broadband investments as recorded in Croatia.
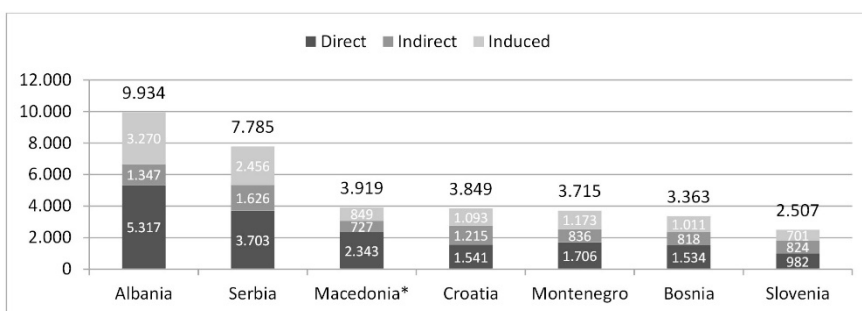
Source: Authors' calculations.

Note: *North Macedonia

Figure 3 GVA (in Mil. euro) induced by BB investment of 100 Mil. euro

Source: Authors' calculations.

Broadband investments could contribute to the dynamics of new job openings in Western Balkan economies (Table 2 and Figure 4). It is estimated that broadband investments of 100 million euros could induce new jobs ranging from 2,500 (Slovenia) to 10,000 (Albania). As a result of lower labor productivity (more labor is required per unit of output), the employment potential of broadband investments is the highest in Albania and Serbia. Despite lower productivity, effects on employment are limited by a lower share of domestic components in total investment in Montenegro, Bosnia and Herzegovina and North Macedonia. The effects of broadband investment on job creation in the WB region are significantly higher than those recorded in developed countries. For example, Katz et al. (2010) estimated 1.5 thousand jobs induced by 100 million euros BB investments in Germany which is significantly lower than estimated for WB region. The factor behind BB investment's intensive job creation potential in the WB region is lower productivity.
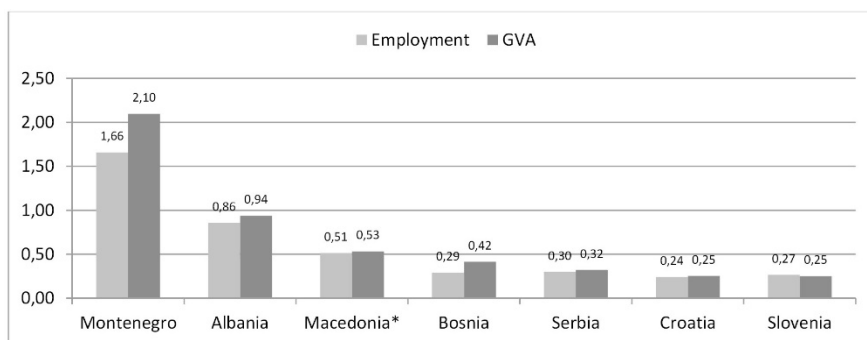

Note: *North Macedonia

Figure 4 Number of jobs (FTE) induced by 100 Mil. euro BB investment

Source: Authors' calculations.

Investments of 100 million euros could stimulate the region characterized by stagnant or mediocre economic growth. Depending on the size of the economy and productivity, a demand stimulus through 100 million euros broadband investments would induce additional GVA in the range between 0.3 percent in larger economies such as Croatia, Serbia, and Slovenia, and 0.4 percent in Bosnia and Herzegovina, 0.5 percent in North Macedonia, to 0.9 percent in Albania, and 2.1 percent in Montenegro (Figure 5). The results on the potential of BB investments to increase economic growth in the WB region are in line with previous studies conducted for other economies (Katz et al., 2010; Rohman & Bohlin, 2013; Crandall et al., 2007).

Note: *North Macedonia

Figure 5 Effects of 100 Mil. euro BB investment, in % of total GVA and employment

Source: Authors' calculations.

Broadband investments will improve overall productivity as the relative effects on GVA exceed the impacts on employment. By adding new economic benefits and job vacancies, broadband investments induce economic benefits and promote greater political stability and higher quality of public services. A more comprehensive reach of broadband access can reap substantial political and social benefits, as it provides e-governance and social inclusion.

The share of imports in the total value of broadband investment is significant in most Western Balkan economies. Even if the investment is contracted directly to domestic producers, a certain proportion of sophisticated equipment must be imported. The indirect import incorporated in broadband infrastructure includes imports of domestic producers along the overall value-added chain. It is estimated to be the lowest in Albania and Croatia but still accounts for 25 to 35 percent of initial investment value. The total import content, including direct, indirect, and induced effects, is highest for Montenegro, Bosnia and Herzegovina, and North Macedonia, reaching more than 50 percent of the initial investment value (Table 2).

The deployment of broadband infrastructure in areas where relative costs per user are high could be considered unattractive from the standpoint of private investors if not subsidized by public funds. As investments positively affect economic activity, induced government revenues from taxes and contributions could be used as an additional source to finance unprofitable projects. Based on current tax burdens[3] in Western Balkan economies, an investment of 100 million euros could induce between 15 (North Macedonia) to 47 (Serbia and Croatia) million euros of additional government revenues.

5.   CONCLUSIONS

Our results show slightly lower multiplicative effects of the telecommunication industry in the Western Balkan compared to more developed economies (Katz et al., 2010; Rohman, 2013). This lag could be due to less developed and less integrated domestic high-tech sectors and high-import content. Still, our results report the multiplicative effects of BB investments in the Western Balkan region, showing that induced domestic output is estimated to be (on average) two times higher than the initial investment value. Broadband networks based on fiber require a higher share of construction works based on the technologies adopted by Western Balkan producers and induce higher multiplicative effects in comparison to mobile network projects where the share of imported electronic equipment is higher. A stable demand for broadband equipment expected in the foreseeable future is an opportunity for Western Balkan economies to improve both economic activity and institutional framework while attracting foreign direct investments and speeding up the adoption of modern technologies. Increased production of sophisticated products required for broadband deployment could result in a more intense integration of domestic producers and higher multiplicative effects than we estimated by applying the standard IO model based on current technological coefficients.

The deployment of broadband infrastructure in areas where relative costs per user are high could be viewed as unattractive from the standpoint of private investors if not subsidized by public funds. As investments positively affect economic activity, induced government revenues from taxes and contributions could be used as an additional source to finance unprofitable projects. The government's participation in funding such projects is reasonable due to the many positive socio-economic effects generated by the availability of the BB.

The effects presented in this study relate to the one-off short-term economic impact of demand stimulus, active only during broadband infrastructure deployment. However, the positive economic impact of available broadband internet will not be fully exhausted once infrastructure is developed. Broadband operators could increase the number of users and revenues, value added, and employment through broadband investments. As broadband output increases,

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[3] Ratio of total government revenues to GVA (including taxes, social contributions, and non-tax revenues).

operators require more intermediate inputs such as network maintenance, insurance, marketing activities, business, legal and other services. The intensity of backward linkages (increased demand for intermediate inputs required by broadband operators) and positive impact on all economic units participating in the value-added chain depends on the level of integration of domestic producers.

The impact of broadband services on all domestic producers that use it as an intermediate input could be described by forward linkages (increased availability of broadband services improves the productivity of other domestic sectors that use broadband services as an intermediate input). Both backward and forward effects are spreading to other industries through inter-sectoral connections. Future forward effects are unpredictable. According to the existing studies (Heng, 2014; Davies, 2015), the availability of high-speed internet could be a basis for the development of a whole set of new activities which are currently not important in Western Balkan economies, such as e-commerce, telemedicine, call centers, software exports and other high-value activities. The importance of broadband infrastructure was confirmed during the pandemic of the Covid 19 virus coupled with measures of social distancing and many other limitations. The availability of high-speed and stable internet infrastructure enabled the transformation of certain sectors that continued operation based on online platforms such as work at home, e-health, or even e-education thus partly mitigating negative economic and social effects.

If supported by other policy measures related to education, research and development, health, or other areas, impulse derived from broadband investments could be used in Western Balkan economies to completely restructure economies, upgrade productivity and a technological level, as well as ensure higher quality of public services and quality of life in general. Effective e-governance, including open budgets, e-procurement, and other tools for citizens and businesses to access government services and information online, requires fast, reliable, and widespread broadband availability. These are essential for moving the region forward regarding the rule of law and reducing corruption.

To wrap up, policymakers in the Western Balkans should prioritize fostering public-private partnerships (PPPs) to expand broadband infrastructure in less profitable areas, drawing in private investment where market forces fall short. Streamlining regulatory processes and providing tax relief on broadband equipment would also reduce costs and make these investments more attractive. Oughton et al. (2022) emphasized that achieving broadband infrastructure goals in developing countries can be reached by a combination of supply-side policies, including infrastructure sharing, optimized spectrum pricing, and taxation reductions. Their study, which focused on selected developing countries, revealed that creating a regulatory environment that promotes infrastructure sharing could reduce the costs of achieving universal broadband coverage by approximately 10–70%. Demand-side measures also play an important role, particularly those aimed at enhancing broadband adoption (Briglauer, Krämer & Palan, 2024). Policies that support digital literacy and inclusion, especially in rural areas, would increase the adoption rates and positively impact productivity and innovation. Finally,

policymakers should implement robust monitoring frameworks to assess socio-economic impacts and adjust policies as necessary.

While this paper provides valuable insights into the multiplicative effects of broadband investments in the Western Balkans, we recognize limitations in the methodology applied. Specifically, static input-output tables do not capture dynamic technological and productivity changes over time, offering a snapshot of the current economic environment without fully reflecting long-term impacts. Future research should incorporate longitudinal data to uncover trends and deepen understanding of broadband's role in economic resilience. Comparative studies across regions with similar structures, along with an analysis of social impacts, would broaden our perspective on broadband's benefits beyond economic indicators.

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RAZLIČITE ZEMLJE, RAZLIČITI ISHODI: MULTIPLIKATIVNI UČINCI ULAGANJA U ŠIROKOPOJASNI PRISTUP INTERNETU U ZEMLJAMA ZAPADNOG BALKANA

Sažetak

Cilj je rada utvrditi kako različite strukture gospodarstava mogu doprinijeti razlikama u kratkoročnim ekonomskim učincima ulaganja u širokopojasni pristup. U radu se istražuju multiplikativni učinci ulaganja u širokopojasni pristup u šest zemalja Zapadnog Balkana primjenom input-output metodologije. Multiplikativnim učincima ulaganja u širokopojasni pristup izračunavaju se učinci tih ulaganja na bruto dodanu vrijednost, zaposlenost, uvoz i porezne prihode, što može utjecati na sklonosti ulaganjima te na oblikovanje odgovarajućih odgovora javnih politika. Rezultati otkrivaju značajne ekonomske koristi, uključujući povećanu proizvodnju, otvaranje radnih mjesta i državne prihode, naglašavajući važnost poticajnih javnih politika i regulatornih okvira.

***Ključne riječi:** ulazak poduzeća, digitalno intenzivni sektori, brzina širokopojasnog pristupa, digitalna transformacija, Hrvatska, prostorna prelijevanja.*

JEL klasifikacija: R11, O33, H54, L96, C67.